Appendices

Appendix A1

San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse Initial Study, February 2019

San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse

Initial Study

Prepared for
Sanitation Districts of Los Angeles County

February 2019

ESA

Draft

San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse

Initial Study

Prepared for
Sanitation Districts of Los Angeles County

February 2019

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SECTION 1
Project Description

1.1 Introduction

In anticipation of increased future recycled water demands, the Sanitation Districts of Los Angeles County (Sanitation Districts) are proposing to incrementally reduce discharges of recycled water from five water reclamation plants (WRPs), including the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP, each of which currently discharges into the San Gabriel River, San Jose Creek, or Coyote Creek. The diverted water would supply recycled water programs implemented by other agencies. The proposed reduction in water discharges would occur over time, and would not involve any construction activities or other physical changes to the environment other than the decreased volume of discharge.

1.2 Project Location

The locations of the five WRPs are shown in **Figure 1-1**. The Pomona WRP currently discharges recycled water to San Jose Creek. The San Jose Creek WRP, Whittier Narrows WRP, and Los Coyotes WRP each discharge to the San Gabriel River.[1] The Long Beach WRP discharges to Coyote Creek at the confluence with the San Gabriel River. The project study area includes the San Gabriel River and San Jose Creek.

1.3 Project Background

Sanitation Districts of Los Angeles County

The Sanitation Districts are a public agency created under state law to manage wastewater and solid waste on a regional scale and consist of 24 independent special districts serving approximately 5.6 million people in Los Angeles County (County). The Sanitation Districts' service area covers approximately 850 square miles and encompasses 78 cities and unincorporated territory within the County. The Sanitation Districts operate 10 WRPs and the Joint Water Pollution Control Plant. Seventeen sanitation districts provide sewerage services in the metropolitan Los Angeles area are signatory to a Joint Outfall Agreement that provides for the regional, interconnected systems of facilities known as the Joint Outfall System (JOS).

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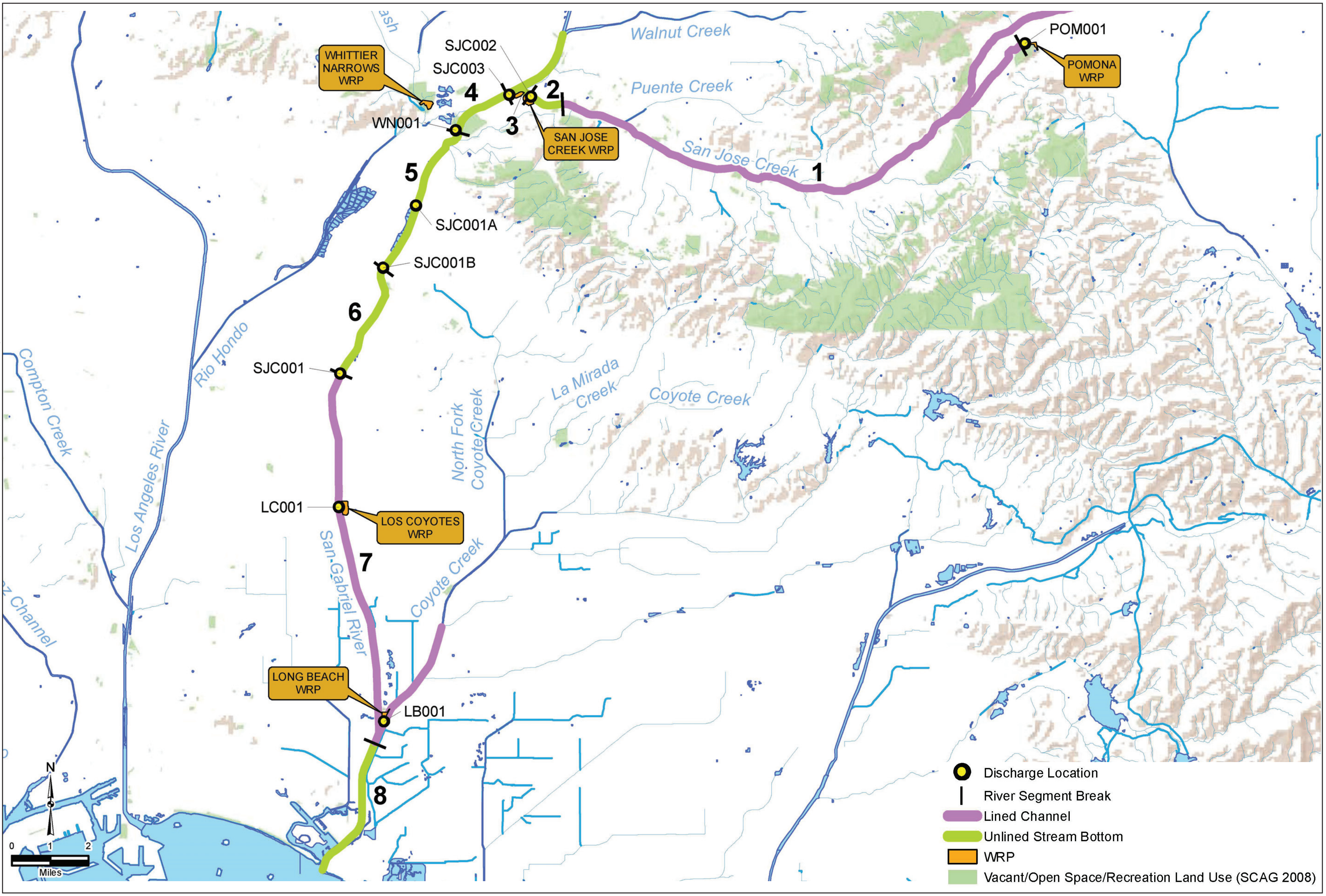
[1] The Whittier Narrows WRP also discharges to the Rio Hondo River.



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SOURCE: Clearwater EIR Segment Map

San Gabriel River Watershed Project to Reduce River Discharge
in Support of Increased Recycled Water Reuse

Figure 1-1
Sanitation Districts Receiving Water Stations and Discharges to San Gabriel System

ESA

The service area of the JOS encompasses 73 cities and unincorporated territory, providing sewage treatment, reuse, and ocean disposal for residential, commercial, and industrial wastewater. Under the Joint Outfall Agreement, Sanitation District No. 2 of Los Angeles County (District) has been appointed managing authority over the JOS.

Montebello Forebay

The Los Angeles County Department of Public Works (County) owns and operates an extensive system of flood control and groundwater recharge facilities along the San Gabriel and Rio Hondo Rivers that make up the Montebello Forebay Groundwater Recharge Program. The Montebello Forebay, located just south of Whittier Narrows, is a valuable area for groundwater recharge due to its highly permeable soils which allow deep percolation of surface waters. The Rio Hondo Coastal Basin Spreading Grounds, the San Gabriel Coastal Basin Spreading Grounds (SGSG), and the lower San Gabriel River spreading area comprise the Montebello Forebay recharge facilities. The County notes that operations at these recharge facilities recharge an average of approximately 150,000 acre-feet (AF) of water annually.

The Rio Hondo Coastal Basin Spreading Grounds, the County's largest spreading facility, covers approximately 570 acres. Water is diverted from the Rio Hondo Channel by use of three large radial gates. The County operates a connection channel between the San Gabriel River and the Rio Hondo within the Whittier Narrows Recreational Area known as the Zone 1 Ditch (see **Figure 1-2**). This channel can convey San Gabriel River water to the Rio Hondo Coastal Basin Spreading Grounds.

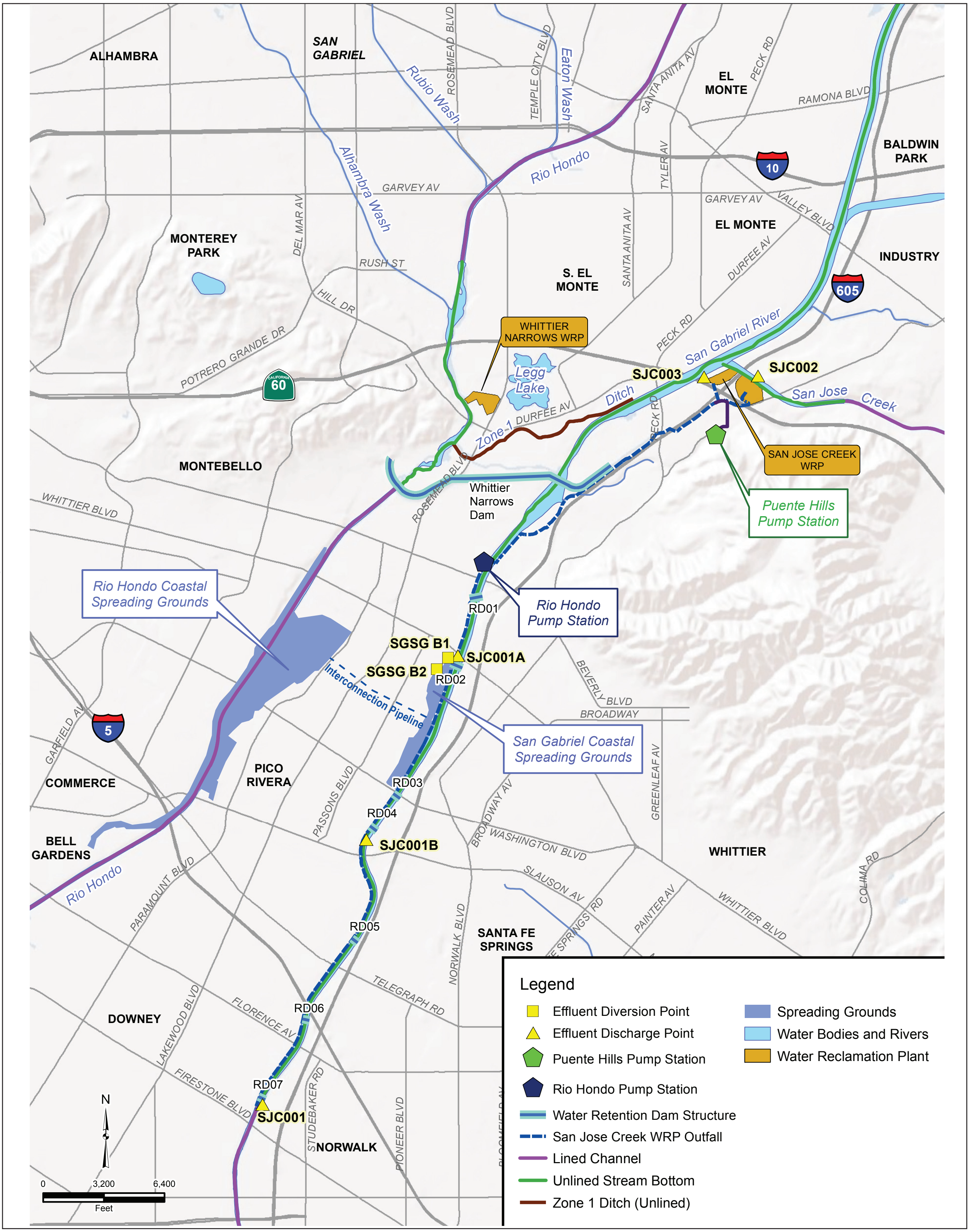
The SGSG are approximately 128 acres in size. Recycled water is conveyed to the spreading grounds via the San Jose Creek Outfall Pipeline (SJC Outfall Pipeline), which includes a discharge point at the head of the facility capable of discharging to the river or the spreading grounds or diverting water from the San Gabriel River into the spreading grounds.

The lower San Gabriel River, from Whittier Narrows Dam to North of Firestone Boulevard, also allows spreading by percolation through its unlined bottom. Seven inflatable rubber dams have been installed to increase spreading capacity along this portion of the river, replacing sand levees that washed out when high flows occurred.
(http://ladpw.org/wrd/publication/system/montebello.cfm)

1.4 Water Reclamation Facilities

San Jose Creek Water Reclamation Plant

The San Jose Creek WRP is located at 1965 Workman Mill Road, in unincorporated Los Angeles County, adjacent to the city of Whittier at the confluence of San Jose Creek and the San Gabriel River. The San Jose Creek WRP consists of two independently operated treatment plants: San Jose Creek East (SJCE) on the east side of the Interstate 605 Freeway and San Jose Creek West (SJCW) on the west side of I-605 near the intersection of California State Route 60 Freeway (CA-60). The SJCE and SJCW facilities have a design capacity of 62.5 million gallons per day (MGD) and 37.5 MGD, respectively, resulting in a combined treatment capacity of 100 MGD for the San Jose Creek WRP.



SOURCE: Amec, Foster, Wheeler, 2017

San Gabriel River Watershed Project to Reduce River Discharge
in Support of Increased Recycled Water Reuse

Figure 1-2
SJCWRP Discharge Points

The San Jose Creek WRP serves a large residential population of approximately one million people. In 2018, the San Jose Creek WRP generated approximately 53.6 MGD of tertiary-recycled water, most of which is reused. The facility supplies approximately 42 MGD of recycled water to over 170 different reuse sites, including groundwater recharge, industrial facilities, and irrigation of parks, schools, and greenbelts. An average of approximately 9.48 MGD is discharged to San Jose Creek.

The San Jose Creek WRP is permitted to discharge at seven distinct surface water points; however, only five are currently constructed: Discharge Points SJC001A, SJC001B, SJC001, SJC002, and SJC003, are each shown on Figure 1-2. Three of these discharge points (SJC001, SJC001A, and SJC001B) are downstream of Whittier Narrows Dam on the San Gabriel River, and are supplied by the 8-mile-long SJC Outfall Pipeline that conveys recycled water from the San Jose Creek WRP to these downstream discharge points. The other two discharge points (SJC002 and SJC003) discharge to San Jose Creek and the San Gabriel River, respectively, above the Whitter Narrows Dam (see **Table 1-1**).

TABLE 1-1
LOS ANGELES COUNTY SANITATION DISTRICTS WRP SAN GABRIEL WATERSHED DISCHARGE POINTS

Discharge Point	Receiving Water	Channel Type	NPDES Annual Average Daily Discharge (MGD) (Water Year[1] 2014–2018)	Annual Average Discharge Days (Water Year[1] 2014–2018)
San Jose Creek WRP				
SJC001	San Gabriel River	Concrete-lined	5.44	77
SJC001A	San Gabriel River	Soft-bottomed	7.30	74
SJC001B	San Gabriel River	Soft-bottomed	4.90 [2]	83 [2]
SJC002	San Jose Creek	Soft-bottomed	9.48	169
SJC003	San Gabriel River above Whittier Narrows Dam	Soft-bottomed	0.04	2
Pomona WRP				
POM001	South Fork San Jose Creek	Concrete-lined	3.27	361
Los Coyotes Creek WRP				
LC001	San Gabriel River	Concrete-lined	17.0	365
Long Beach WRP				
LB001	Coyote Creek	Concrete-lined	6.72	348
Whitter Narrows WRP				
WN001	San Gabriel River	Soft-bottomed	1.19	72

[1] The water year runs from October 1 of the previous year to September 30 of the labeled year.
[2] Discharge from SJC001B began in March 2016; therefore, Annual Average shown is for Water Year 2017-2018.

Discharge Point No. SJC001A is located in the unlined portion of the San Gabriel River near the headworks of the SGSG and just upstream of Rubber Dam No. 2. Discharge Point No. SJC001B is located in the unlined portion of the San Gabriel River downstream of Rubber Dam No. 4.

Discharge Point No. SJC001 is located in the concrete-lined portion of the San Gabriel River near Firestone Boulevard. Flow from the SJC Outfall Pipeline can also be diverted for recycled water use by pump stations to purveyors' distribution line or into the SGSG via two diversion points (SGSG B1 and SGSG B2).

Historical and Current Operations

The San Jose Creek WRP discharge location may vary depending on the recharge facility availability, maintenance activities, or other factors. The County attempts to recharge the entire volume available at any time in the array of groundwater recharge facilities within the Montebello Forebay.

Recycled water from the San Jose Creek WRP can be recharged within the SGSG, the Rio Hondo Coastal Spreading Grounds, or unlined portions of the San Gabriel River via Discharge Point Nos. SJC001A, SJC001B, SJC002, and SJC003. Discharge into San Jose Creek or the San Gabriel River above the Whittier Narrows Dam (Discharge Points No. SJC002 and SJC003) recharge groundwater above the Whittier Narrows Dam, which is in the south-western edge of the Main San Gabriel Groundwater Water Basin. The County has the ability to divert surface water from the San Gabriel River to the Rio Hondo River and Rio Hondo Coastal Basin Spreading Grounds via the Zone 1 Ditch. (Figure 1-2). Discharges to Discharge Point Nos. SJC001A and SJC001B, accessed via the SJC Outfall Pipeline, recharge the Central Groundwater Water Basin via the unlined San Gabriel River channel.

Table 1-1 summarizes a 5-water-year average from 2014 through 2018 of discharge volumes at each point. These various discharge points are historically used interchangeably throughout the year. Discharge Point No. SJC003 is historically rarely used.

Existing Permits

The San Jose Creek WRP is currently covered by three permits: one for groundwater recharge in the Montebello Forebay (Order No. 91-100), one for the National Pollutant Discharge Elimination System (NPDES) discharge into surface waters (Order No. R4-2015-0070 and NPDES No. CA0053911), and one for reuse of recycled water for non-potable purposes (Order No. 87-50 and readopted under Order No. 97-072). The San Jose Creek WRP is permitted by the Los Angeles Regional Water Quality Control Board (LARWQCB) to discharge to the San Gabriel River and San Jose Creek pursuant to the NPDES Order.

Pomona Water Reclamation Plant

The Pomona WRP is located at 295 Humane Way in the city of Pomona. The plant occupies 14 acres northeast of the intersection of CA-60 and the California State Route 57 Freeway (CA-57). The original plant, known as the Tri-City Plant, was owned by the Cities of Pomona, Claremont, and La Verne. It was placed into operation in July 1926, with reuse beginning in 1927. The Sanitation Districts took over operations in 1966 and increased the plant capacity to 4 MGD. In 1970, the plant capacity was expanded to 10 MGD with the construction of additional primary, aeration, and final sedimentation tanks. In 1977, the plant capacity increased to 15 MGD with the implementation of tertiary-level water treatment, including activated-carbon gravity filters, chlorine contact tanks, and a dechlorination system. In the early 1990s, the plant underwent a third expansion with the construction and retrofit of the activated-carbon gravity filters to deep-bed anthracite filters and the addition of a third chlorine contact tank for additional disinfection capacity.

Current Operations

The Pomona WRP provides primary, secondary, and tertiary treatment for up to 15 MGD. The plant serves a population of approximately 130,000 persons. Approximately 2.6 MGD of the recycled water during water year 2018 was used at over 210 different sites. Reuse applications include landscape irrigation of parks, schools, golf courses, greenbelts, etc.; irrigation and dust control at the Spadra Landfill; and industrial use by local manufacturers. The remainder of the recycled water is discharged into San Jose Creek, where it flows through a concrete-lined portion for 16 miles until it reaches the unlined portions of the San Gabriel River, where it percolates into the groundwater. Table 1-1 summarizes a 5-water-year average from 2014 through 2018 of discharge volumes.

Existing Permits

The Pomona WRP is currently covered by three LARWQCB permits: an NPDES Permit to discharge into surface waters (Order No. R4-2014-0212-A01 and NPDES No. CA0053619), a permit for groundwater recharge in the Montebello Forebay (Order No. 91-100), and a recycled water use permit for non-potable purposes (Order No. 81-34 and readopted under Order No. 97-072).

Whittier Narrows Water Reclamation Plant

The Whittier Narrows WRP is located at 301 North Rosemead Boulevard in the city of El Monte. The plant occupies 27 acres south of the CA-60. The plant was originally constructed for the purpose of demonstrating the feasibility of large scale water reclamation. The original plant was placed in operation on July 26, 1962, and consisted of primary sedimentation and secondary treatment with activated sludge.

Current Operations

The Whitter Narrows WRP was the first reclamation plant built by the Sanitation Districts. It provides primary, secondary and tertiary treatment for up to 15 MGD. The plant serves a population of approximately 150,000 persons. Reclaimed water produced by the WRP is reused for irrigation and groundwater recharge at the Rio Hondo and San Gabriel Coastal Spreading Grounds. Table 1-1 summarizes a 5-water-year average from 2014 through 2018 of discharge volumes.

Existing Permits

The Whitter Narrows WRP is currently covered by three permits: an NPDES Permit to discharge into surface waters (Order No. R4-2014-0213-A01 and NPDES No. CA0053716), a permit for groundwater recharge in the Montebello Forebay (Order No. 91-100), and a recycled water use permit for non-potable purposes (Order No. WQ 2016-0068-DDW, File No. 88-040, CI No. 6844).

Los Coyotes Water Reclamation Plant

The Los Coyotes WRP is located at 16515 Piuma Avenue in the city of Cerritos and occupies 34 acres at the northwest junction of the I-605 and the California State Route 91 Freeway (CA-91). Of the 34 acres, 20 are occupied by the Iron Wood Nine Golf Course, which is built on adjoining Sanitation Districts' property. The plant was placed in operation on May 25, 1970, with an initial capacity of 12.5 MGD, and consisted of primary treatment and secondary treatment with activated sludge.

Current Operations

The Los Coyotes WRP provides primary, secondary, and tertiary treatment for up to 37.5 MGD. The plant serves a population of approximately 370,000 persons. Approximately 3.2 MGD of the recycled water is used at over 310 sites. Reuses include landscape irrigation of schools, golf courses, parks, nurseries, and greenbelts and industrial use at local companies for carpet dying and concrete mixing. The remainder of the recycled water is discharged to the San Gabriel River. Table 1-1 summarizes a 5-water-year average from 2014 through 2018 of discharge volumes.

Existing Permits

The Los Coyotes WRP is covered by an NPDES Permit to discharge into surface waters (Order No. R4-2015-0124 and NPDES No. CA0054011) and a recycled water use permit for non-potable purposes (Order No. 87-51 and readopted under Order No. 97-072).

Long Beach Water Reclamation Plant

The Long Beach WRP is located at 7400 E. Willow Street in the city of Long Beach. The plant occupies 17 acres west of the I-605 and began operation in 1973.

Current Operations

The Long Beach WRP provides primary, secondary and tertiary treatment for up to 25 MGD. The plant serves a population of approximately 250,000 persons. Approximately 3.9 MGD of the recycled water is used at over 60 sites. Reuses include landscape irrigation of schools, golf courses, parks, and greenbelts by the City of Long Beach, the repressurization of oil-bearing strata off the coast of Long Beach, and the replenishment of the Central Basin groundwater supply from water processed at the Leo J. Vander Lans Advanced Water Treatment Facility. The remainder is discharged to the Coyote Creek. The advanced water treatment facility uses microfiltration, reverse osmosis, and ultraviolet disinfection to produce near distilled quality water, and is blended with imported water and pumped into the Alamitos Seawater Barrier to protect the groundwater basin from seawater intrusion. Table 1-1 summarizes a 5-water-year average from 2014 through 2018 of discharge volumes.

Existing Permits

The Long Beach WRP is covered by an NPDES Permit to discharge into surface waters (Order No. R4-2015-0123 and NPDES No. CA0054119) and a recycled water use permit for non-potable purposes (Order No. 87-47 and readopted under Order No. 97-072).

1.5 Project Objectives

The objectives of the proposed project are as follows:

- Support increased water recycling in the San Gabriel River watershed through maximizing availability of treated effluent otherwise discharged to flood control channels
- Create a more efficient utilization of treated effluent to support both recycled water reuse and sensitive riparian habitat.
- Sustain sensitive habitat supported by historic treated effluent discharges to the San Gabriel River watershed

1.6 Relationship of Project to Local Recycled Water Programs

The proposed project would facilitate the increased reuse of treated wastewater consistent with state law and policy, including Water Code Sections 461, 13500 et seq., and 13575 et seq.; Government Code Section 65601 et seq.; the State Water Resources Control Board's (SWRCB's) Policy for Water Quality Control for Recycled Water (Recycled Water Policy); and the Executive Order issued by the Governor on April 25, 2014. The Executive Order promotes the development of recycled water to serve areas in need, and encourages the SWRCB to expedite requests to change water permits to enable those deliveries. The Sanitation Districts is proposing to submit a Wastewater Change Petition pursuant to California Water Code Section 1211 to change the place and purpose of use of recycled water, while maintaining sensitive habitat supported by historic effluent discharges.

In its Recycled Water Policy, the SWRCB has set a goal of increasing the use of recycled water over 2002 levels by at least one million acre-feet (MAF) per year by 2020 and by at least 2 MAF per year by 2030. Included in its conservation goals is to substitute as much recycled water for potable water as possible by 2030. "The purpose of the [Board's Recycled Water Policy] is to increase the use of recycled water from municipal wastewater sources…." (SWRCB "Recycled Water Policy," Jan. 22, 2013). (http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2013/ rs2013 _0003_a.pdf)

Table 1-2 summarizes the new purpose-of-use for each diversion that primarily includes expanded landscape irrigation and increased groundwater recharge subject to California Code of Regulations Title 22 water quality requirements for recycled water use. The reduced discharges from the San Jose Creek WRP would facilitate a more efficient delivery of recycled water to reuse projects including the recently completed Albert Robles Center (ARC) by the Water Replenishment District of Southern California.

TABLE 1-2
EXISTING AND PROPOSED FUTURE ANNUAL DAILY AVERAGE DISCHARGES

Treatment Plant	Existing Annual Daily Average Discharge (MGD)*	Proposed Future Annual Daily Average Discharge (MGD)	New Purpose of Use
San Jose Creek WRP (SJC001)	5.44	0	All Title 22 Recycled Water Uses Allowed
San Jose Creek WRP (SJC001A)	7.30	Variable***	All Title 22 Recycled Water Uses Allowed
San Jose Creek WRP (SJC001B)	4.90**	Variable***	All Title 22 Recycled Water Uses Allowed
San Jose Creek WRP (SJC002)	9.48	5	All Title 22 Recycled Water Uses Allowed
San Jose Creek WRP (SJC003)	0.04	0	All Title 22 Recycled Water Uses Allowed
Pomona WRP	3.27	0	All Title 22 Recycled Water Uses Allowed
Whittier Narrows WRP****	1.19	1.18	All Title 22 Recycled Water Uses Allowed
Los Coyotes WRP	17.0	2	All Title 22 Recycled Water Uses Allowed
Long Beach WRP	6.72	0	All Title 22 Recycled Water Uses Allowed
TOTAL	55.34	8.18	

* Based on average flow data from Water Year 2014-2018.

** Discharge from SJC001B began in March 2016; therefore, Annual Average shown is for Water Year 2017-2018.

*** Discharge point is used in conjunction with SGSG as part of the Montebello Forebay groundwater recharge project. Actual discharge from this location may vary with the overall recharge volume being approximately 40 MGD (44,400 acres-feet per year [AFY])

**** As explained above, the Whittier Narrows WRP discharges to both the Rio Hondo/LA River watershed and the San Gabriel River watershed. The proposed project and table only assesses changes in discharges to the San Gabriel River watershed. Proposed reductions to the Rio Hondo/LA River watershed are a separate project and distinct project and the environmental impacts of those reductions will be considered in a separate CEQA document.

The ARC project includes a new Advanced Water Treatment Plant designed to provide additional treatment to tertiary-treated effluent from the San Jose Creek WRP. The highly-treated ARC effluent will be directly injected into the underlying groundwater aquifer or conveyed to the SGSG or Rio Hondo Coastal Basin Spreading Grounds to replenish the Central Groundwater Basin.

In addition, the Long Beach WRP would increase contributions to the Alamitos Seawater Intrusion Barrier injection well system and may increase recycled water available for other non-potable reuse projects such as landscape irrigation or industrial uses. Los Coyotes, Pomona, and Whittier Narrows WRPs would also increase contributions to recycled water use projects.

1.7 Discharge Operation Modifications

The District is proposing to incrementally reduce discharges of recycled water from the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP. The District is not proposing to construct any new facilities. The proposed use of the recycled water would be implemented by water agencies and other users over time. The District will continue to maintain the ability to discharge treated water at the same points but anticipates lesser quantities. Table 1-2 summarizes the existing and proposed future annual daily average discharges for each treatment plant. A brief description of this information is provided below:

- The San Jose Creek WRP discharge is currently rotated between five discharge locations within the San Gabriel River watershed as show on in Figure 1. The use of the discharge locations is irregular throughout the year and varies year-to-to, depending on the availability of groundwater recharge facilities and channel maintenance activities. Under the proposed project, discharges from the San Jose Creek WRP at discharge point SJC002 would be reduced from an annual average of approximately 9.48 million MGD to a minimum monthly average of approximately 5 MGD. Although the total annual volume would be reduced, the new monthly average discharge would provide a more consistent discharge rate compared to existing conditions. Discharges would be timed to more efficiently meet the water demand needs of sensitive habitat. The diverted water would be conveyed for beneficial reuse to groundwater recharge basins or other reuse facilities.
- The Pomona WRP discharges into a concrete-lined portion of San Jose Creek which contains no sensitive habitat. As San Jose Creek nears the San Gabriel River, the concrete lining gives way to a soft-bottom reach. Current and historic groundwater upwelling occurs within the lined portion of San Jose Creek upstream of the transition location. The proposed project would result in zero discharge from the Pomona WRP. Habitat in the soft-bottomed portion of San Jose Creek would continue to be sustained by rising groundwater.
- The Whittier Narrows WRP has three discharge locations but only one tributary to the San Gabriel River. A recently approved modification to discharge from the Whittier Narrows WRP will reduce discharges to the San Gabriel River by approximately 1 percent (0.01 mgd).
- The Los Coyotes WRP discharges into a concrete-lined portion of the San Gabriel River. Discharge flow is contained within the low-flow channel of the river under typical dry-weather conditions. The proposed project proposes to maintain a minimum discharge flow of 2 MGD to prevent the low-flow channel from going completely dry downstream of the plant.
- The Long Beach WRP discharges into the concrete-lined Coyote Creek approximately 3,000 feet before the start of the San Gabriel River estuary. Urban runoff and natural flows in Coyote Creek upstream of the Long Beach WRP maintain a consistent flow in the creek at the discharge location. The proposed project proposes a minimum discharge flow of zero from the Long Beach WRP.

1.8 Project Construction

No construction activities would be associated with the proposed project, as the project entails reductions in the rate and volume of recycled water discharged into the San Gabriel River and San Jose Creek. As such, no construction would occur and no physical changes to the environment, aside from reduced discharges to the San Gabriel River and San Jose Creek, would occur under the proposed project.

1.9 Project Approvals

The proposed project would require approval from the California SWRCB for the Wastewater Change Petition pursuant to California Water Code Section 1211. No other approvals would be required.

SECTION 2

Environmental Checklist / Initial Study

1. **Project Title:**	San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse
2. **Lead Agency Name and Address:**	Sanitation Districts of Los Angeles County 1955 Workman Mill Road Whittier, CA 90601
3. **Contact Person and Phone Number:**	Jodie Lanza 562-908-4288 ext. 2707
4. **Project Location:**	San Gabriel River and San Jose Creek
5. **Project Sponsor's Name and Address:**	Sanitation Districts of Los Angeles County 1955 Workman Mill Road Whittier, CA 90601
6. **General Plan Designation(s):**	N/A
7. **Zoning:**	N/A

8. **Description of Project:**

The District is proposing to incrementally reduce discharges of recycled water from the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP, each of which currently discharges into the San Gabriel River, San Jose Creek, or Coyote Creek. The District is not proposing to construct any new facilities. The proposed use of the recycled water would be implemented by water agencies and other users over time. The District will continue to maintain the ability to discharge treated water at the same points but anticipates lesser quantities.

9. **Surrounding Land Uses and Setting.**

Land uses in the areas of the San Gabriel River and San Jose Creek range from predominantly open space in the upper watershed to urban land uses in the middle and lower parts of the watershed including, but not limited to, residential, commercial, industrial, public facilities, and recreation uses.

10. **Other public agencies whose approval is required**

California SWRCB

11. Have California Native American tribes traditionally and culturally affiliated with the project area requested consultation pursuant to Public Resources Code section 21080.3.1? If so, is there a plan for consultation that includes, for example, the determination of significance of impacts to tribal cultural resources, procedures regarding confidentiality, etc.?

Yes, under Assembly Bill 52 (AB 52), the Districts prepared and mailed notification letters to California Native American tribes traditionally and culturally affiliated with the project area on March 23, 2018. The Gabrieleño Band of Mission Indians responded and requested consultation, which was completed on May 18, 2018. No additional requests for consultation have been received to date.

Environmental Factors Potentially Affected

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages.

☐ Aesthetics
☒ Biological Resources
☐ Geology/Soils
☒ Hydrology/Water Quality
☐ Noise
☒ Recreation
☐ Utilities/Service Systems
☐ Agriculture and Forestry Resources
☐ Cultural Resources
☐ Greenhouse Gas Emissions
☐ Land Use/Planning
☐ Population/Housing
☐ Transportation
☐ Wildfire
☐ Air Quality
☐ Energy
☐ Hazards & Hazardous Materials
☐ Mineral Resources
☐ Public Services
☐ Tribal Cultural Resources
☐ Mandatory Findings of Significance

DETERMINATION: (To be completed by the Lead Agency)

On the basis of this initial study:

☐ I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☐ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☒ I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Jodie Lanza
2/6/19
Date

Signature
Date

Environmental Checklist

Aesthetics

Issues (and Supporting Information Sources):		*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
I.	**AESTHETICS — Except as provided in Public Resources Code Section 21099, would the project:**				
a)	Have a substantial adverse effect on a scenic vista?	☐	☐	☒	☐
b)	Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☒	☐
c)	In non-urbanized areas, substantially degrade the existing visual character or quality of public views of the site and its surroundings? (Public views are those that are experienced from publicly accessible vantage point). If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality?	☐	☐	☒	☐
d)	Create a new source of substantial light or glare which would adversely affect daytime or nighttime views in the area?	☐	☐	☐	☒

Discussion

a) **Less Than Significant Impact.** The District is proposing to incrementally reduce discharges of recycled water from five WRPs: the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP, each of which currently discharges into the San Gabriel River, San Jose Creek, or Coyote Creek. The proposed reduction in discharges of recycled water would not involve any construction activities or other physical changes to the environment other than the decreased volume of discharge. The proposed use of the recycled water would be implemented by water agencies and other uses over time. The District will continue to maintain the ability to discharge treated water at the same points but anticipates lesser quantities. The project study area includes the San Gabriel River and San Jose Creek, which contain no designated scenic resources and do not provide views of such resources. Views of the San Gabriel River or San Jose Creek from publicly available viewpoints might be considered as providing a scenic vista; however, implementation of the proposed project would have no measurable effect on the scenic value of the San Gabriel River or San Jose Creek. As discussed in Section 2.4, *Biological Resources*, below, the proposed flow reductions would not result in significant adverse effects on downstream habitat such that visible reduction in vegetation or other visible features of the San Gabriel River or San Jose Creek would occur. As such, impacts to scenic vistas would be less than significant.

b) **Less Than Significant Impact.** The project study area is entirely urbanized with no scenic resources including trees, rock outcroppings, or historic buildings (including those within a state scenic highway) occurring on-site. As discussed above, the proposed project would incrementally reduce discharges of recycled water from five WRPs, each of which currently discharges into the San Gabriel River, San Jose Creek, or Coyote Creek. The San Gabriel River and San Jose Creek could both be considered a valued scenic resource. Nonetheless, as also discussed above, the proposed reductions in discharges to the San Gabriel River and San Jose Creek are not expected to result in measurable changes to the appearance of the San Gabriel River or San Jose Creek, as flow reductions and related effects on water levels and vegetation would not be noticeable to viewers. As such, while the proposed project would incrementally reduce discharges of recycled water to the San Gabriel River and San Jose Creek, its implementation would not substantially damage scenic resources in the project study area, including the San Gabriel River and San Jose Creek as viewed from surrounding locations. A less than significant impact would occur.

c) **Less than Significant Impact.** As discussed in Responses 2.1.a. and 2.1.b. above, while the proposed project would reduce the flow levels and vegetation within the San Gabriel River or San Jose Creek, the project does not involve any other physical changes to the environment such that its implementation could substantially adversely affect visual resources on- or off-site. As noted previously, San Gabriel River and San Jose Creek are surrounded by urban areas and are not considered to be valuable scenic resources. Portions of the San Gabriel River and San Jose Creek are concrete-lined. Given the minimal effect of the proposed discharge reductions on the San Gabriel River and San Jose Creek's water levels and associated vegetation, it is anticipated that the reduced flows in the San Gabriel River and San Jose Creek will not have the potential to degrade the existing visual character or quality of public views of the project study area and its surroundings. Impacts would be less than significant.

d) **No Impact.** The proposed project does not propose development or change in current operations beyond the incremental reduction in discharges of recycled water from the five WRPs. The proposed project would not create a new source of substantial light or glare which would adversely affect the day or nighttime views in the area. As such, no impacts would occur in this regard.

Agriculture and Forestry Resources

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
II. AGRICULTURE AND FORESTRY RESOURCES — In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board. **Would the project:**				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☒
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☐	☐	☐	☒
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?	☐	☐	☐	☒
d) Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	☒
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?	☐	☐	☐	☒

Discussion

a) **No Impact.** No agricultural uses or related operations are present within the project study area or the immediate vicinity. No portion of the project study area is located on designated Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland) as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program. Therefore, the proposed project would not convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance to non-agricultural uses. No impact would occur in this regard.

b) **No Impact.** As discussed above, no agricultural zoning is present within the project study area and no portion of the site is enrolled in a Williamson Act contract. As such, the proposed project would not conflict with existing zoning for agricultural use or a Williamson Act contract and no impact would occur in this regard.

c, d) **No Impact.** As discussed above, the project study area's existing zoning designations do not include agricultural or forestry-related uses or activities. No forest land or timberland zoning is present on the project study area or in the surrounding area. The proposed incremental reduction in discharges of recycled water from the five WRPs to the San

Gabriel River and San Jose Creek would not have the potential to affect forest land. As such, the proposed project would not have the potential to conflict with existing zoning for forest land or timberland nor result in the loss of forest land or conversion of forest land to non-forest use. No impact would occur in this regard.

e) **No Impact.** Since there are no agricultural uses or related operations on or near the project study area, and the proposed project would only involve the reduction in discharges of recycled water from the five WRPs to the San Gabriel River and San Jose Creek, the proposed project would not involve the conversion of farmland to other uses, either directly or indirectly. No impacts to farmland or agricultural uses would occur.

References

State of California Department of Conservation, California Important Farmland Finder, https://maps.conservation.ca.gov/dlrp/ciff/, accessed February 2018.

Air Quality

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
III. AIR QUALITY — Where available, the significance criteria established by the applicable air quality management district or air pollution control district may be relied upon to make the following determinations. **Would the project:**				
a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☐	☒
b) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard?	☐	☐	☐	☒
c) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☐	☒
d) Result in other emissions (such as those leading to odors adversely affecting a substantial number of people?	☐	☐	☐	☒

Discussion

a) **No Impact.** The project study area is located within the 6,745-square-mile South Coast Air Basin (SoCAB). Air quality planning for the SoCAB is under the jurisdiction of the South Coast Air Quality Management District (SCAQMD). The proposed project would be subject to the SCAQMD's Air Quality Management Plan (AQMP), which contains a comprehensive list of pollution control strategies directed at reducing emissions and achieving ambient air quality standards. These strategies are developed, in part, based on regional population, housing, and employment projections prepared by the Southern California Association of Governments.

The District is proposing to incrementally reduce discharges of recycled water from five WRPs, each of which currently discharges into the San Gabriel River or San Jose Creek. This proposed reduction would not require the construction of additional facilities or grading-related activity. The District is not proposing to construct any new facilities. The District will continue to maintain the ability to discharge treated water at the same points but anticipates lesser quantities. As such, the proposed project would not generate any additional air pollutant emissions that would conflict with the AQMP. No impact would occur in this regard.

b) **No Impact.** The proposed project would not generate any additional air pollutant emissions that could exceed the SCAQMD significance thresholds. As such, no impact would occur in this regard.

c) **No Impact.** Land uses that are generally considered more sensitive to air pollution than others are as follows: hospitals, schools, residences, playgrounds, child care centers, athletic facilities, and retirement/convalescent homes. The project study area is located in a highly urbanized area with a wide variety of land uses, and although there are a number of sensitive receptors located within the project study area, the project does not propose physical development or changes in current operations other than the decreased volume of discharge. As such, no impacts would occur in this regard.

d) **No Impact.** As no development or changes in current operations are proposed by the project, aside from the decreased volume of discharge, no odors adversely affecting a substantial number of people are expected as a result of project implementation. As such, no impacts would occur in this regard.

Biological Resources

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
IV. BIOLOGICAL RESOURCES — Would the project:				
a) 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 California Department of Fish and Game or U.S. Fish and Wildlife Service?	☒	☐	☐	☐
b) 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 California Department of Fish and Game or U.S. Fish and Wildlife Service?	☒	☐	☐	☐
c) Have a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☐	☒	☐
d) 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 wildlife nursery sites?	☐	☐	☒	☐
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒

Discussion

a) **Potentially Significant Impact.** The proposed project would reduce discharges from five WRPs. The sensitive species and related habitat within the San Gabriel River and San Jose Creek vary depending on the segment. Reduction in discharges from SJC 002 could affect vegetation used by sensitive species in the channel. Reduction in discharges from other WRPs could reduce freshwater availability in concrete-lined channels. Impacts are considered potentially significant and further analysis of this issue will be included in an EIR.

b) **Potentially Significant Impact.** The proposed reduction of recycled water discharged to the San Gabriel River could affect riparian vegetation or other sensitive natural communities. As such, impacts are considered potentially significant and further analysis of this issue will be included in an EIR.

c) **Less Than Significant Impact.** The proposed reduction in discharges of recycled water will not result in any discharge of dredge or fill material to waters of the United States or wetlands subject to regulatory protection under the Clean Water Act. The proposed project will not result in the filling of any such “waters” or wetlands. The existing channels would remain unchanged. The proposed project would reduce discharges, but as described above, the modified hydrology would not result in habitat conversion of existing wetlands.. Impacts would be less than significant.

d) **Less Than Significant Impact.** The proposed reduction in discharges of recycled water will not interfere substantially with the movement of any native resident or migratory fish or wildlife species. No anadromous fish or other terrestrial migratory species presently occur in the study area. Migratory birds will not be impeded from moving within or through the study area. The proposed incremental reduction of discharges of recycled water will not interfere with wildlife movement or obstruct any wildlife corridor as compared with existing conditions. No known nursery sites or rookeries occur within the study area that could be affected by the reduced discharge.

e) **No Impact.** The reduced discharges would not conflict with any local wildlife protection plan or ordinance. The existing habitat values would be maintained. No impact would occur.

f) **No Impact**. The reduced discharge would not affect any habitat conservation planning area. The existing habitat values would be maintained. No impact would occur.

Cultural Resources

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
V. CULTURAL RESOURCES — Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource pursuant to §15064.5?	☐	☐	☐	☒
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	☐	☐	☐	☒
c) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☐	☒

Discussion

a) **No Impact.** The District is proposing to incrementally reduce discharges of recycled water from five WRPs, each of which currently discharges into the San Gabriel River or San Jose Creek. The proposed reduction in discharges of recycled water would occur over time, and would not involve any construction activities or other physical changes to the environment other than the decreased volume of discharge. As such, project implementation would not have any physical effect on historical resources in the area. Thus, the proposed project would not cause a substantial adverse change in the significance of a historical resource. No impact would occur in this regard.

b) **No Impact.** As no physical development or changes in current operations are proposed by the project other than the decreased volume of discharge, project implementation would not result in construction or excavation, or any other activities that could cause a substantial adverse change in the significance of an archaeological resource. No impact would occur in this regard.

c) **No Impact.** As no physical development or changes in current operations are proposed by the project other than the decrease in discharges of recycled water, project implementation would not result in construction or excavation, or any other activities that could disturb human remains, including those interred outside of dedicated cemeteries. No impact would occur in this regard.

Energy

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
VI. ENERGY — Would the project:				
a) Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation?	☐	☐	☐	☒
b) Conflict with or obstruct a state or local plan for renewable energy or energy efficiency?	☐	☐	☐	☒

Discussion

a) **No Impact.** The project proposes to incrementally reduce discharges of recycled water from five WRPs, each of which currently discharges into the San Gabriel River or San Jose Creek. The Districts is not proposing to construct new facilities and will continue to maintain the ability to discharge treated water at the same points but anticipates lesser quantities. As no construction activities or changes in current operations are proposed by the project, project implementation would not result in wasteful, inefficient, or unnecessary consumption of energy resources. No impact would occur in this regard.

b) **No Impact.** The proposed reduction in discharges of recycled water would occur over time, and would not involve any construction activities or physical changes to the environment other than the decreased volume of discharge. As such, the proposed project would not conflict with or obstruct a state or local plan for renewable energy or energy efficiency. No impact would occur in this regard.

Geology and Soils

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
VII. GEOLOGY AND SOILS — Would the project:				
a) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? (Refer to Division of Mines and Geology Special Publication 42.)	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☐	☒
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☐	☒
iv) Landslides?	☐	☐	☐	☒
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☐	☒
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	☐	☐	☐	☒
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property?	☐	☐	☐	☒
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	☐	☐	☐	☒
f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☐	☒

Discussion

a.i) **No Impact.** Fault rupture is displacement that occurs along the surface of a fault during an earthquake. The project study area is currently developed with the San Gabriel River and San Jose Creek, which is located in a seismically active area, as is the case throughout the Southern California region. Major faults and fault zones characterize the region. Faults located within the vicinity of the project study area include the Whittier Fault, Chino Fault, San Jose Fault, Norwalk Fault, and the Inglewood Fault. The Whittier Fault traverses the San Gabriel River. Although portions of the project study area may be located within one or more designated Alquist-Priolo Earthquake Fault Zones, since no physical development or changes in the current facilities or operations are proposed by the project, its implementation would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault or active fault trace. No impact would occur in this regard.

a.ii) **No Impact.** Seismicity is the geographic and historical distribution of earthquake, including their frequency, intensity, and distribution. The level of ground shaking at a given location depends on many factors, including the site and type of earthquake, distance from the earthquake, and subsurface geologic conditions. The type of construction also affects how particular structures and improvements perform during ground shaking. As discussed above, the project study area is located in a seismically active region. There is potential for significant ground shaking within the project study area during a strong seismic event on active regional faults in the southern California area. The Whittier Fault traverses the San Gabriel River. However, as no physical development or changes in current facilities or operations are proposed beyond the decreased volume of discharge, the proposed project would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking. No impact would occur in this regard.

a.iii) **No Impact.** Liquefaction is a process that occurs when saturated sediments are subjected to repeated strain reversals during a seismic event. The strain reversals cause increased pore water pressure such that the internal pore pressure approaches the overburden stress and the shear strength approaches zero. Liquefied soils are subject to flow or excessive strain. Liquefaction occurs in soils below the groundwater table. Loose to medium dense sand and silty sand are particularly susceptible to liquefaction. Predominantly fine-grained soils, such as silts and clay, are less susceptible to liquefaction. Portions of the project study area are located within liquefaction zones. However, as no physical development or changes in current facilities or operations are proposed by the project, its implementation would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving seismic-related ground failure, including liquefaction. No impact would occur in this regard.

a.iv) **No Impact.** The project study area is located in a highly urbanized area. The vast majority of the project area is not located within an area susceptible to landslides. Further, as no physical development or changes in current facilities or operations are proposed beyond the decreased volume of discharge, the proposed project would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving landslides. As such, no impact would occur in this regard.

b) **No Impact.** As no physical development or changes in current facilities or operations are proposed beyond the decreased volume of discharge, the proposed project would not result in any site disturbance or grading activity that could expose soils susceptible to erosion. As such, project implementation would not result in substantial soil erosion or the loss of topsoil. No impact would occur in this regard.

c) **No Impact.** Refer to Responses 2.7.a.i.-iv. As no additional development or changes in current operations are proposed by the project, no impacts would occur in this regard.

d) **No Impact.** Expansive soils are defined as fine-grained clayey soils that have the potential to shrink and swell with repeated cycles of wetting and drying. As no development or changes in current operations are proposed by the project, the project would not have the potential to be affected by expansive soils or otherwise result in adverse effects related to such soils. The proposed project would not cause any disturbance to the existing soils that are beneath the site or in any off-site areas. No impact would occur in this regard.

e) **No Impact.** The proposed project does not include the use or development of septic tanks or alternative wastewater disposal systems. Thus, no impacts would occur in this regard.

f) **No Impact. No Impact.** As no physical development or changes in current operations are proposed by the project, project implementation would not result in construction or excavation, or any other activities that could cause a substantial adverse change in the significance of a unique paleontological resource or site or unique geologic feature. No impact would occur in this regard.

References

California Department of Conversation Website, California Geological Survey, Fault Activity Map of California (2010), http://maps.conservation.ca.gov/cgs/fam/, accessed February 2018.

Earthquake Zones of Required Investigation Baldwin Park Quadrangle, California Geological Survey, Official Map, released March 25, 1999, http://gmw.conservation.ca.gov/SHP/EZRIM/Maps/BALDWIN_PARK_EZRIM.pdf

Earthquake Zones of Required Investigation El Monte Quadrangle, California Geological Survey, Earthquake Fault Zones, Revised Official Map, released June 15, 2017; Seismic Hazard Zones Official Map, released March 25, 1999, http://gmw.conservation.ca.gov/SHP/EZRIM/Maps/EL_MONTE_EZRIM.pdf

Earthquake Zones of Required Investigation Whittier Quadrangle, California Geological Survey, Official Map, released March 25, 1999, http://gmw.conservation.ca.gov/SHP/EZRIM/Maps/WHITTIER_EZRIM.pdf.

Greenhouse Gas Emissions

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
VIII. GREENHOUSE GAS EMISSIONS — Would the project:				
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☐	☐	☐	☒
b) Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	☐	☐	☐	☒

Discussion

a) **No Impact.** As the project does not propose development or change in current facilities or operations beyond the decreased volume of discharge, the proposed project would not generate greenhouse gas emissions, either directly or indirectly. No impact would occur in this regard.

b) **No Impact.** No development or changes in current facilities or operations are proposed by the project, and thus its implementation would not have the potential to conflict with any applicable plans. No impact would occur in this regard.

Hazards and Hazardous Materials

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
IX. HAZARDS AND HAZARDOUS MATERIALS — Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☐	☒
b) 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?	☐	☐	☐	☒
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard or excessive noise for people residing or working in the project area?	☐	☐	☐	☒
f) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
g) Expose people or structures, either directly or indirectly, to a significant risk of loss, injury, or death involving wildland fires?	☐	☐	☐	☒

Discussion

a) **No Impact.** The proposed project would incrementally reduce discharges of recycled water from five WRPs, each of which currently discharges into the San Gabriel River or San Jose Creek. No development or changes in current facilities or operations are proposed by the project beyond the decreased volume of discharge. No additional sources of hazardous materials or increases in activities involving hazardous materials would occur under the proposed project. No impact would occur in this regard.

b) **No Impact**. No construction activities involving hazardous materials or other activities that could result in releases of hazardous materials would occur under the proposed project. Likewise, no changes to current facilities or operations are proposed by the project, and thus there would be no additional risks associated with hazardous materials releases relative to existing conditions. It should be noted that while recycled water is not suitable for human consumption, it is not considered a hazardous material, and thus the diverted water to supply recycled water programs implemented by other agencies would not create a significant hazard to the public or the environment. No impact would occur in this regard.

c) **No Impact.** Sensitive land uses are generally considered uses such as playground, schools, senior citizen centers, hospitals, day-care facilities, or other uses that are more susceptible to poor air quality, such as residential neighborhoods. The project study area is located in an urbanized area characterized by a variety of land uses, and although there are a number of sensitive receptors located within the area, no physical development or changes in current facilities and operations are proposed by the project. As such, the proposed project would not have the potential to result in hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste in any greater capacity than is necessary under existing conditions. Therefore, no impact would occur.

d) **No Impact.** According to the California Department of Toxic Substances Control website, a number of properties that are included in a list of hazardous materials sites are located within the vicinity of the project study area. Nonetheless, no physical development or other changes in current operations that could potentially result in hazardous materials releases from known hazardous materials site are proposed by the project. As such, the proposed project would not create a significant hazard to the public or the environment. No impact would occur in this regard.

e) **No Impact.** No public airports are located within 2 miles of the project study area. Further, as noted previously, no construction or any changes in current facilities or operations are proposed by the project. As such, the proposed project would not result in a safety hazard or excessive noise for people residing or working in the project area related to aircraft or airport activities. No impact would occur in this regard.

f) **No Impact.** Adopted emergency response plans or emergency evacuations plan could be located within the vicinity of the project study area. However, since no development or changes in current operations are proposed by the project beyond the decreased volume of discharge, the proposed project would not impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan. Thus, no impacts would occur in this regard.

g) **No Impact.** In anticipation of increased future recycled water demand, the District is proposing to incrementally reduce discharges of recycled water from five WRPs, each of which currently discharges into the San Gabriel River or San Jose Creek. No physical development or changes in current facilities or operations are proposed by the project that would expose people or structures, either directly or indirectly, to a significant risk of loss, injury, or death involving wildland fires. Thus, no impacts would occur in this regard.

References

California Environmental Protection Agency, Department of Toxic Substances Control, Envirostor Database, http://www.envirostor.dtsc.ca.gov/public/, accessed February 2018.

Hydrology and Water Quality

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
X. HYDROLOGY AND WATER QUALITY — Would the project:				
a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality?	☐	☐	☒	☐
b) Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?	☒	☐	☐	☐
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of imperious surfaces, in a manner which would:				
i) result in substantial erosion or siltation on- or off-site;	☒	☐	☐	☐
ii) substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite;	☐	☐	☒	☐
iii) create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or	☐	☐	☒	☐
iv) impede or redirect flood flows?	☐	☐	☐	☒
d) In flood hazard, tsunami, or seiche zones, risk or release of pollutants due to project inundation?	☐	☐	☐	☒
e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?	☐	☐	☐	☒

Discussion

a) **Less Than Significant Impact.** The District is proposing to incrementally reduce discharges of recycled water from five WRPs including the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP, each of which currently discharges into the San Gabriel River or San Jose Creek. While the proposed reduction in recycled water discharges would occur over time, the treatment process and discharge requirements for effluent for the five WRPs would not change pursuant to the NPDES permit covering each WRP. Effluent limitations imposed by the NPDES discharge permits would not change. Thus, impacts in this regard would be less than significant.

b) **Potentially Significant Impact**. The proposed project would involve the gradual reduction of discharges of recycled water from five WRPs, each of which currently discharges into the San Gabriel River, San Jose Creek or Coyote Creek. The discharges from three of the five WRPs (Pomona WRP, San Jose Creek WRP, and Whittier WRP) are to the soft-bottom channel of the San Gabriel River that allows some percolation and contribute to groundwater supplies. The proposed project would reduce river-bottom recharge. Some of the recycled water that will not be discharged to the soft-bottom channel of the San Gabriel River will be used to recharge groundwater as part of regional groundwater recharge facilities and will help meet potable demands. Impacts are considered potentially significant and further analysis of this issue will be included in an EIR.

c.i) **Potentially Significant Impact.** The proposed project would not physically alter the existing drainage pattern of the project study area. The proposed reduction would alter surface water flow conditions within the San Gabriel River. Impacts are considered potentially significant and further analysis of this issue will be included in an EIR.

c.ii) **Less Than Significant Impact.** While the proposed project would alter the volume of water discharged to the San Gabriel River and San Jose Creek, it would not increase the rate or amount of surface runoff or alter the drainage pattern of the site or surrounding area in a manner which would result in flooding on- or off-site. Thus, given that flows would be reduced under the proposed project, impacts in this regard would be less than significant.

c.iii) **Less Than Significant Impact.** Based on the projected reduction in discharges to the San Gabriel River and San Jose Creek from the five WRPs under the proposed project, the capacity of existing or planned stormwater drainage systems would not be exceeded. In addition, the quality of treated effluent discharged would not change from that required by the Waste Discharge Requirements/Waste Recycling Requirements (WDRs/WRRs) for each of the five WRPs. Therefore, impacts to stormwater systems related to increased runoff volumes or polluted runoff would be less than significant.

c.iv) **No Impact.** The project does not propose development or change in current operations beyond the incremental reduction in discharges of recycled water from the five WRPs. As such, the proposed project would not impede or redirect flood flows. Thus, no impacts would occur in these regards.

d) **No Impact.** A tsunami is a large sea wave produced by a significant undersea disturbance. Given the proximity to the Pacific Ocean, a majority of the project study area is not susceptible to inundation by a tsunami. A seiche is an oscillation of an enclosed or semi-enclosed basin, such as a reservoir, harbor, lake, or storage tank. A portion of the project study area is located within the vicinity of the Puddingstone Reservoir while another portion is located within the vicinity of Legg Lake. The San Gabriel River estuary portion of the project study area is located near Alamitos Bay. As no physical development or changes in current facilities or operations are proposed by the project, its implementation would have no impact with regard to inundation by seiche or tsunami.

e) **No Impact.** The project does not propose development or change in current operations beyond the incremental reduction in discharges of recycled water from the five WRPs. As such, the proposed project would not conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan. No impact would occur in this regard.

Land Use and Planning

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XI. LAND USE AND PLANNING — Would the project:				
a) Physically divide an established community?	☐	☐	☐	☒
b) Cause a significant environmental impact due to a conflict with any land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒

Discussion

a) **No Impact.** The proposed project would incrementally reduce discharges of recycled water from five WRPs, each of which currently discharges into the San Gabriel River or San Jose Creek. No development or changes in current facilities or operations are proposed by the project beyond the decreased volume of discharge. As such, the proposed project would not have the potential to physically divide an established community. No impacts would occur in this regard.

b) **No Impact.** The proposed project does not propose changes to the existing land use or zoning designations within the project study area or surrounding areas. Further, the proposed project would not involve any physical development or changes in current facilities or operations beyond the decreased volume of discharge that could cause a significant environmental impact due to a conflict with any land use plan, policy, or regulation over the proposed project. Therefore, no impacts would occur in this regard.

Mineral Resources

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XII. MINERAL RESOURCES — Would the project:				
a) 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?	☐	☐	☐	☒
b) 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?	☐	☐	☐	☒

Discussion

a) **No Impact.** The proposed project does not propose any physical development or changes in current facilities or operations beyond the decreased volume of discharge. As such, the proposed project would not have the potential to 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. No impact would occur.

b) **No Impact.** The proposed project does not propose any physical development or changes in current facilities or operations beyond the decreased volume of discharge. As such, the proposed project would not result in the loss of availability of, or access to, a locally-important mineral resource recovery site. No impact would occur.

Noise

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XIII. NOISE — Would the project result in:				
a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☐	☒
b) Generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☐	☒
c) For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒

Discussion

a) **No Impact.** Noise sensitive areas typically include residential areas, schools, convalescent hospitals, acute care facilities, and park and recreational areas. The project area is located in a highly urbanized area characterized by a wide variety of land uses, and although there are numerous sensitive receptors located within the vicinity of the project study area, the proposed project does not propose any physical development or changes in current facilities or operations beyond the decreased volume of discharge. As such, the proposed project would not generate a substantial temporary or permanent increase in ambient noise in excess of standards established in a city's General Plan or noise ordinance. No impact would occur in this regard.

b) **No Impact.** The proposed project does not propose development or any change in current operations or facilities that could result in new or increased sources of groundborne noise or vibration. As such, project implementation would not result in generation of excessive groundborne vibration or groundborne noise levels. No impact would occur in this regard.

c) **No Impact.** No physical development or changes in current facilities and operations are proposed by the project. As such, the proposed project would not have the potential to expose people residing or working in the project area to excessive noise levels associated with airport operations or aircraft. No impact would occur in this regard.

Population and Housing

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XIV. POPULATION AND HOUSING — Would the project:				
a) Induce substantial unplanned population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☒	☐
b) Displace substantial numbers of existing people or housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

Discussion

a) **Less Than Significant Impact.** The proposed project would incrementally reduce discharges of recycled water from five WRPs, each of which currently discharges into the San Gabriel River or San Jose Creek. No development or changes in current facilities or operations are proposed by the project beyond the decreased volume of discharge. Increased use of recycled water to meet local demands is consistent with urban water management plans in the region, reducing dependency on imported water. As such, project implementation would not induce substantial unplanned population growth in the area, either directly or indirectly. Impacts would be less than significant.

b) **No Impact.** The project study area is currently developed with the San Gabriel River and San Jose Creek and does not include existing housing. As discussed above, the proposed project does not propose any physical development or changes in current facilities or operations beyond the decreased volume of discharge. As such, the proposed project would have no potential to displace substantial numbers of existing people or housing. No impact would occur in this regard.

Public Services

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XV. PUBLIC SERVICES — Would the project:				
a) Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered government 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 following public services:				
i) Fire protection?	☐	☐	☐	☒
ii) Police protection?	☐	☐	☐	☒
iii) Schools?	☐	☐	☐	☒
iv) Parks?	☐	☐	☐	☒
v) Other public facilities?	☐	☐	☐	☒

Discussion

a.i) **No Impact.** As no development or changes in current operations are proposed under the project beyond the incremental reduction of recycled water discharges from the five WRPs, it is anticipated that no increases in the demand for fire protection services or for physical or staff resources associated with fire protection would result from its implementation. In addition, the increased use of recycled water for irrigation and other non-potable uses would offset potable water supplies that could be used for potable applications, including firefighting. No impact would occur in this regard.

a.ii) **No Impact.** As no development or changes in current operations are proposed under the project, it is anticipated that no increases in the demand for police protection services or for physical or staff resources associated with police protection would result from its implementation. No impact would occur in this regard.

a.iii) **No Impact.** The proposed project would not involve any physical development or other changes that could generate students or increase demands for schools or other related facilities. No impact would occur in this regard.

a.iv) **No Impact.** The proposed project would not introduce any new population that would create additional demands on existing or planned park facilities. Furthermore, the proposed project would not displace or directly impact any parks or recreational facilities. Thus, no impacts to park facilities would occur.

a.v) **No Impact.** No other public facilities are anticipated to have the potential to be subject to adverse physical impacts associated with project implementation. No impact would occur in this regard.

Recreation

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XVI. RECREATION:				
a) Would the project increase 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?	☒	☐	☐	☐
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	☐	☐	☐	☒

Discussion

a) **Potentially Significant Impact.** The proposed project does not propose development that could result in an increased demand for the use of park or other recreational facilities in the area. However, the Whittier Narrows Recreation Area is a popular recreation area and the proposed project could affect the open space resources within public access. Impacts are considered potentially significant and further analysis of this issue will be included in an EIR.

b) **No Impact.** The proposed project does not propose neighborhood or regional parks and implementation of the proposed project would not result in an increased demand for parks or recreational facilities. No impact would occur in this regard.

Transportation

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XVII. TRANSPORTATION — Would the project:				
a) Conflict with a program plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities?	☐	☐	☐	☒
b) Would the project conflict or be inconsistent with CEQA Guidelines section 15064.3, subdivision (b)?	☐	☐	☐	☒
c) Substantially increase hazards due to a geometric design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒
d) Result in inadequate emergency access?	☐	☐	☐	☒

Discussion

a) **No Impact.** As no development or changes in current operations are proposed by the project beyond the incremental reduction in discharges of recycled water from the five WRPs, the proposed project would not generate any traffic or result in any adverse effects on the traffic system. As such, the proposed project would have no potential to conflict with program plan, ordinance, or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities. No impact would occur in this regard.

b) **No Impact**. As no development or changes in current operations are proposed by the project beyond the incremental reduction in discharges of recycled water from the five WRPs, the proposed project would not conflict or be inconsistent with CEQA Guidelines section 15064.3, subdivision (b).

c) **No Impact**. As no development or changes in current facilities or operations are proposed by the project, it would not have the potential to increase hazards due to a geometric design feature. Thus, no impacts would occur in this regard.

d) **No Impact**. The proposed project would not result in any physical development or other changes to the project study area or surrounding area such that emergency access would be reduced or otherwise adversely affected. Thus, no impacts would occur in this regard.

Tribal Cultural Resources

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XVIII. TRIBAL CULTURAL RESOURCES — Would the project:				
a) Cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:				
i) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k), or	☐	☐	☐	☒
ii) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resources Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.	☐	☐	☐	☒

Discussion

a.i) **No Impact.** No physical development on- or off-site or changes in current facilities or operations are proposed by the project, and thus its implementation would have no potential to physically affect Tribal Cultural Resources (TCRs) in the area. The Sanitation District’s correspondence with affected tribes regarding formal government-to-government consultation is provided in Appendix A, Native American Tribal Consultation, of this Draft Initial Study. No impact to TCRs would occur.

a.ii) **No Impact.** Refer to Response 2.18.a. No impact would occur in this regard.

Utilities and Service Systems

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XIX. UTILITIES AND SERVICE SYSTEMS — Would the project:				
a) Require or result in the relocation or construction of new or expanded water, wastewater treatment or storm water drainage, electric power, or telecommunications facilities, the construction or relocation of which could cause significant environmental effects?	☐	☐	☐	☒
b) Have sufficient water supplies available to serve the project and responsibly foreseeable future development during normal, dry and multiple dry years?	☐	☐	☐	☒
c) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☐	☒
d) Generate solid waste in excess of State or local standards, or in excess of the capacity of local infrastructure, or otherwise impair the attainment of solid waste reduction goals?	☐	☐	☐	☒
e) Comply with federal, state, and local management and reduction statutes and regulations related to solid waste?	☐	☐	☐	☒

Discussion

a) **No Impact.** Project implementation would not create water or wastewater system capacity problems. Instead, the District would continue to discharge recycled water from the five WRPs at the same locations, but in reduced quantities. The proposed project would not require or result in the relocation or construction of new or expanded water, wastewater treatment facilities or stormwater drainage, electric power, or telecommunications facilities. As such, no impacts would occur.

b) **No Impact.** No new or expanded water entitlements would be required with implementation of the proposed project, as the project does not propose development or change in current operations beyond the incremental reduction in discharges of recycled water. The proposed use of the recycled water would be implemented by water agencies and other users over time. Thus, the proposed project would result in an increase in recycled water supplies and no impacts would occur in this regard.

c) **No Impact.** As mentioned above, in anticipation of increased future recycled water demands, the District is proposing to incrementally reduce discharges of recycled water from five WRPs, each of which currently discharges into the San Gabriel River or San Jose Creek. The proposed use of recycled water would be implemented by water agencies and other users over time. The proposed project would not require additional wastewater treatment capacity or new or expanded facilities. As such, project implementation would not impact the treatment capacity of the wastewater treatment facilities serving the project study area. Thus, no impacts would occur in this regard.

d) **No Impact.** As no development or changes in current operations are proposed by the project, project implementation would not generate solid waste in excess of State or local standards, or in excess of the capacity of local infrastructure, or otherwise impact the attainment of solid waste reduction goals. No impact would occur in this regard.

e) **No Impact.** No physical development or changes in current operations are proposed by the project such that compliance with solid waste regulations beyond what is already required would be necessary. As such, no impacts would occur in this regard.

Wildfire

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XX. WILDFIRE — If located in or near state responsibility areas or lands classified as very high fire hazard severity zones, would the project:				
a) Substantially impair an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
b) Due to slope, prevailing winds, and other factors, exacerbate wildfire risks, and thereby expose project occupants to, pollutant concentrations from a wildfire or the uncontrolled spread of a wildfire?	☐	☐	☐	☒
c) Require the installation or maintenance of associated infrastructure (such as roads, fuel breaks, emergency water sources, power lines or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment?	☐	☐	☐	☒
d) Expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes?	☐	☐	☐	☒

Discussion

a) **No Impact**. Adopted emergency response plans or emergency evacuations plan could be located within the vicinity of the project study area. However, since no development or changes in current operations are proposed by the project beyond the decreased volume of discharge, the proposed project would not substantially impair an adopted emergency response plan or emergency evacuation plan. Thus, no impacts would occur in this regard

b) **No Impact.** The proposed project would incrementally reduce discharges of recycled water from five WRPs, each of which currently discharges into the San Gabriel River or San Jose Creek. No development or changes in current facilities or operations are proposed by the project beyond the decreased volume of discharge. As such, no impact would occur in this regard.

c) **No Impact.** The proposed project would incrementally reduce discharges of recycled water from five WRPs, each of which currently discharges into the San Gabriel River or San Jose Creek. No development or changes in current facilities or operations are proposed by the project beyond the decreased volume of discharge. The proposed project would not require the installation or maintenance of associated infrastructure that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment. As such, no impact would occur in this regard.

d) **No Impact.** The proposed project would incrementally reduce discharges of recycled water from five WRPs, each of which currently discharges into the San Gabriel River or San Jose Creek. No development or changes in current facilities or operations are proposed by the project beyond the decreased volume of discharge. Therefore, the proposed project would not expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes. As such, no impact would occur in this regard.

Mandatory Findings of Significance

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
XXI. MANDATORY FINDINGS OF SIGNIFICANCE —				
a) Does the project have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☒	☐	☐	☐
b) Does the project have impacts that are individually limited but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	☒	☐	☐	☐
c) Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☒	☐

Discussion

a) **Potentially Significant Impact.** As discussed above, the proposed project could potentially result in significant impacts regarding biological resources. Impacts related to biological resources could be considered a substantial degrade to the quality of the environment. This impact is considered potentially significant and will be analyzed in the EIR.

b) **Potentially Significant Impact.** As discussed above, the proposed project could potentially result in significant impacts regarding biological resources, hydrology and water quality, and recreation. The EIR will assess potential cumulative impacts associated with these issues.

c) **Less Than Significant Impact.** As noted previously, the District is proposing to incrementally reduce discharges of recycled water from five WRPs, each of which currently discharges into the San Gabriel River or San Jose Creek. The proposed use of recycled water would be implemented by water agencies and other users. The District will continue to maintain the ability to discharge treated water at the same points but anticipates lesser quantities. The proposed reduction in discharges of recycled water would occur over time, and would not involve any construction activities or other physical changes to the environment other than the decreased volume of discharge. The project does not propose development or change in current operations beyond the incremental reduction in recycled water discharges from the five WRPs, of which would not be considered a substantial adverse effect on human beings.

Thus, substantial adverse effects on human beings, either directly or indirectly, are not anticipated to occur as a result of project implementation. A less than significant impact would occur in this regard.

Appendix A

Native American Tribal Consultation

WATER RECLAMATION
SOLID WASTE MANAGEMENT

COUNTY SANITATION DISTRICTS
OF LOS ANGELES COUNTY

1955 Workman Mill Road, Whittier, CA 90601-1400
Mailing Address: P.O. Box 4998, Whittier, CA 90607-4998
Telephone: (562) 699-7411, FAX: (562) 699-5422
www.lacsd.org

GRACE ROBINSON HYDE
Chief Engineer and General Manager

March 23, 2018

Donna Yocum, Chairperson
San Fernando Band of Mission Indians
P.O. Box 221838
Newhall, CA 91322

Dear Ms. Yocum:

San Gabriel River Watershed Project to
Reduce River Discharge in Support of Increased Recycled Water Reuse

In conformance with the tribal consultation requirements of Assembly Bill (AB) 52, this letter is to inform you that the Sanitation Districts of Los Angeles County (Districts) is reviewing the proposed project described below. Per AB 52, the tribe has the right to consult on a proposed public or private project prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report. The project description is as follows:

In anticipation of increased future recycled water demands, the Districts are proposing to incrementally reduce discharges of tertiary-treated wastewater from five water reclamation plants (WRPs) including the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP, each of which currently discharge into the San Gabriel River or the San Jose Creek; refer to **Figure 1-1**, *LACSD Receiving Water Stations and Discharges to San Gabriel System* and **Figure 1-2**, *San Jose Creek WRP Discharge Points*. The diverted water would supply recycled water programs implemented by other agencies. The proposed reduction in wastewater discharges would occur over time, and would not involve any construction activities or other physical changes to the environment other than the decreased volume of discharge. The Districts will continue to maintain the ability to discharge treated water at the same points of diversion, but anticipate lesser quantities.

You have 30 calendar days from receipt of this letter to notify us in writing that you want to consult on this project. Please provide the lead contact person's contact information. Please mail your request to:

Winnie Siauw
Project Engineer, Wastewater Planning Section
Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90601
(562) 908-4288 x2740
winniesiauw@lacsd.org

Sincerely,

Jodie Lanza

Jodie Lanza
Supervising Engineer, Wastewater Planning
Facilities Planning Department

JL:VC:pb

Attachments:
Figure 1-1, LACSD Receiving Water Stations and Discharges to San Gabriel System;
Figure 1-2, San Jose Creek WRP Discharge Points

WATER
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GRACE ROBINSON HYDE
Chief Engineer and General Manager

March 23, 2018

Temet Aguilar, Chairperson
Pauma Band of Luiseno Indians - Pauma & Yuima Reservation
P.O. Box 369
Pauma Valley, CA 92061

Dear Mr. Aguilar:

San Gabriel River Watershed Project to
Reduce River Discharge in Support of Increased Recycled Water Reuse

In conformance with the tribal consultation requirements of Assembly Bill (AB) 52, this letter is to inform you that the Sanitation Districts of Los Angeles County (Districts) is reviewing the proposed project described below. Per AB 52, the tribe has the right to consult on a proposed public or private project prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report. The project description is as follows:

In anticipation of increased future recycled water demands, the Districts are proposing to incrementally reduce discharges of tertiary-treated wastewater from five water reclamation plants (WRPs) including the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP, each of which currently discharge into the San Gabriel River or the San Jose Creek; refer to **Figure 1-1**, *LACSD Receiving Water Stations and Discharges to San Gabriel System* and **Figure 1-2**, *San Jose Creek WRP Discharge Points*. The diverted water would supply recycled water programs implemented by other agencies. The proposed reduction in wastewater discharges would occur over time, and would not involve any construction activities or other physical changes to the environment other than the decreased volume of discharge. The Districts will continue to maintain the ability to discharge treated water at the same points of diversion, but anticipate lesser quantities.

You have 30 calendar days from receipt of this letter to notify us in writing that you want to consult on this project. Please provide the lead contact person's contact information. Please mail your request to:

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Project Engineer, Wastewater Planning Section
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Whittier, CA 90601
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Sincerely,

Jodie Lanza

Jodie Lanza
Supervising Engineer, Wastewater Planning
Facilities Planning Department

JL:VC:pb

Attachments:
Figure 1-1, LACSD Receiving Water Stations and Discharges to San Gabriel System;
Figure 1-2, San Jose Creek WRP Discharge Points

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GRACE ROBINSON HYDE
Chief Engineer and General Manager

March 23, 2018

Charles Alvarez, Councilperson
Gabrielino-Tongva Tribe
23454 Vanowen Street
West Hills, CA 91307

Dear Mr. Alvarez:

San Gabriel River Watershed Project to
Reduce River Discharge in Support of Increased Recycled Water Reuse

In conformance with the tribal consultation requirements of Assembly Bill (AB) 52, this letter is to inform you that the Sanitation Districts of Los Angeles County (Districts) is reviewing the proposed project described below. Per AB 52, the tribe has the right to consult on a proposed public or private project prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report. The project description is as follows:

In anticipation of increased future recycled water demands, the Districts are proposing to incrementally reduce discharges of tertiary-treated wastewater from five water reclamation plants (WRPs) including the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP, each of which currently discharge into the San Gabriel River or the San Jose Creek; refer to **Figure 1-1**, *LACSD Receiving Water Stations and Discharges to San Gabriel System* and **Figure 1-2**, *San Jose Creek WRP Discharge Points*. The diverted water would supply recycled water programs implemented by other agencies. The proposed reduction in wastewater discharges would occur over time, and would not involve any construction activities or other physical changes to the environment other than the decreased volume of discharge. The Districts will continue to maintain the ability to discharge treated water at the same points of diversion, but anticipate lesser quantities.

You have 30 calendar days from receipt of this letter to notify us in writing that you want to consult on this project. Please provide the lead contact person's contact information. Please mail your request to:

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Project Engineer, Wastewater Planning Section
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1955 Workman Mill Road
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winniesiauw@lacsd.org

Sincerely,

Jodie Lanza

Jodie Lanza
Supervising Engineer, Wastewater Planning
Facilities Planning Department

JL:VC:pb

Attachments:
Figure 1-1, LACSD Receiving Water Stations and Discharges to San Gabriel System;
Figure 1-2, San Jose Creek WRP Discharge Points

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GRACE ROBINSON HYDE
Chief Engineer and General Manager

March 23, 2018

Robert Dorame, Chairperson
Gabrielino Tongva Indians of California Tribal Council
P.O. Box 490
Bellflower, CA 90707

Dear Mr. Dorame:

San Gabriel River Watershed Project to
Reduce River Discharge in Support of Increased Recycled Water Reuse

In conformance with the tribal consultation requirements of Assembly Bill (AB) 52, this letter is to inform you that the Sanitation Districts of Los Angeles County (Districts) is reviewing the proposed project described below. Per AB 52, the tribe has the right to consult on a proposed public or private project prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report. The project description is as follows:

In anticipation of increased future recycled water demands, the Districts are proposing to incrementally reduce discharges of tertiary-treated wastewater from five water reclamation plants (WRPs) including the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP, each of which currently discharge into the San Gabriel River or the San Jose Creek; refer to **Figure 1-1**, *LACSD Receiving Water Stations and Discharges to San Gabriel System* and **Figure 1-2**, *San Jose Creek WRP Discharge Points*. The diverted water would supply recycled water programs implemented by other agencies. The proposed reduction in wastewater discharges would occur over time, and would not involve any construction activities or other physical changes to the environment other than the decreased volume of discharge. The Districts will continue to maintain the ability to discharge treated water at the same points of diversion, but anticipate lesser quantities.

You have 30 calendar days from receipt of this letter to notify us in writing that you want to consult on this project. Please provide the lead contact person's contact information. Please mail your request to:

Winnie Siauw
Project Engineer, Wastewater Planning Section
Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90601
(562) 908-4288 x2740
winniesiauw@lacsd.org

Sincerely,

Jodie Lanza

Jodie Lanza
Supervising Engineer, Wastewater Planning
Facilities Planning Department

JL:VC:pb

Attachments:
Figure 1-1, LACSD Receiving Water Stations and Discharges to San Gabriel System;
Figure 1-2, San Jose Creek WRP Discharge Points

WATER RECLAMATION
SOLID WASTE MANAGEMENT

COUNTY SANITATION DISTRICTS
OF LOS ANGELES COUNTY

1955 Workman Mill Road, Whittier, CA 90601-1400
Mailing Address: P.O. Box 4998, Whittier, CA 90607-4998
Telephone: (562) 699-7411, FAX: (562) 699-5422
www.lacsd.org

GRACE ROBINSON HYDE
Chief Engineer and General Manager

March 23, 2018

Sandonne Goad, Chairperson
Gabrielino /Tongva Nation
106 1/2 Judge John Aiso St #231
Los Angeles, CA 90012

Dear Ms. Goad:

San Gabriel River Watershed Project to
<u>Reduce River Discharge in Support of Increased Recycled Water Reuse</u>

In conformance with the tribal consultation requirements of <u>Assembly Bill (AB) 52</u>, this letter is to inform you that the Sanitation Districts of Los Angeles County (Districts) is reviewing the proposed project described below. Per AB 52, the tribe has the right to consult on a proposed public or private project prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report. The project description is as follows:

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<u>winniesiauw@lacsd.org</u>

Sincerely,

Jodie Lanza

Jodie Lanza
Supervising Engineer, Wastewater Planning
Facilities Planning Department

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Attachments:
Figure 1-1, LACSD Receiving Water Stations and Discharges to San Gabriel System;
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GRACE ROBINSON HYDE
Chief Engineer and General Manager

March 23, 2018

Anthony Morales, Chairperson
Gabrieleno/Tongva San Gabriel Band of Mission Indians
P.O. Box 693
San Gabriel, CA 91778

Dear Mr. Morales:

San Gabriel River Watershed Project to
Reduce River Discharge in Support of Increased Recycled Water Reuse

In conformance with the tribal consultation requirements of Assembly Bill (AB) 52, this letter is to inform you that the Sanitation Districts of Los Angeles County (Districts) is reviewing the proposed project described below. Per AB 52, the tribe has the right to consult on a proposed public or private project prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report. The project description is as follows:

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1955 Workman Mill Road
Whittier, CA 90601
(562) 908-4288 x2740
winniesiauw@lacsd.org

Sincerely,

Jodie Lanza

Jodie Lanza
Supervising Engineer, Wastewater Planning
Facilities Planning Department

JL:VC:pb

Attachments:
Figure 1-1, LACSD Receiving Water Stations and Discharges to San Gabriel System;
Figure 1-2, San Jose Creek WRP Discharge Points

COUNTY SANITATION DISTRICTS
OF LOS ANGELES COUNTY

1955 Workman Mill Road, Whittier, CA 90601-1400
Mailing Address: P.O. Box 4998, Whittier, CA 90607-4998
Telephone: (562) 699-7411, FAX: (562) 699-5422
www.lacsd.org

GRACE ROBINSON HYDE
Chief Engineer and General Manager

March 23, 2018

Andrew Salas, Chairperson
Gabrieleno Band of Mission Indians - Kizh Nation
P.O. Box 393
Covina, CA 91723

Dear Mr. Salas:

San Gabriel River Watershed Project to
Reduce River Discharge in Support of Increased Recycled Water Reuse

In conformance with the tribal consultation requirements of Assembly Bill (AB) 52, this letter is to inform you that the Sanitation Districts of Los Angeles County (Districts) is reviewing the proposed project described below. Per AB 52, the tribe has the right to consult on a proposed public or private project prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report. The project description is as follows:

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1955 Workman Mill Road
Whittier, CA 90601
(562) 908-4288 x2740
winniesiauw@lacsd.org

Sincerely,

Jodie Lanza

Jodie Lanza
Supervising Engineer, Wastewater Planning
Facilities Planning Department

JL:VC:pb
Attachments:
Figure 1-1, LACSD Receiving Water Stations and Discharges to San Gabriel System;
Figure 1-2, San Jose Creek WRP Discharge Points

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www.lacsd.org

GRACE ROBINSON HYDE
Chief Engineer and General Manager

March 27, 2018

Matias Belardes, Chairperson
Juaneno Band of Mission Indians Acjachemen Nation
32161 Avenida Los Amigos
San Juan Capistrano, CA 92675

Dear Mr. Salas:

San Gabriel River Watershed Project to
Reduce River Discharge in Support of Increased Recycled Water Reuse

In conformance with the tribal consultation requirements of Assembly Bill (AB) 52, this letter is to inform you that the Sanitation Districts of Los Angeles County (Districts) is reviewing the proposed project described below. Per AB 52, the tribe has the right to consult on a proposed public or private project prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report. The project description is as follows:

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(562) 908-4288 x2740
winniesiauw@lacsd.org

Sincerely,

Jodie Lanza

Jodie Lanza
Supervising Engineer, Wastewater Planning
Facilities Planning Department

JL:VC:pb

Attachments:
Figure 1-1, LACSD Receiving Water Stations and Discharges to San Gabriel System;
Figure 1-2, San Jose Creek WRP Discharge Points

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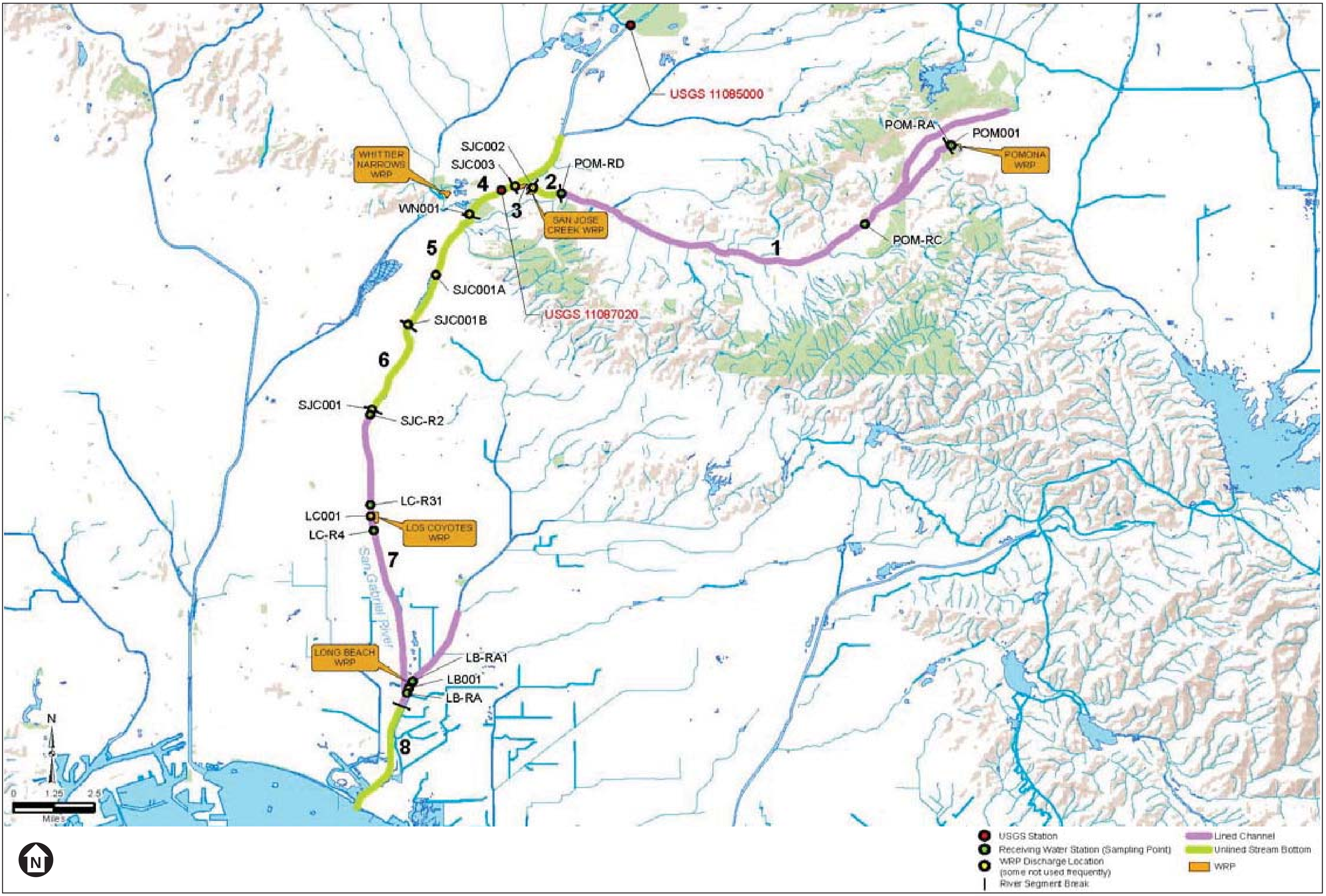

SOURCE: Clearwater EIR Segment Map, prepared by Chambers Group, Inc., 2015

LACSD San Gabriel River Wastewater Diversion Program

Figure 1-1
LACSD Receiving Water Stations and Discharges to San Gabriel System

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SOURCE: Amec, Foster, Wheeler, 2017

Figure 1-2
SJCWRP Discharge Points

GABRIELEÑO BAND OF MISSION INDIANS - KIZH NATION
Historically known as The San Gabriel Band of Mission Indians
recognized by the State of California as the aboriginal tribe of the Los Angeles basin

County Station District
1955 Workman Mill Road
Whittier, CA 90607-4998

March 29, 2018

Re: AB52 Consultation request for San Gabriel River Watershed Project

Dear Jodie Lanza,

Please find this letter as a written request for consultation regarding the above-mentioned project pursuant to Public Resources Code § 21080.3.1, subd. (d). Your project lies within our ancestral tribal territory, meaning belonging to or inherited from, which is a higher degree of kinship than traditional or cultural affiliation. Your project is located within a sensitive area and may cause a substantial adverse change in the significance of our tribal cultural resources. Most often, a records search for our tribal cultural resources will result in a "no records found" for the project area. The Native American Heritage Commission (NAHC), ethnographers, historians, and professional archaeologists can only provide limited information that has been previously documented about California Native Tribes. This is the reason the NAHC will always refer the lead agency to the respective Native American Tribe of the area because the NAHC is only aware of general information and are not the experts on each California Tribe. Our Elder Committee & tribal historians are the experts for our Tribe and are able to provide a more complete history (both written and oral) regarding the location of historic villages, trade routes, cemeteries and sacred/religious sites in the project area. Therefore, to avoid adverse effects to our tribal cultural resources, we would like to consult with you and your staff to provide you with a more complete understanding of the prehistoric use(s) of the project area and the potential risks for causing a substantial adverse change to the significance of our tribal cultural resources.

Consultation appointments are available on Wednesdays and Thursdays at our offices at 910 N. Citrus Ave. Covina, CA 91722 or over the phone. Please call toll free 1-844-390-0787 or email gabrielenoindians@yahoo.com to schedule an appointment.

** Prior to the first consultation with our Tribe, we ask all those individuals participating in the consultation to view a video produced and provided by CalEPA and the NAHC for sensitivity and understanding of AB52. You can view their videos at: http://calepa.ca.gov/Tribal/Training/ or http://nahc.ca.gov/2015/12/ab-52-tribal-training/

With Respect,

Andrew Salas, Chairman

Andrew Salas, Chairman
Nadine Salas, Vice-Chairman
Christina Swindall Martinez, secretary
Albert Perez, treasurer I
Martha Gonzalez Lemos, treasurer II
Richard Gradias, Chairman of the Council of Elders
PO Box 393, Covina, CA 91723
www.gabrielenoindians.org
gabrielenoindians@yahoo.com

Appendix A2

Notice of Preparation and Notice of Public Scoping Meeting, February 5, 2019

SANITATION DISTRICTS OF LOS ANGELES COUNTY

NOTICE OF PREPARATION AND NOTICE OF PUBLIC SCOPING MEETING

Date:	February 5, 2019
To:	California Office of Planning and Research, Responsible and Trustee Agencies, and Other Interested Parties
Lead Agency:	Sanitation Districts of Los Angeles County 1955 Workman Mill Road, Whittier, CA, 90601
Subject:	Notice of Preparation of an Environmental Impact Report for the San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse

Notice of Preparation

This Notice of Preparation (NOP) has been prepared to notify responsible and trustee agencies and interested parties that the Sanitation Districts of Los Angeles County (Sanitation Districts) as the Lead Agency has independently chosen to prepare an Environmental Impact Report (EIR) evaluating the potential environmental impacts associated with implementation of the San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse (proposed project). The Sanitation Districts has prepared this NOP in accordance with the State CEQA Guidelines (Section 15082). The Sanitation Districts had previously published an Initial Study and a Notice of Intent to adopt a Mitigated Negative Declaration (MND) for the same project in July 2018, which concluded that the proposed project would result in no significant impacts to the environment. Following public review of the MND and accompanying Initial Study, the Sanitation Districts decided to prepare an EIR.

The Sanitation Districts are soliciting input from interested persons and responsible and trustee agencies to assist in the development of the scope and content of the environmental information to be studied in the EIR. In accordance with CEQA, agencies are requested to review the project description and provide comments on environmental issues related to the statutory responsibilities of the agency. The EIR will be used by the Sanitation Districts when considering approval of the proposed project.

NOP Comment Period: In accordance with CEQA, comments to the NOP must be received by Sanitation Districts no later than 30 days after publication of this notice. The review period for this NOP is from February 6, 2019 to March 9, 2019. We request that comments to this NOP be received no later than March 9, 2019 at 5:00 PM. Please include a return address and contact name with your comments and send them to the address shown below or email to jlanza@lacsd.org.

Jodie Lanza, Supervising Engineer
Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90601
(562) 908-4288, extension 2707

Document Availability: The project description, location, and potential environmental effects are described herein. Copies of the NOP have been transmitted to the California State Clearinghouse and to responsible and trustee agencies. Copies of this NOP, the Initial Study, and future environmental documents prepared in conjunction with the proposed project will be available for public review on the Sanitation Districts' website at: http://www.lacsd.org/residents/documents_for_public_review.asp, and at the following location.

- Sanitation Districts of Los Angeles County, 1955 Workman Mill Road, Whittier, CA 90601

A Notice of Availability will be issued when the Draft EIR is published for public review.

Notice of Scoping Meeting

A Public Scoping Meeting will be held to receive public comments and suggestions on the environmental issues associated with implementation of the proposed project that will be addressed in the EIR. At the Public Scoping Meeting, a brief presentation and overview of the proposed project will be provided. After the presentation, oral and written comments on the scope of the environmental issues to be addressed in the EIR will be accepted. The Public Scoping Meeting will be open to the public and held at the following location:

Date:	Wednesday, February 20, 2019
Time:	6:00 PM – 9:00 PM
Location:	Sanitation Districts of Los Angeles County District’s Board Room 1955 Workman Mill Road Whittier, CA 90601

Proposed Project

In anticipation of increased future recycled water demands, the Sanitation Districts are proposing to incrementally reduce discharges of recycled water from five water reclamation plants (WRPs), including the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP, each of which currently discharges into the San Gabriel River, San Jose Creek, or Coyote Creek. The diverted water would supply recycled water programs implemented by other agencies. The proposed reduction in water discharges would occur over time, and would not involve any construction activities or other physical changes to the environment other than the decreased volume of discharge. Future construction of infrastructure projects to deliver recycled water will be covered under separate CEQA compliance documents prepared by the implementing agencies.

Project Location: The locations of the five WRPs are shown in **Figure 1**. The Pomona WRP currently discharges recycled water to San Jose Creek. The San Jose Creek WRP, Whittier Narrows WRP[1], and Los Coyotes WRP each discharge to the San Gabriel River. The Long Beach WRP discharges to Coyote Creek at the confluence with the San Gabriel River. The project study area includes the San Gabriel River and San Jose Creek.

Project Background: The Sanitation Districts are a public agency created under state law to manage wastewater and solid waste on a regional scale and consist of 24 independent special districts serving approximately 5.6 million people in Los Angeles County (County). The Sanitation Districts' service area covers approximately 850 square miles and encompasses 78 cities and unincorporated territory within the County. The Sanitation Districts operate 10 WRPs and the Joint Water Pollution Control Plant. Seventeen sanitation districts provide sewerage services in the metropolitan Los Angeles area are signatory to a Joint Outfall Agreement that provides for the regional, interconnected systems of facilities known as the Joint Outfall System (JOS). The service area of the JOS encompasses 73 cities and unincorporated territory, providing sewage treatment, reuse, and ocean disposal for residential, commercial, and industrial wastewater. Under the Joint Outfall Agreement, Sanitation District No. 2 of Los Angeles County (District) has been appointed managing authority over the JOS.

Project Objectives: (1) Support increased water recycling in the San Gabriel River watershed through maximizing availability of treated effluent otherwise discharged to flood control channels; (2) Create a more efficient utilization of treated effluent to support both recycled water reuse and sensitive riparian habitat; (3) Sustain sensitive habitat supported by historical treated effluent discharges to the San Gabriel River watershed.

Project Description: The Sanitation Districts are proposing to incrementally reduce discharges of recycled water from the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP. The Sanitation Districts are not proposing to construct any new facilities. The proposed use of the recycled water would be implemented by water agencies and other users over time. The Sanitation Districts will continue to maintain the ability to discharge treated water at the same points but anticipates discharging lesser quantities. A brief description of the proposed project's discharge operation modifications is provided below:

- The San Jose Creek WRP discharge is currently rotated between five discharge locations within the San Gabriel River watershed as show on in Figure 1. The use of the discharge locations is irregular throughout the year and varies year-to-year, depending on the availability of groundwater recharge facilities and channel maintenance activities. Under the proposed project, discharges from the San Jose Creek WRP at discharge point SJC002 would be reduced from an annual average of approximately 9.48 million of gallons per day (MGD) to a minimum monthly average of approximately 5 MGD. Although the total annual volume would be reduced, the new monthly average discharge would provide a more consistent discharge rate compared to existing conditions. Discharges would be timed to more

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[1] The Whittier Narrows WRP has 3 discharge locations; of which only one is to the San Gabriel River.

efficiently meet the water demand needs of sensitive habitat. The diverted water would be conveyed for beneficial reuse to groundwater recharge basins or other reuse facilities.

- The Pomona WRP discharges into a concrete-lined portion of San Jose Creek which contains no sensitive habitat. As San Jose Creek nears the San Gabriel River, the concrete lining gives way to a soft-bottom reach. Current and historic groundwater upwelling occurs within the lined portion of San Jose Creek upstream of the transition location. The proposed project would result in zero discharge from the Pomona WRP. Habitat in the soft-bottomed portion of San Jose Creek would continue to be sustained by rising groundwater.
- The Whittier Narrows WRP has three discharge locations but only one tributary to the San Gabriel River. A recently approved modification to discharge from the Whittier Narrows WRP will reduce discharges to the San Gabriel River by approximately 1 percent (0.01 MGD).
- The Los Coyotes WRP discharges into a concrete-lined portion of the San Gabriel River. Discharge flow is contained within the low-flow channel of the river under typical dry-weather conditions. This project proposes to maintain a minimum discharge flow of 2 MGD to prevent the low-flow channel from going completely dry downstream of the plant.
- The Long Beach WRP discharges into the concrete-lined Coyote Creek approximately 3,000 feet before the start of the San Gabriel River estuary. Urban runoff and natural flows in Coyote Creek upstream of the Long Beach WRP maintain a consistent flow in the creek at the discharge location. This project proposes a minimum discharge flow of zero from the Long Beach WRP.[2]

Environmental Evaluation

The Sanitation Districts prepared and published an Initial Study in July 2018 that evaluated potential environmental impacts associated with implementation of the proposed project. The Sanitation Districts initially issued a Notice of Intent to adopt an MND and received public comments. After considering the public comments submitted, the Sanitation Districts has elected to prepare an EIR. Based on the Initial Study, the EIR will focus on potential impacts to biological resources, hydrological resources, and recreation. All other effects were determined to be less than significant in the Initial Study. The Initial Study is available for review on the Sanitations Districts' website as provided above. The following environmental topic areas will be addressed in the EIR.

Biological Resources: The proposed project would reduce discharges from five WRPs. Potential sensitive biological resources within and along the San Gabriel River and other tributaries could be impacted by changes in operations under the proposed project. All potential impacts to biological resources will be further evaluated in the EIR. If the EIR identifies significant adverse

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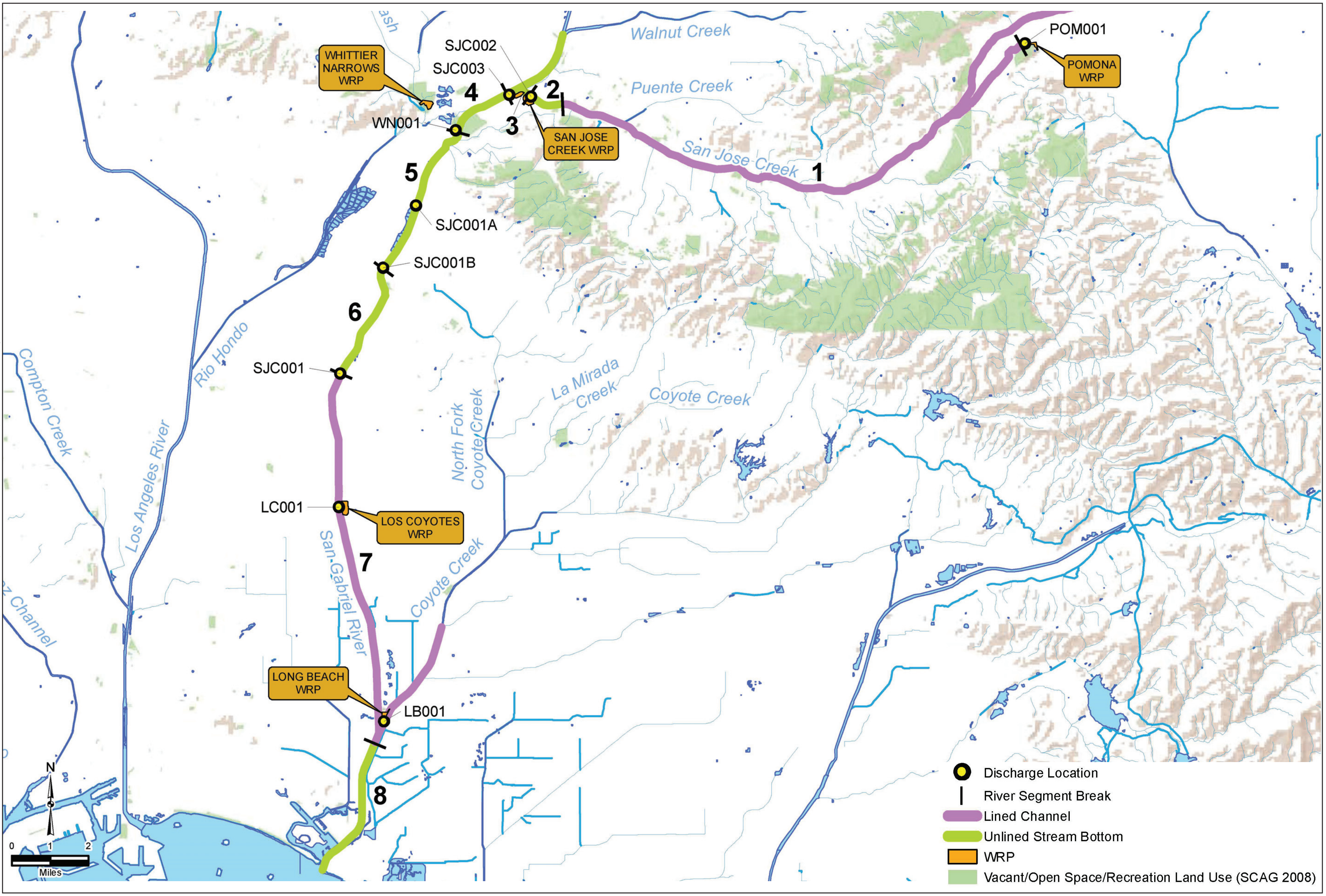
[2] In addition, the Long Beach WRP would increase contributions to the Alamitos Seawater Intrusion Barrier injection well system and may increase recycled water available for other reuse projects. Los Coyotes, Pomona, and Whittier Narrows WRPs would also increase contributions to recycled water use projects.

impacts to biological resources, it will also include mitigation measures to reduce potential impacts, where feasible.

Hydrology and Water Quality: The Sanitation Districts are proposing to reduce discharges of recycled water from five WRPs including the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP, each of which currently discharges into the San Gabriel River or San Jose Creek. The EIR will evaluate potential hydrology and water quality impacts of the proposed changes in operation on the tributaries and groundwater resources within the San Gabriel River Watershed. If it is determined that the project could have significant hydrology and water quality impacts related to surface water hydrology or groundwater or water quality, mitigation measures will be identified to reduce the impacts, where feasible.

Recreation: The proposed project does not propose development that could result in an increased demand for the use of park or other recreational facilities in the area. However, the Whittier Narrows Recreation Area is a popular recreation area, and the proposed project could affect the open space resources or infringe on public access. As such, impacts are considered potentially significant and further analysis of this issue in an EIR is required.



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SOURCE: Clearwater EIR Segment Map

San Gabriel River Watershed Project to Reduce River Discharge
in Support of Increased Recycled Water Reuse

Figure 1
Sanitation Districts Receiving Water Stations and Discharges to San Gabriel System

ESA

Appendix A3

NOP and Scoping Meeting Comments

South Coast
Air Quality Management District
South Coast AQMD
21865 Copley Drive, Diamond Bar, CA 91765-4178
(909) 396-2000 • www.aqmd.gov

SENT VIA USPS AND E-MAIL: February 21, 2019
jlanza@lacsd.org
Jodie Lanza, Supervisor Engineer
Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90601

Notice of Preparation of an Environmental Impact Report for the Proposed San Gabriel River Watershed Project

South Coast Air Quality Management District (SCAQMD) staff appreciates the opportunity to comment on the above-mentioned document. SCAQMD staff's comments are recommendations regarding the analysis of potential air quality impacts from the Proposed Project that should be included in the Environmental Impact Report (EIR). Please send SCAQMD a copy of the EIR upon its completion. Note that copies of the EIR that are submitted to the State Clearinghouse are not forwarded to SCAQMD. Please forward a copy of the EIR directly to SCAQMD at the address shown in the letterhead. **In addition, please send with the EIR all appendices or technical documents related to the air quality, health risk, and greenhouse gas analyses and electronic versions of all air quality modeling and health risk assessment files[1]. These include emission calculation spreadsheets and modeling input and output files (not PDF files). Without all files and supporting documentation, SCAQMD staff will be unable to complete our review of the air quality analyses in a timely manner. Any delays in providing all supporting documentation will require additional time for review beyond the end of the comment period.**

Air Quality Analysis

SCAQMD adopted its California Environmental Quality Act (CEQA) Air Quality Handbook in 1993 to assist other public agencies with the preparation of air quality analyses. SCAQMD recommends that the Lead Agency use this Handbook as guidance when preparing its air quality analysis. Copies of the Handbook are available from SCAQMD's Subscription Services Department by calling (909) 396-3720. More guidance developed since this Handbook is also available on SCAQMD's website at: http://www.aqmd.gov/home/regulations/ceqa/air-quality-analysis-handbook/ceqa-air-quality-handbook-(1993). SCAQMD staff also recommends that the Lead Agency use the CalEEMod land use emissions software. This software has recently been updated to incorporate up-to-date state and locally approved emission factors and methodologies for estimating pollutant emissions from typical land use development. CalEEMod is the only software model maintained by the California Air Pollution Control Officers Association (CAPCOA) and replaces the now outdated URBEMIS. This model is available free of charge at: www.caleemod.com.

SCAQMD has also developed both regional and localized significance thresholds. SCAQMD staff requests that the Lead Agency quantify criteria pollutant emissions and compare the results to SCAQMD's CEQA regional pollutant emissions significance thresholds to determine air quality impacts.

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[1] Pursuant to the CEQA Guidelines Section 15174, the information contained in an EIR shall include summarized technical data, maps, plot plans, diagrams, and similar relevant information sufficient to permit full assessment of significant environmental impacts by reviewing agencies and members of the public. Placement of highly technical and specialized analysis and data in the body of an EIR should be avoided through inclusion of supporting information and analyses as appendices to the main body of the EIR. Appendices to the EIR may be prepared in volumes separate from the basic EIR document, but shall be readily available for public examination and shall be submitted to all clearinghouses which assist in public review.

SCAQMD's CEQA regional pollutant emissions significance thresholds can be found here: http://www.aqmd.gov/docs/default-source/ceqa/handbook/scaqmd-air-quality-significance-thresholds.pdf. In addition to analyzing regional air quality impacts, SCAQMD staff recommends calculating localized air quality impacts and comparing the results to localized significance thresholds (LSTs). LSTs can be used in addition to the recommended regional significance thresholds as a second indication of air quality impacts when preparing a CEQA document. Therefore, when preparing the air quality analysis for the Proposed Project, it is recommended that the Lead Agency perform a localized analysis by either using the LSTs developed by SCAQMD staff or performing dispersion modeling as necessary. Guidance for performing a localized air quality analysis can be found at: http://www.aqmd.gov/home/regulations/ceqa/air-quality-analysis-handbook/localized-significance-thresholds.

The Lead Agency should identify any potential adverse air quality impacts that could occur from all phases of the Proposed Project and all air pollutant sources related to the Proposed Project. Air quality impacts from both construction (including demolition, if any) and operations should be calculated, if applicable[2]. Construction-related air quality impacts typically include, but are not limited to, emissions from the use of heavy-duty equipment from grading, earth-loading/unloading, paving, architectural coatings, off-road mobile sources (e.g., heavy-duty construction equipment) and on-road mobile sources (e.g., construction worker vehicle trips, material transport trips). Operation-related air quality impacts may include, but are not limited to, emissions from stationary sources (e.g., boilers), area sources (e.g., solvents and coatings), and vehicular trips (e.g., on- and off-road tailpipe emissions and entrained dust). Air quality impacts from indirect sources, such as sources that generate or attract vehicular trips, should be included in the analysis.

In the event that the Proposed Project generates or attracts vehicular trips, especially heavy-duty diesel-fueled vehicles, it is recommended that the Lead Agency perform a mobile source health risk assessment. Guidance for performing a mobile source health risk assessment ("*Health Risk Assessment Guidance for Analyzing Cancer Risk from Mobile Source Diesel Idling Emissions for CEQA Air Quality Analysis*") can be found at: http://www.aqmd.gov/home/regulations/ceqa/air-quality-analysis-handbook/mobile-source-toxics-analysis. An analysis of all toxic air contaminant impacts due to the use of equipment potentially generating such air pollutants should also be included.

In addition, guidance on siting incompatible land uses (such as placing homes near freeways) can be found in the California Air Resources Board's *Air Quality and Land Use Handbook: A Community Health Perspective*, which can be found at: http://www.arb.ca.gov/ch/handbook.pdf. CARB's Land Use Handbook is a general reference guide for evaluating and reducing air pollution impacts associated with new projects that go through the land use decision-making process. Guidance[3] on strategies to reduce air pollution exposure near high-volume roadways can be found at: https://www.arb.ca.gov/ch/rd_technical_advisory_final.PDF.

Mitigation Measures

In the event that the Proposed Project generates significant adverse air quality impacts, CEQA requires that all feasible mitigation measures that go beyond what is required by law be utilized during project

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[2] According to the Notice of Preparation, the Lead Agency stated that the Proposed Project would not involve any construction activities or other physical changes to the environment other than the decreased volume of discharge.

[3] In April 2017, CARB published a technical advisory, *Strategies to Reduce Air Pollution Exposure Near High-Volume Roadways: Technical Advisory*, to supplement CARB's Air Quality and Land Use Handbook: A Community Health Perspective. This technical advisory is intended to provide information on strategies to reduce exposures to traffic emissions near high-volume roadways to assist land use planning and decision-making in order to protect public health and promote equity and environmental justice. The technical advisory is available at: https://www.arb.ca.gov/ch/landuse.htm.

construction and operation to minimize these impacts. Pursuant to CEQA Guidelines Section 15126.4 (a)(1)(D), any impacts resulting from mitigation measures must also be discussed. Several resources are available to assist the Lead Agency with identifying potential mitigation measures for the Proposed Project, including:

- Chapter 11 "Mitigating the Impact of a Project" of SCAQMD'S *CEQA Air Quality Handbook.* SCAQMD's CEQA web pages available here: http://www.aqmd.gov/home/regulations/ceqa/air-quality-analysis-handbook/mitigation-measures-and-control-efficiencies
- SCAQMD's Rule 403 – Fugitive Dust, and the Implementation Handbook for controlling construction-related emissions and Rule 1403 – Asbestos Emissions from Demolition/Renovation Activities
- SCAQMD's Mitigation Monitoring and Reporting Plan (MMRP) for the 2016 Air Quality Management Plan (2016 AQMP) available here (starting on page 86): http://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2017/2017-mar3-035.pdf
- CAPCOA's *Quantifying Greenhouse Gas Mitigation Measures* available here: http://www.capcoa.org/wp-content/uploads/2010/11/CAPCOA-Quantification-Report-9-14-Final.pdf

Alternatives

In the event that the Proposed Project generates significant adverse air quality impacts, CEQA requires the consideration and discussion of alternatives to the project or its location which are capable of avoiding or substantially lessening any of the significant effects of the project. The discussion of a reasonable range of potentially feasible alternatives, including a "no project" alternative, is intended to foster informed decision-making and public participation. Pursuant to CEQA Guidelines Section 15126.6(d), the EIR shall include sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison with the Proposed Project.

Permits and SCAQMD Rules

In the event that the Proposed Project requires a permit from SCAQMD, SCAQMD should be identified as a Responsible Agency for the Proposed Project in the EIR. The assumptions in the air quality analysis in the EIR will be the basis for permit conditions and limits. For more information on permits, please visit SCAQMD's webpage at: http://www.aqmd.gov/home/permits. Questions on permits can be directed to SCAQMD's Engineering and Permitting staff at (909) 396-3385.

Data Sources

SCAQMD rules and relevant air quality reports and data are available by calling SCAQMD's Public Information Center at (909) 396-2039. Much of the information available through the Public Information Center is also available at SCAQMD's webpage at: http://www.aqmd.gov.

SCAQMD staff is available to work with the Lead Agency to ensure that project air quality and health risk impacts are accurately evaluated and mitigated where feasible. If you have any questions regarding this letter, please contact me at lsun@aqmd.gov or (909) 396-3308.

Sincerely,

Lijin Sun

Lijin Sun, J.D.
Program Supervisor, CEQA IGR
Planning, Rule Development & Area Sources

LS
LAC190205-02
Control Number

ORANGE COUNTY WATER DISTRICT
SINCE 1933

ORANGE COUNTY WATER DISTRICT
ORANGE COUNTY'S GROUNDWATER AUTHORITY

February 26, 2019

Ms. Jodie Lanza
Los Angeles County Sanitation District
1955 Workman Mill Road
Whittier, CA 90601

Subject: ***San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse, SCH Number 2018071021***

Dear Ms. Lanza:

Please add the Orange County Water District to the distribution list for CEQA documents related to the above-mentioned project. Please send CEQA Notices to Greg Woodside, OCWD, 18700 Ward Street, Fountain Valley, CA 92708 or electronic notices to gwoodside@ocwd.com.

Thank you.

Sincerely,

Greg Woodside

Greg Woodside, P.G., C.Hg.
Executive Director of Planning and Natural Resources

MAR 1'19 AM9:34

DOC #

Lanza, J

PO Box 8300
Fountain Valley, CA 92728-8300

18700 Ward Street
Fountain Valley, CA 92708

(714) 378-3200
(714) 378-3373 fax

www.ocwd.com

ORANGE COUNTY WATER DISTRICT
SINCE 1933

ORANGE COUNTY WATER DISTRICT
ORANGE COUNTY'S GROUNDWATER AUTHORITY

PO Box 8300
Fountain Valley, CA 92728-8300

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Ms. Jodie Lanza
Los Angeles County Sanitation District
1955 Workman Mill Road
Whittier, CA 90601

90601$1400 C050

STATE OF CALIFORNIA—CALIFORNIA STATE TRANSPORTATION AGENCY Gavin Newsom, Governor

DEPARTMENT OF TRANSPORTATION
DISTRICT 7 – Office of Regional Planning
100 S. MAIN STREET, MS 16
LOS ANGELES, CA 90012
PHONE (213) 897-9140
FAX (213) 897-1337
TTY 711
www.dot.ca.gov

Making Conservation a California Way of Life.

February 27, 2019

Jodie Lanza
Los Angeles County Sanitation District
1955 Workman Mill Road
Whittier, CA 90601

RE: San Gabriel River Watershed Project to Reduce River Discharge in Support of increased Recycled Water Reuse – Notice of Preparation (NOP)
SCH # 2018071021
GTS # 07-LA-2018-02252
Vic. LA-1/PM:0.161 – LA-60/PM:11.545
LA-60/PM:11.545 – LA-10/PM:42.596

Dear Ms. Jodie Lanza:

Thank you for including the California Department of Transportation (Caltrans) in the environmental review process for the above referenced project's Notice of Preparation (NOP). The district is proposing to incrementally reduce discharges of recycled water from the San Jose Creek water reclamation plant, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP. The district is not proposing to construct any new facilities. The proposed use of the recycled water would be implemented by water agencies and other users over time. The district will continue to maintain the ability to discharge treated water at the same points but anticipates lesser quantities.

After reviewing the NOP, Caltrans does not expect project approval to result in a direct adverse impact to the existing State transportation facilities.

If you have any questions regarding these comments, please contact project coordinator Reece Allen, at reece.allen@dot.ca.gov and refer to GTS# 07-LA-2018-02252

Sincerely,

MIYA EDMONSON
IGR/CEQA Branch Chief

cc: Scott Morgan, State Clearinghouse

MAR 1 '19 AM9:33

DOC #

Lanza, J

"Provide a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability"

Department of Transportation
District 7
100 South Main st, MS 16
Los Angeles, CA 90012

Jodie Lanza
Los Angeles County Sanitation District
1955 Workman Mill Road
Whittier, CA 90601

90601-140099

COUNTY OF LOS ANGELES
DEPARTMENT OF PARKS AND RECREATION
"Parks Make Life Better!"
John Wicker, Director
Norma E. Garcia, Chief Deputy Director

March 7, 2019

Ms. Jodie Lanza
Supervising Engineer
Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90601

Dear Ms. Lanza:

NOTICE OF PREPARATION OF AN ENVIRONMENTAL IMPACT REPORT FOR THE SAN GABRIEL RIVER WATERSHED PROJECT

Thank you for the opportunity to comment on the document cited above. The San Gabriel River Watershed Project (project) involves the reduction of river discharge in support of increased recycled water. The proposed project would not involve any construction activities or other physical changes to the environment other than the decreased volume of discharge. Please find our comments below:

Whittier Narrows Recreation and Natural Areas
The southwest corner of the Whittier Narrows Recreation Area (WNRA) and the Whittier Narrows Natural Area (WNNA) fall within the Puente Hills Significant Ecological Area, as designed by the Department of Regional Planning. Riparian habitats that are found at the WNNA include lowland riparian and freshwater marsh habitat, rich soils deposited from flood waters, and impressive streamside vegetation of willows, sycamores, cottonwoods, and mulefat. All of the above rely on consistent discharges of water.

Former staff member Michael Long published a book titled the Birds of the Whittier Narrows Recreation Area. The book and its updates provide a useful reference concerning avian resources. Many of these birds rely on water provided by the Whittier Narrows and San Jose Creek water treatment plants for habitat and food resources. The Department of Parks and Recreation (DPR) values these wildlife resources and the recreation benefits they provide to visitors through bird watching and creating a serene environment. Consistent discharges of water, particularly in the breeding season, would benefit birds and the biological resources in the area. Changes in discharge levels can potentially have an adverse effect on wildlife and habitats, which should be analyzed in the environmental impact report. We recommend consulting with local conservation organizations using the facilities, such as the Whittier and Pasadena Audubon Society Chapters.

There are lakes within WNRA that could be considered for groundwater recharge use, while providing a secondary benefit for wildlife and potential restoration activities. The lakes within WNRA would benefit from the treated water provided by both the Whittier Narrows and San Jose Creek water reclamation plants.

Los Angeles County Multi-Use Trails

DPR operates multi-use trails along both the San Gabriel and Rio Hondo River. Reduced discharges into San Jose Creek and both rivers would potentially reduce the aesthetic appeal of these trails and the enjoyment of visitors. The Zone One Ditch that conveys water from the San Gabriel to Rio Hondo River is both an aesthetic and biological enhancement to the adjacent Whittier Narrows Recreation Area. Strong consideration should be given to providing consistent flow through this channel for the benefit of wildlife and visitors.

Thank you for including DPR in the review of this document. Should you have any questions or require additional information, please feel free to contact Ms. Jui Ing Chien of my staff at (626) 588-5317 or jchien@parks.lacounty.gov

Sincerely,

Kathline King

Kathline J. King
Chief of Planning

c: Parks and Recreation (K. Regan, M. O'Connor, C. Lau, D. Jallo, K. Bosell, J. Chien)

CALIFORNIA
Water Boards

GAVIN NEWSOM
GOVERNOR

JARED BLUMENFELD
SECRETARY FOR
ENVIRONMENTAL PROTECTION

State Water Resources Control Board

MAR 07 2019

Ms. Jodie Lanza, Supervising Engineer
Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90601
jlanza@lacsd.org

Dear Ms. Lanza:

REVIEW OF NOTICE OF PREPARATION (NOP) OF AN ENVIRONMENTAL IMPACT REPORT (EIR) FOR THE SAN GABRIEL RIVER WATERSHED PROJECT TO REDUCE RIVER DISCHARGE IN SUPPORT OF RECYCLED WATER REUSE, SANITATION DISTRICTS OF LOS ANGELES COUNTY

The State Water Resources Control Board (State Water Board) Division of Water Rights (Division) appreciates the opportunity to review the NOP of an EIR for the above-mentioned Project and has the following comments:

The NOP addresses reduced discharges from five water reclamation plants (WRPs), including the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP, each of which currently discharges into the San Gabriel River, San Jose Creek, or Coyote Creek. The diverted water would supply recycled water programs implemented by other agencies.

We understand that the means by which the Sanitation Districts of Los Angeles County propose to reduce discharges through expansion of a recycled water program will require a change in the place of use or purpose of use of treated wastewater that will result in reduced flow discharges to the San Gabriel River, San Jose Creek, or Coyote Creek. It appears that a wastewater change petition is required to be submitted to the Division and approved pursuant to Water Code section 1211, prior to reducing discharges associated with the Project.

Water Code section 1211 states the following:

> (a) Prior to making any change in the point of discharge, place of use, or purpose of use of treated wastewater, the owner of any wastewater treatment plant shall obtain approval of the board for that change. The board shall review the changes pursuant to the provisions of Chapter 10 (commencing with Section 1700) of Part 2 of Division 2.
>
> (b) Subdivision (a) does not apply to changes in the discharge or use of treated wastewater that do not result in decreasing the flow in any portion of a watercourse.

Information regarding the process for filing a wastewater change petition can be found here:

https://www.waterboards.ca.gov/waterrights/water_issues/programs/petitions/#wastewater

As part of the California Environmental Quality Act (CEQA) process, please continue to coordinate your review with the Division, the Los Angeles Regional Water Quality Control Board, and the California Department of Fish and Wildlife. The EIR should include an evaluation of the impacts of reduced discharges to other beneficial uses of the water, including fish and wildlife resources and the environment.

If you have any questions regarding this matter, please contact Patricia Fernandez at (916) 319-9141 or patricia.fernandez@waterboards.ca.gov. Written correspondence or inquiries should be addressed as follows: State Water Resources Control Board, Division of Water Rights, Attn: Patricia Fernandez, P.O. Box 2000, Sacramento, CA, 95812-2000.

Sincerely,

ORIGINAL SIGNED BY

Scott McFarland, P.E., Acting Program Manager
Petitions, Licensing and Registrations Section
Division of Water Rights

State of California – Natural Resources Agency
GAVIN NEWSOM, Governor
DEPARTMENT OF FISH AND WILDLIFE
CHARLTON H. BONHAM, Director
South Coast Region
3883 Ruffin Road
San Diego, CA 92123
(858) 467-4201
www.wildlife.ca.gov

March 8, 2019

Ms. Jodie Lanza, Supervising Engineer
Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90601
jlanza@wlacsd.org

Subject: Comments on the Notice of Preparation of an Environmental Impact Report for the San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse (SCH# 2018071021), Los Angeles County

Dear Ms. Lanza:

The California Department of Fish and Wildlife (CDFW) has reviewed the above-referenced Notice of Preparation (NOP) for the San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse (Project) Environmental Impact Report (EIR).

Thank you for the opportunity to provide comments and recommendations regarding those activities involved in the Project that may affect California fish and wildlife. Likewise, we appreciate the opportunity to provide comments regarding those aspects of the Project that CDFW, by law, may be required to carry out or approve through the exercise of its own regulatory authority under the Fish and Game Code.

CDFW ROLE

CDFW is California's Trustee Agency for fish and wildlife resources and holds those resources in trust by statute for all the people of the State (Fish & G. Code §§ 711.7, subd. (a) & 1802; Pub. Resources Code § 21070; CEQA Guidelines § 15386, subd. (a)). CDFW, in its trustee capacity, has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and habitat necessary for biologically sustainable populations of those species (Fish & G. Code § 1802). Similarly, for purposes of CEQA, CDFW is charged by law to provide, as available, biological expertise during public agency environmental review efforts, focusing specifically on projects and related activities that have the potential to adversely affect fish and wildlife resources.

CDFW is also submitting comments as a Responsible Agency under CEQA (Pub. Resources Code § 21069; CEQA Guidelines § 15381). CDFW expects that it may need to exercise regulatory authority as provided by the Fish and Game Code. As proposed, for example, the Project may be subject to CDFW's lake and streambed alteration regulatory authority (Fish & G. Code § 1600 et seq.). Likewise, to the extent implementation of the Project as proposed may result in "take" as defined by State law of any species protected under the California Endangered Species Act (CESA) (Fish & G. Code § 2050 et seq.), related authorization as provided by the Fish and Game Code will be required.

Proponent: Sanitation Districts of Los Angeles County (LACSD)

Project Location: Los Angeles County. The Pomona Water Reclamation Plant (WRP) currently discharges recycled water to San Jose Creek. San Jose Creek WRP, Whittier Narrows WRP, and Los Coyotes WRP each discharge to the San Gabriel River. Long Beach WRP discharges to Coyote Creek at the confluence with the San Gabriel River. The Project study area includes the San Gabriel River and San Jose Creek.

Project Description/Objective: The objective of the Project is to incrementally reduce discharges of recycled water from five water reclamation plants, including San Jose Creek WRP, Pomona WRP, Whittier Narrows WRP, Los Coyotes WRP, and Long Beach WRP, each of which currently discharges in the San Gabriel River, San Jose Creek, or Coyote Creek. The proposed use of the recycled water would be implemented by water agencies and other users over time. The Sanitation Districts will continue to maintain the ability to discharge treated water at the same points, but anticipates discharging lesser quantities. A brief description of the proposed project's discharge operation modifications is provided below:

- The San Jose Creek WRP discharge is currently rotated between five discharge locations within the San Gabriel River watershed as show on in Figure 1. The use of the discharge locations is irregular throughout the year and varies year-to-year, depending on the availability of groundwater recharge facilities and channel maintenance activities. Under the proposed project, discharges from the San Jose Creek WRP at discharge point SJC002 would be reduced from an annual average of approximately 9.48 million of gallons per day (MGD) to a minimum monthly average of approximately 5 MGD. Although the total annual volume would be reduced, the new monthly average discharge would provide a more consistent discharge rate compared to existing conditions. Discharges would be timed to more efficiently meet the water demand needs of sensitive habitat. The diverted water would be conveyed for beneficial reuse to groundwater recharge basins or other reuse facilities.

- The Pomona WRP discharges into a concrete-lined portion of San Jose Creek which contains no sensitive habitat. As San Jose Creek nears the San Gabriel River, the concrete lining gives way to a soft-bottom reach. Current and historic groundwater upwelling occurs within the lined portion of San Jose Creek upstream of the transition location. The proposed project would result in zero discharge from the Pomona WRP. Habitat in the soft-bottomed portion of San Jose Creek would continue to be sustained by rising groundwater.

- The Whittier Narrows WRP has three discharge locations but only one tributary to the San Gabriel River. A recently approved modification to discharge from the Whittier Narrows WRP will reduce discharges to the San Gabriel River by approximately 1 percent (0.01 MGD).

- The Los Coyotes WRP discharges into a concrete-lined portion of the San Gabriel River. Discharge flow is contained within the low-flow channel of the river under typical dry weather conditions. This project proposes to maintain a minimum discharge flow of 2 MGD to prevent the low-flow channel from going completely dry downstream of the plant.

- The Long Beach WRP discharges into the concrete-lined Coyote Creek approximately 3,000 feet before the start of the San Gabriel River estuary. Urban runoff and natural flows in Coyote Creek upstream of the Long Beach WRP maintain a consistent flow in the creek at the discharge location. This project proposes a minimum discharge flow of zero from the Long Beach WRP.

HISTORY

LACSD has been working with CDFW over the last several years to address concerns regarding the potential impacts to biological resources associated with the proposed Wastewater Change Petitions from the San Gabriel River. The LACSD has proposed several small reductions through the Water Code section 1211 process, Notice of Wastewater Change Petition WW0098 (WW0098) and Notice of Wastewater Change Petition WW0100 (WW0100), for which CDFW had protested but subsequently dismissed. There were two principal concerns: 1) the use of a categorical exemption to satisfy CEQA, and 2) cumulative impacts to biological resources including habitat communities. LACSD has subsequently prepared the San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse Initial Study/Mitigated Negative Declaration (2018 MND) to address the WW0098 and WW0100 protests. The impacts to biological resources should be addressed through the Adaptive Management Plan proposed in the 2018 MND. The Adaptive Management Plan will include the formation of a working group that includes the entities that manage the surface and ground water of the San Gabriel River (Los Angeles County Flood Control District, LACSD, U.S. Fish and Wildlife Service, and CDFW) to develop guidelines that protect existing biological resources.

LACSD will be required to submit a Wastewater Change Petition to the State Water Resources Control Board to approve the reduction of wastewater associated with the EIR. CDFW will have the opportunity to protest the Wastewater Change Petition and propose measures to remedy any unresolved concerns related to potential impacts to biological resources.

COMMENTS AND RECOMMENDATIONS

CDFW offers the following comments and recommendations to assist LACSD in adequately identifying and/or mitigating the Project's significant, or potentially significant, direct and indirect impacts on fish and wildlife (biological) resources.

Specific Comments

1) Vegetation and Habitat Communities. The EIR should include a detailed habitat community map, a detailed quantification of the vegetation communities present in the Project area, a Project impact assessment, and a cumulative impacts assessment to the vegetation and habitat communities. This data will assist in the analysis of the Project impacts on the habitat volume and density of riparian and aquatic species habitat.

   CDFW considers natural communities with ranks of S1-S3 to be sensitive natural communities that should be addressed in CEQA (CEQA Guidelines § 15125[c]). An S3 ranking indicates there are 21-80 occurrences of this community in existence in California, S2 has 6-20 occurrences and S1 has less than 6 occurrences. CDFW recommends avoiding any sensitive natural communities found on or adjacent to the Project.

2) Focused Aquatic Surveys. Project implementation may result in direct or indirect impacts to breeding and foraging aquatic species, such as the western pond turtle (*Actinemus marmorata pallida*) and arroyo chub (*Gila orcuttii*). CDFW recommends that focused surveys for fish, amphibians, and marine species be conducted with particular emphasis on identifying special-status species within the open water habitat of the San Jose Creek and within the confluence of the San Gabriel River and San Jose Creek. Focused species-specific surveys should consider seasonal variations and should be conducted at the appropriate time of the year and time of day when sensitive species are active or otherwise identifiable.

3) Bat, Bird and Raptor Surveys. Project implementation may result in direct or indirect impacts to nesting, foraging, and wintering bat and avian species such as the western mastiff bat (*Eumops perotis californicus*), silver-haired bat (*Lasionycteris noctivagans*), western red bat (*Lasiurus blossevillii*), hoary bat (*Lasiurus cinereus*), and western yellow bat (*Lasiurus xanthinus*), least bell's vireo (*Vireo bellil pusillus*), southwestern willow flycatcher (*Empidonax traillii extimus*), burrowing owl (*Athene cunicularia*), coastal California gnatcatcher (*Polioptila californica californica*), tricolored blackbird (*Agelaius tricolor*), yellow-breasted chat (*Icteria virens*), yellow warbler (*Setophaga petechia*), and the Cooper's hawk (*Accipiter cooperii*). Reducing the flow discharged to the San Gabriel system may increase human-introduced disturbances and habitat conversion due to hydrology alterations, resulting in Project impacts to nesting and foraging birds and raptors. Surveys should be conducted for all species listed above to allow CDFW to determine the extent of impacts to the species associated with the Project and to provide meaningful avoidance, minimization, and mitigation measures.

4) Baseline Conditions. The San Gabriel River currently receives an annual average of approximately 9.48 million of gallons per day (MGD) or 29 acre-feet (AF) per day from LACSD's recycled water discharges. These discharges have altered the baseline hydrograph and have created ecosystem reliance on the recycled water. LACSD's proposed measurements and statistically analysis only identifies evapotranspiration (via stem water potential) for riparian trees and large shrub species as the basis for the minimum flow requirements to sustain riparian habitat. CDFW recommends that the baseline conditions identify the seasonal variations or the minimum flow criteria to maintain the structural diversity and integrity of the vegetation communities, which are complementary indicators to the health of the whole stream. The calculations should include the dry weather and wet weather baseline, evaluate the vegetation acreages and canopy layer assessments, identify the reference sites, and identify the methods used in the analysis.

5) Adaptive Management Plan. CDFW recommends the working group developed from the AMP should include the entities that manage the San Gabriel River channel and the surface and ground water of the San Gabriel River to develop guidelines for:

   a) Approaches to establish baseline conditions;
   b) Statistics, surveys, and methods used to detect significant changes;

c) Change in results and how it will be monitoring and analyzed;
d) Approaches to establish the proposed timeline and seasonal restrictions for data collection, monitoring, and proposed discharge reductions;
e) Parameters for the trigger thresholds; and,
f) Course of actions and mitigation measures to be implemented in the event that thresholds are triggered.

CONCLUSION

CDFW appreciates the opportunity to comment on the NOP to assist LACSD in identifying and mitigating Project impacts on biological resources.

Questions regarding this letter and further coordination on these issues should be directed to Mary Ngo, Senior Environmental Scientist (Specialist), at (562) 342-2140 or Mary.Ngo@wildlife.ca.gov.

Sincerely,

Randy Rodriguez for

Erinn Wilson
Environmental Program Manager I

ec: CDFW
Kelly Schmoker – Glendora
Andrew Valand – Los Alamitos
Victoria Tang – Los Alamitos

U.S. Fish and Wildlife Service
Christine Medak

State Clearinghouse
Scott Morgan

San Gabriel & Lower Los Angeles
Rivers and Mountains Conservancy
California Natural Resources Agency

March 5, 2019

Jodie Lanza
Los Angeles County Sanitation District
1955 Workman Mill Road
Whittier, CA 90601

RE: NOP - San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse

Dear Ms. Lanza,

The San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy (RMC) is one of ten conservancies within the California Resources Agency. Our mission is to preserve open space and habitat in order to provide for low-impact recreation and educational use, wildlife habitat restoration and protection, and watershed improvements within our jurisdiction. The proposed project is within RMC's jurisdictional area.

We received the above referenced NOP and ask that you consider analyzing the following potential impacts and mitigation in the DEIR:

A. Biological Resource impacts to:
   1. Existing riparian habitat;
   2. Current native avian and amphibian use and habitat along and in channel;
   3. Movement of native resident or migratory wildlife;
   4. Impediment of channel as use as native wildlife nesting sites;
   5. In-channel aquatic invertebrate and fish abundance, used by wildlife as a food source.

B. Impacts to the soft bottom habitat just north of the Interstate 605 and 405 interchange.

C. In the event that mitigation is required, consider habitat enhancements with native plants in San Gabriel River tributaries not affected by the proposed project, such as Avocado Creek, or at the Los Cerritos Wetlands.

Should you have any questions, please contact project manager, Sally Gee, at sgee@rmc.ca.gov or at 626-815-1019 ext. 104.

Sincerely,

Mark Stanley
Executive Officer

100 N. Old San Gabriel Canyon Rd, Azusa CA 917902 | (626) 815-1019 | www.rmc.ca.gov

3250 Wilshire Blvd #1106,
Los Angeles, CA 90010

SIERRA CLUB
FOUNDED 1892

Telephone: 213-387-4287
E-mail: angeles.chapter@sierraclub.org

San Gabriel Valley Task Force

Mar. 7, 2019

To: Jodie Lanza, Supervising Engineer
Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90601
(562) 908-4288

From: San Gabriel Valley Task Force
Angeles Chapter of Sierra Club

Re: Scoping comments for NOP to **Prepare an Environmental Impact Report for the San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse**

To Whom it May Concern:

The San Gabriel Valley Task Force thanks the Sanitation District for the opportunity to submit scoping comments relative to the NOP of an EIR for the San Gabriel River Watershed Project designed to Reduce River Discharge in Support of Increased Recycled Water Reuse. The San Gabriel Valley Task Force was organized by the Angeles Chapter of the Sierra Club in 1999 to work with San Gabriel Valley cities, governmental agencies and political leaders to seek ways to create a more livable environment for San Gabriel Valley residents while preserving or improving natural resources including water resources and water quality, recreational opportunities and wildlife habitat.

We attended the recent scoping meeting (Feb. 20, 2019), have reviewed the NOP and the Initial Study related to this project designed to facilitate the increased reuse of treated wastewater consistent with state law and policy. The stated goals of the project include the following:

- Support increased water recycling in the San Gabriel River watershed through maximizing availability of treated effluent otherwise discharged to flood control channels.
- Create more efficient utilization of treated effluent to support both recycled water reuse and sensitive riparian habitat.
- Sustain sensitive habitat supported by historic treated effluent discharges to the San Gabriel River watershed.

We also understand that the California State Water Resources Control Board has set a goal of increasing the use of recycled water over 2002 levels by at least one million acre-feet (MAF) per year by 2020 and by at least 2 MAF per year by 2030.

Included in the State's conservation goals is substitution of as much recycled water for potable water as possible by 2030.

In anticipation of increased future recycled water demands, the Sanitation Districts of Los Angeles County (Sanitation Districts) are proposing to incrementally reduce discharges of recycled water from five water reclamation plants (WRPs), including the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP, each of which currently discharges into the San Gabriel River, San Jose Creek, or Coyote Creek.

In the NOP, it is stated that the proposed reduction in discharge of recycled water would not involve any construction activities or other physical changes to the environment other than the decreased volume of discharge. The proposed use of the recycled water would be implemented by water agencies.

We offer the following comments that must be addressed in the Draft and Final EIR:

- A complete evaluation of the cycling of water including the variable precipitation, variations in surface flow, infiltration and percolation, impacts to groundwater quality and amounts in this area must be completed to determine impacts of this project. As noted in the NOP, "reductions in discharges to the San Gabriel River and San Jose Creek are not expected to result in measurable changes to the appearance of the San Gabriel River or San Jose Creek, as flow reductions and related effects on water levels and vegetation would not be noticeable to viewers". Although the reductions may not bring changes noticeable to viewers" that does not mean they are not causing important and damaging impacts to wildlife, the flora and ecosystems all along and in the channels downstream all the way to the Pacific coast.

  Therefore, a full evaluation of the potential impacts of the changes in recycled water utilization/ discharges on the flora and fauna currently existing within the area affected by the projects, particularly those areas with unlined channels. Areas of past restoration and plantings along the banks and in the channels add to the aesthetics of the areas and pleasure of walking, equestrian activities or cycling along the existing trails that line the San Gabriel River, the Rio Hondo, San Jose Creek and Coyote Creek. How will these be affected/damaged? We suggest these changes may be more significant than indicated in the checklist (pages 2-4, 2-5).

  What impacts may occur along the margins and in the 4 stream channels in areas downstream of the changes in discharge all the way to the coast?

  What impacts to coastal ecosystems may occur? What changes will occur in total discharge at the coast? Will this affect salt water intrusion projects now and in the future with predicted sea level increases?

- We agree (page 2-10) that there could be "Potentially Significant Impact" to "sensitive or listed species" and related habitat within the San Gabriel River and San Jose Creek that would depend on the segment. Reduction in discharges could affect vegetation used by sensitive species in the channel". These must be fully evaluated in the Draft EIR.

- What anticipated changes will occur to the groundwater resources in aquifers within the groundwater basins impacted by these discharge points? These resources provide potable water to local residents and commercial activities. Recently, the key well level in the Upper San Gabriel Basin was at its historic low point prior to the series of storms passing through Southern California. Reduction in recycled water previously discharged along the channel could impact native species and any protected species. These impacts must be fully evaluated.

- How would these projects affect those activities already utilizing recycled water in the area or those already proposed? A new park in the region of the Duck Farm is planned for construction this year including a riparian area, also a suggested possible kayaking area in Phase 1. Are there potential impacts to the Duck Farm park and other parks along the channels all the way to the coast.
- What impacts will occur due to redirection of recycled water now flowing into the river channels on current public uses i.e. fishing. We agree (Page 2-20, 2-21) that "The proposed project would involve the gradual reduction of discharges of recycled water from five WRPs, each of which currently discharges into the San Gabriel River, San Jose Creek or Coyote Creek". This may decrease the amount of recycled water available to infiltrate and percolate contributing to local groundwater levels. How will this impact local area water supplies available for current residential, commercial and industrial uses or future, already proposed projects?
- Will there be any impact to water use, habitat changes along the Rio Hondo channels related to changes in use of recycling from the Whittier Narrow Water Reclamation Plant and infiltration in the Rio Hondo Coastal Spreading Grounds? What impacts may occur in the Whittier Narrows Recreation Area? All these must be evaluated. In the NOP there is little mention of the Rio Hondo and the Rio Hondo Coastal Spreading Grounds.
- Will there be impacts downstream to Long Beach and into coastal waters from the increased diversions of recycled water? Will there be impacts to recreational areas such as El Dorado Park downstream?
- What other alternative uses are there for this high quality treated water? One of the State goals is to increase the reuse of recycled water for potable water supplies. Is this being considered as an alternative? Could the water being considered for sale and distribution of water districts be piped up to be stored at Santa Fe Dam or underground in the Upper San Gabriel Basin for local potable use?

Thank you again for this opportunity to comment on this project and its evaluation in the proposed EIR.

Respectfully submitted,

Joan Licari

Joan Licari, Chair
San Gabriel Valley Task Force

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EMERALD NECKLACE

March 8, 2019

Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90601
Attention: Ms. Jodie Lanza, Supervising Engineer

Via e-mail to JLanza@lacsd.org with original to follow via US Mail

RE: Comments on "San Gabriel River Watershed Project to Reduce Discharge in Support of Increased Recycled Water Reuses EIR" Notice of Preparation

Dear Ms. Lanza:

Los Angeles Waterkeeper, Heal the Bay, Nature for All, and Amigos de los Rios have reviewed the Notice of Preparation (NOP) and Initial Study (IS) for the "San Gabriel River Watershed Project to Reduce Discharge in Support of Increased Recycled Water Reuse EIR" Project ("the Project") which will be prepared pursuant to the California Environmental Quality Act (CEQA). We submit the following comments for consideration as the Sanitation Districts of Los Angeles County (LACSD) prepares the Environmental Impact Review (EIR).

Since submitting comments on the previously proposed Mitigated Negative Declaration (MND) last summer, Los Angeles Waterkeeper and Heal the Bay have had two productive meetings with LACSD staff. We look forward to continued engagement with LACSD as the EIR process moves forward. This letter highlights our chief areas of concern for consideration in the EIR, including evaluation of various diversion levels on beneficial uses such as rare species habitat, recreation (both in Whittier Narrows Recreation Area and the River more generally), and wildlife habitat, as well as an assessment of cumulative impacts.

I. <u>Our Organizations Advocate for Water Quality and Sustainable Water Policies for the San Gabriel and Los Angeles Rivers and their Watersheds.</u>

Los Angeles Waterkeeper (LAW) is a non-profit environmental organization with over 3,000 members dedicated to protecting and restoring the inland and coastal surface and ground waters throughout Los Angeles County, and ensuring an environmentally sustainable water supply that includes water recycling, preferably for potable reuse. LAW also advocates for the ecologically sensitive restoration of all of our region's waterways, including the San Gabriel and Los Angeles Rivers.

Heal the Bay (HTB) is a non-profit organization with over 30 years of experience and 15,000 members dedicated to making the coastal waters and watersheds of Greater Los Angeles safe, healthy, and clean. HTB monitors water quality in the coastal waters and watersheds in the Greater Los Angeles area in support of its education and advocacy programs.

Nature for All (N4A) is a coalition of 11 organizations working to ensure that everyone in the Los Angeles area has equitable access to the wide range of benefits that nature can provide. N4A is best known as the leading community group that built support for the designation of the San Gabriel Mountains National Monument in 2014. For more than a decade, N4A has been advocating for policies and programs to protect the mountains, rivers, and parks in our area, create more natural spaces, connect people to public lands, and positively impact our historically-underserved communities.

Amigos de los Rios (ADLR) is a non-profit organization whose mission is to create an "Emerald Necklace" natural infrastructure network of river greenways keyed off urban river corridors, creeks, washes, and streams throughout the Los Angeles Basin; enhancing recreation, active transit, and ecosystem services; and protecting urban communities from the threats of climate change.

II. Our Organizations Support the Decision to Prepare an EIR.

We strongly support LACSD's decision to reverse the previously proposed reliance on an MND, and instead prepare an EIR for the Project. We also strongly support increased water recycling in the Los Angeles area. Nonetheless, we recognize that increased diversions, for recycling or for any purpose, can have potentially significant impacts on river ecology that require evaluation and, where necessary, mitigation.[1]

Based on the information contained in the NOP and IS; two meetings with LACSD staff by representatives from LAW and HTB; and the CEQA Scoping Meeting, we believe that the Project may have potentially significant impacts on the San Gabriel River, particularly on river hydrology, recreational uses, rare species, wildlife habitat, as well as potential cumulative effects.

We suggest that LACSD consider preparation of a Master EIR. Creation of an adequate Master EIR could facilitate review of individual diversion projects and Section 1211 Change Petitions as those plans develop.[2] However, our substantive concerns with the project are the same regardless of whether LACSD prepares a Master EIR or Project EIR.

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[1] This view is in accordance with the 2018 update to the recycled water policy, which states that recycled water facilities must minimize their discharge, except where that discharge supports beneficial uses. *See* STATE WATER RESOURCES CONTROL BOARD, RESOLUTION NO. 2018-0057 (2018), https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2018/rs2018_0057.pdf.

[2] *See* Cal. Wat. Code § 1211 (2001).

III. LACSD Should Consider the Following Comments During Preparation of the EIR.

a. LACSD Should Consider Strengthening Project Objective Three, Recognizing Opportunities for Habitat Restoration in the Floodplain.

We generally agree with and support the objectives outlined in the NOP. With regard to Objective Three, which currently reads "(3) Sustain sensitive habitat supported by historical treated effluent discharges to the San Gabriel River watershed," we propose amending the language to read "Sustain, and where feasible, qualitatively enhance..." This additional language will allow LACSD to take advantage of the possibility for significant opportunities for habitat restoration in the floodplain, and improve LACSD's negotiating position with relevant federal agencies. We suggest adding the word "qualitatively" in recognition that some overall decrease in flows likely will occur, but that the quantitative flow reduction does not necessarily translate to habitat degradation.

b. The EIR Should Evaluate Alternatives, Including Focusing Increased Water Recycling Efforts (at Least Initially) Further Downstream.

The EIR should evaluate a reasonable range of alternatives to the diversion of water associated with the Project. Based on initial assessments between flows and beneficial uses, we suggest a "no build," a "full build," and one or more intermediate scenarios.

We suggest that the EIR should also evaluate whether the majority of the Project's increased water recycling efforts could be implemented further downstream, at least in earlier phases of the Project (i.e. phase the Long Beach WRP diversion first). Doing so would likely decrease the possibility of significant impacts to the habitat of rare species and other wildlife, and/or recreational uses further upstream within the watershed. The Long Beach WRP is located furthest downstream, approximately five miles from the Pacific Ocean. It therefore is potentially less likely than WRPs located further upstream to have as significant an impact on the hydrology and beneficial uses of the San Gabriel River considered as a whole.

Additionally, it would be useful for the EIR to study potential "tipping points" or other numerical figures to assist in determining the amount of reduced discharge at which potentially adverse effects on species habitat, recreational activities, or river hydrology would be likely. This type of study could provide useful projected impacts for various levels of discharge reductions and facilitate the review of any subsequent Change Petitions.

Further, the EIR should take climate change into account and evaluate the climate resiliency of potential alternatives, given the inevitability of sea level rise and other changes to the watershed that are reasonably foreseeable in the planning horizon of the project.

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c. LACSD Should Evaluate the Relationship Between Flows and Beneficial Uses.

It is important for the EIR to evaluate the relationships between flows and beneficial uses generally, although we are not suggesting that the EIR needs to duplicate the efforts at analyzing the relationship between flows and beneficial uses that the Water Boards are sponsoring on the Los Angeles River.[3] The EIR should demonstrate: (1) protection of the existing recreational uses within both the Whittier Narrows Recreation Area (WNRA) and the river mainstream itself; (2) prevention of take of rare species and negative impacts to other species; and (3) appropriate mitigation of potential cumulative impacts of the Project.

1. There are Existing and Potential Recreational Uses Throughout the Watershed that Should be Protected.

Much of the San Gabriel River has existing or potential recreational uses, both for REC-1 and REC-2.[4] Therefore, the EIR should evaluate the impacts to these recreational uses along the entire length of the San Gabriel River, and not just in the WRNA.

2. LACSD Should Ensure that the AMP Proactively Prevents Takes of Rare Species and Impacts to Other Species.

The reactive nature of the original Adaptive Management Plan (AMP) was our single greatest concern in the previously proposed MND. From meetings with staff, we believe there has been positive movement toward proactively preventing take of rare species, rather than reacting after a take has already occurred. The EIR should aim to refine the AMP such that it is proactive; prevents takes of the least Bell's vireo; prevents impacts to the yellow warbler, yellow-breasted chat, and other uncommon species; and attempts to identify opportunities for habitat restoration. It is also critical that the EIR include specific permanence standards to guide later AMP development.[5]

Changes in flow, even in concrete-lined areas of the River, can have an impact on more common birds and other species in the affected area, for example by impacting algal mats upon which many common species rely. If flows are completely eliminated in certain areas, even if only within concrete-lined sections of the River, there is the potential for impacts to species that

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[3] The Southern California Coastal Water Research Project (SCCWRP) is currently undertaking a flows study of the Los Angeles River, funded by the Regional Water Quality Control Boards and State Water Resources Control Board.

[4] For a complete listing of existing and potential beneficial uses within the San Gabriel River watershed, including the various recreational uses, please see the attached Beneficial Uses Table from the Los Angeles Regional Water Quality Control Board's Basin Plan [Attachment A]. The Basin Plan includes a notation that access is restricted for these uses. Nonetheless, since access is constitutionally protected under Cal. Const., art. X, § 4, impacts to recreational uses of the River should be evaluated. Moreover, signatories to this letter have anecdotal evidence that significant recreational use of the River occurs anyway, despite the access issues. For further detail on these recreational uses, see Attachment B.

[5] *See Sundstrom v. Cty. of Mendocino*, 202 Cal. App. 3d 296 (Ct. App. 1988).

rely on these algal mats and other features of the river. The EIR should evaluate the potential for these impacts as well.

3. LACSD Should Evaluate the Potential Cumulative Impacts of the Project.

The EIR should also evaluate the potential cumulative impacts of the Project when considered in conjunction with other projects that may decrease the water flow in the San Gabriel River watershed. The EIR should also present the rather complicated "accounting" inherent in managing the watershed, as discussed in the meetings between LAW, HTB, and LACSD staff. For example, LACSD has the ability to allocate water to various subareas of the watershed to respond to its management needs. LAW and HTB found this discussion useful for understanding how the LACSD manages diversions and flows. The discussion also allowed for more focused attention on impacts to especially critical areas of the river.

d. LACSD Should Evaluate the Feasibility of Using the Army Corps Parcel for Restoration and/or Rare Species Mitigation.

The parcel of land owned by the Army Corps of Engineers represents a significant opportunity to restore rare species habitat and/or provide rare species mitigation. While we recognize the difficulties presented by federal ownership of this land, we believe that the EIR should still evaluate the feasibility of using this parcel for possible restoration and/or rare species mitigation, and requires a quite modest annual flow to meet these purposes.[6]

Save Round Valley Alliance v. County of Inyo, 157 Cal. App. 4th (2007), is instructive, even if the case is not dispositive under the current circumstances. In *Save Round Valley*, the court held that even though a project alternative would require a literal act of Congress to carry out, that fact alone did not necessarily make the alternative infeasible.[7] Acquisition of a much smaller Army Corps parcel along the San Gabriel River thus is not necessarily impossible. Our organizations are willing to work with California state and local agencies as appropriate to follow up on this idea.

IV. <u>Conclusion</u>

We thank LACSD for correctly reversing its earlier decision on the MND. We also applaud LACSD's willingness to engage with our organizations regarding issues facing the San

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[6] Inclusion of such a discussion can help build the case for local control of the site, and would also help support any eventual Statement of Overriding Considerations ("SOC"). *See* Cal. Code Regs. tit. 14, § 15093.

[7] We also note that a similar issue to this one has arisen in the Los Angeles River, where the County of Los Angeles recently commissioned a study of the possibility of acquiring authority over Army Corps lands to expedite maintenance and water conservation improvements along the river. *See* Louis Sahagun, *County Wants Authority over L.A. River Flood-Control Channels Owned by U.S. Government*, L.A. TIMES, Feb. 24, 2019, https://www.latimes.com/local/lanow/la-me-ln-county-flood-control-20190224-story.html.

Gabriel River. We look forward to further constructive engagement on this Project, as the EIR process moves forward.

Thank you for this opportunity to comment. If you have any questions, please contact the undersigned staff.

Sincerely,

Kristin McCarthy
Kristin McCarthy
Legal Fellow, Spring 2019
Los Angeles Waterkeeper

Arthur S. Pugsley
Arthur Pugsley
Senior Attorney
Los Angeles Waterkeeper

Annelisa Moe
Water Quality Specialist
Heal the Bay

Belinda Faustinos
Belinda Faustinos
Executive Director
Nature for All

Claire Robinson
Claire Robinson
Founder & Managing Director
Amigos de los Rios

Attachment A:	Beneficial Uses Table from the Los Angeles Regional Water Quality Control Board Basin Plan
Attachment B:	Anecdotal Evidence of Recreational Uses of the San Gabriel River Submitted by Belinda Faustinos, Executive Director of Nature for All

ATTACHMENT A

BENEFICIAL USES TABLE

LOS ANGELES REGIONAL WATER QUALITY CONTROL BOARD BASIN PLAN

WATER QUALITY CONTROL PLAN
Los Angeles Region

Basin Plan
for the
Coastal Watersheds of
Los Angeles and Ventura Counties

California Regional Water Quality Control Board

Los Angeles Region (4)

2. BENEFICIAL USES

Table of Contents

Introduction

Beneficial uses form the cornerstone of water quality protection under the Basin Plan. Once beneficial uses are designated, appropriate water quality objectives can be established and programs that maintain or enhance water quality can be implemented to ensure the protection of beneficial uses. The designated beneficial uses, together with water quality objectives (referred to as criteria in federal regulations), form water quality standards. Such standards are mandated for all waterbodies within the state under the California Water Code. In addition, the federal Clean Water Act mandates standards for all surface waters, including wetlands.

Twenty-four beneficial uses in the Region are identified in this Chapter. These beneficial uses and their definitions were developed by the State and Regional Boards for use in the Regional Board Basin Plans. Three beneficial uses were added since the original 1975 Basin Plans. These new beneficial uses are Aquaculture, Estuarine Habitat, and Wetlands Habitat.

Beneficial uses can be designated for a waterbody in a number of ways. Those beneficial uses that have been attained for a waterbody on, or after, November 28, 1975, must be designated as "existing" in the Basin Plans. Other uses can be designated, whether or not they have been attained on a waterbody, in order to implement either federal or state mandates and goals (such as fishable and swimmable) for regional waters. Beneficial uses of streams that have intermittent flows, as is typical of many streams in southern California, are designated as intermittent. During dry periods, however, shallow ground water or small pools of water can support some beneficial uses associated with intermittent streams; accordingly, such beneficial uses (e.g., wildlife habitat) must be protected throughout the year and are designated "existing." In addition, beneficial uses can be designated as "potential" for several reasons, including:

- implementation of the State Board's policy entitled "Sources of Drinking Water Policy" (State Board Resolution No. 88-63, described in Chapter 5),
- plans to put the water to such future use,
- potential to put the water to such future use,
- designation of a use by the Regional Board as a regional water quality goal, or
- public desire to put the water to such future use.

Beneficial Use Definitions

Beneficial uses for waterbodies in the Los Angeles Region are listed and defined below. The uses are listed in no preferential order.

Municipal and Domestic Supply (MUN)
Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Agricultural Supply (AGR)
Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

Industrial Process Supply (PROC)
Uses of water for industrial activities that depend primarily on water quality.

Industrial Service Supply (IND)
Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.

Ground Water Recharge (GWR)
Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Freshwater Replenishment (FRSH)
Uses of water for natural or artificial maintenance of

surface water quantity or quality (e.g., salinity).

Navigation (NAV)
Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Hydropower Generation (POW)
Uses of water for hydropower generation.

Water Contact Recreation (REC-1)
Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Limited Water Contact Recreation (LREC-1)
Uses of water for recreational activities involving body contact with water, where full REC-1 use is limited by physical conditions such as very shallow water depth and restricted access and, as a result, ingestion of water is incidental and infrequent.

Non-contact Water Recreation (REC-2)
Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

High Flow Suspension: The High Flow Suspension shall apply to water contact recreational activities associated with the swimmable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use, non-contact water recreation involving incidental water contact regulated under the REC-2 use, and the associated bacteriological objectives set to protect those activities. Water quality objectives set to protect (1) other recreational uses associated with the fishable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use and (2) other REC-2 uses (e.g., uses involving the aesthetic aspects of water) shall remain in effect at all times for waters where the (av) footnote appears in Table 2-1a. The High Flow Suspension shall apply on days with rainfall greater than or equal to ½ inch and the 24 hours following the end of the ½-inch or greater rain event, as measured at the nearest local rain gauge, using local Doppler radar, or using widely accepted rainfall estimation methods. The High Flow Suspension only applies to engineered channels, defined as inland, flowing surface water bodies with a box, V-shaped or trapezoidal configuration that have been lined on the sides and/or bottom with concrete. The water bodies to which the High Flow Suspension applies are identified in Table 2-1a in the column labeled “High Flow Suspension”.

Commercial and Sport Fishing (COMM)
Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

Aquaculture (AQUA)
Uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.

Warm Freshwater Habitat (WARM)
Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Cold Freshwater Habitat (COLD)
Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Inland Saline Water Habitat (SAL)
Uses of water that support inland saline water ecosystems including, but not limited to, preservation or enhancement of aquatic saline habitats, vegetation, fish, or wildlife, including invertebrates.

Estuarine Habitat (EST)
Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Wetland Habitat (WET)
Uses of water that support wetland ecosystems, including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally

occurring contaminants.

Marine Habitat (MAR)
Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

Wildlife Habitat (WILD)
Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Preservation of Biological Habitats (BIOL)
Uses of water that support designated areas or habitats, such as **Areas of Special Biological Significance (ASBS),** established refuges, parks, sanctuaries, ecological reserves, or other areas where the preservation or enhancement of natural resources requires special protection.

The following coastal waters have been designated as ASBS in the Los Angeles Region. For detailed descriptions of their boundaries see the Ocean Plan discussion in Chapter 5, Plans and Policies:

- San Nicolas Island and Begg Rock
- Santa Barbara Island and Anacapa Island
- San Clemente Island
- Mugu Lagoon to Latigo Point

- Santa Catalina Island, Subarea One, Isthmus Cove to Catalina Head
- Santa Catalina Island, Subarea Two, North End of Little Harbor to Ben Weston Point
- Santa Catalina Island, Subarea Three, Farnsworth Bank Ecological Reserve
- Santa Catalina Island, Subarea Four, Binnacle Rock to Jewfish Point

The following areas are designated Ecological Reserves or Refuges:

- Channel Islands National Marine Sanctuary
- Santa Barbara Island Ecological Reserve
- Anacapa Island Ecological Reserve
- Catalina Marine Science Center Marine Life
- Point Fermin Marine Life Refuge
- Farnsworth Bank Ecological Reserve
- Lowers Cove Reserve
- Abalone Cove Ecological Reserve
- Big Sycamore Canyon Ecological Reserve

Rare, Threatened, or Endangered Species (RARE)
Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

Migration of Aquatic Organisms (MIGR)
Uses of water that support habitats necessary for migration, acclimatization between fresh and salt water, or other temporary activities by aquatic organisms, such as anadromous fish.

Spawning, Reproduction, and/or Early Development (SPWN)
Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

Shellfish Harvesting (SHELL)
Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.

Beneficial Uses for Specific Waterbodies

Tables 2-1 through 2-4 list the major regional waterbodies and their designated beneficial uses. These tables are organized by waterbody type: (i) inland surface waters (rivers, streams, lakes, and inland wetlands), (ii) ground water, (iii) coastal waters (bays, estuaries, lagoons, harbors, beaches, and ocean waters), and (iv) coastal wetlands. Within Tables 2-1 and 2-1a waterbodies are organized by major watersheds. Twelve digit Hydrologic unit codes are noted in the surface water tables (2-1, 2-1a, 2-3, and 2-4) as a cross reference to the Watershed Boundary Dataset developed by the United States Geological Survey (2007). For those surface waterbodies that cross into other hydrologic units, such waterbodies appear more than once in a table. Furthermore, certain coastal waterbodies are duplicated in more than one table for completeness (e.g., many lagoons are listed both in inland surface waters and in coastal features tables). Major groundwater basins are classified in Table 2-2 according to the Department of Water Resources Bulletin No.119 – Update 2003. A series of maps (Figures 2-1 to 2-22) illustrates regional surface waters, ground waters, and major harbors.

The Regional Board contracted with the California Department of Water Resources for a study of beneficial uses and objectives for the upper Santa Clara River (DWR, 1989) and for another study of the beneficial uses and objectives the Piru, Sespe, and Santa Paula Hydrologic areas of the Santa Clara River (DWR, 1993). In addition, the Regional Board contracted with Dr. Prem Saint of California State University at Fullerton to survey and research beneficial uses of all waterbodies throughout the Region (Saint, et al., 1993a and 1993b). Information from these studies was used to update this Basin Plan.

State Board Resolution No. 88-63 (Sources of Drinking Water) followed by Regional Board Resolution No. 89-03 (Incorporation of Sources of Drinking Water Policy into the Water Quality Control Plans (Basin Plans)) states that " All surface and ground waters of the State are considered to be suitable, or potentially suitable, for municipal or domestic waters supply and should be so designated by the Regional Boards ... [with certain exceptions which must be adopted by the Regional Board]." In adherence with these policies, all inland surface and ground waters have been designated as MUN - presuming at least a potential suitability for such a designation.

These policies allow for Regional Boards to consider the allowance of certain exceptions according to criteria set forth in SB Resolution No. 88-63. While supporting the protection of all waters that may be used as a municipal water supply in the future, the Regional Board realizes that there may be exceptions to this policy.

In recognition of this fact, the Regional Board will soon implement a detailed review of criteria in the State Sources of Drinking Water policy and identify those waters in the Region that should be excepted from the MUN designation. Such exceptions will be proposed under a special Basin Plan Amendment and will apply exclusively to those waters designated as MUN under SB Res. No. 88-63 and RB Res. No. 89-03.

In the interim, no new effluent limitations will be placed in Waste Discharge Requirements as a result of these designations until the Regional Board adopts this amendment.

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The following sections summarize general information regarding beneficial uses designated for the various waterbody types.

Inland Surface Waters

Inland surface waters consist of rivers, streams, lakes, reservoirs, and inland wetlands. Beneficial uses of these inland surface waters and their tributaries (which are graphically represented on Figures 2-1 to 2-10) are designated on Tables 2-1 and 2-1a.

Beneficial uses of inland surface waters generally include REC-1 (swimmable) and WARM, COLD, SAL, or COMM (fishable), reflecting the goals of the federal Clean Water Act. In addition, inland waters are usually designated as IND, PRO, REC-2, WILD, and are sometimes designated as BIOL and RARE. In a few cases, such as reservoirs used primarily for drinking water, REC-1 uses can be restricted or prohibited by the entities that manage these waters. Many of these reservoirs, however, are designated as potential for REC-1, again reflecting federal goals. Furthermore, many regional streams are primary sources of replenishment for major groundwater basins that supply water for drinking and other uses, and as such must be protected as GWR. Inland surface waters that meet the criteria mandated by the *Sources of Drinking Water Policy* (which became effective when the State Board adopted Resolution No. 88-63 in 1988) are designated MUN. (This policy is reprinted in Chapter 5, Plans and Policies).

Under federal law, all surface waters must have water quality standards designated in the Basin Plans. Most of the inland surface waters in the Region have beneficial uses specifically designated for them. Those waters not specifically listed (generally smaller tributaries) are designated with the same beneficial uses as the streams, lakes, or reservoirs to which they are tributary. This is commonly referred to as the "tributary rule."

Ground Waters

Beneficial uses for regional groundwater basins (Figure 1-9) are designated on Table 2-2. For reference, Figures 2-11 to 2-18 show enlargements of all of the major basins and sub-basins referred to in the ground water beneficial use table (Table 2-2) and the water quality objective table (Table 3-8) in Chapter 3.

Many groundwater basins are designated MUN, reflecting the importance of ground water as a source of drinking water in the Region and as required by the State Board's *Sources of Drinking Water Policy.* Other beneficial uses for ground water are generally IND, PROC, and AGR. Occasionally, ground water is used for other purposes (e.g., ground water pumped for use in aquaculture operations at the Fillmore Fish Hatchery).

Coastal Waters

Coastal waters in the Region include bays, estuaries, lagoons, harbors, beaches, and ocean waters. Beneficial uses for these coastal waters provide habitat for marine life and are used extensively for recreation, boating, shipping, and commercial and sport fishing, and are accordingly designated in Table 2-3. Figures 2-19 to 2-22 show specific sub-areas of some of these coastal waters.

Wetlands

Wetlands include freshwater, estuarine, and saltwater marshes, swamps, mudflats, and riparian areas. As the California Water Code (§13050[e]) defines "waters of the state" to be "any water, surface or underground, including saline waters, within the boundaries of the state," natural wetlands are therefore entitled to the same level of protection as other waters of the state.

Wetlands also are protected under the Clean Water Act, which was enacted to restore and maintain the physical, chemical, and biological integrity of the nation's waters, including wetlands. Regulations developed under the CWA specifically include wetlands "as waters of the United States" (40 CFR 116.3) and defines them as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Although the definition of wetlands differs widely among federal agencies, both the USEPA and the U.S. Army Corps of Engineers use this definition in administrating the 404 permit program.

Recently, both state and federal wetlands policies have been developed to protect these valuable waters. Executive Order W-59-93 (signed by Governor Pete Wilson on August 23, 1993) established state policy guidelines for wetlands conservation. The primary goal of this policy is to ensure no overall net loss and to achieve a long-term net gain in the quantity, quality, and permanence of wetland acreage in California. The federal wetlands policy, representing a significant advance in wetlands protection, was unveiled by nine federal agencies on August 24, 1993. This policy represents an agreement that is sensitive to the needs of landowners, more efficient, and provides flexibility in the permit process.

The USEPA has requested that states adopt water quality standards (beneficial uses and objectives) for wetlands as part of their overall effort to protect the nation's water resources. The 1975 Basin Plans identified a number of waters which are known to include wetlands; these wetlands, however, were not specifically identified as such. In this Basin Plan, a wetlands beneficial use category has been added to identify inland waters that support wetland habitat as well as a variety of other beneficial uses. The wetlands habitat definition recognizes the uniqueness of these areas and functions they serve in protecting water quality. Tables 2-1a and 2-4 identifies and designates beneficial uses for significant coastal wetlands in the Region. These waterbodies are also included on Tables 2-1 and 2-3. Beneficial uses of wetlands include many of the same uses designated for the rivers, lakes, and coastal waters to which they are adjacent, and include REC-1, REC-2, WARM, COLD, EST, MAR, WET, GWR, COMM, SHELL, MIGR, SPWN, WILD and often RARE or BIOL.

As some wetlands can not be easily identified in southern California because of the hydrologic regime, the Regional Board identifies wetlands using indicators such as hydrology, presence of hydrophytic plants (plants adapted for growth in water), and/or hydric soils (soils saturated for a period of time during the growing season). The Regional Board contracted with Dr. Prem Saint, et al. (1993a and 1993b), to inventory and describe major regional wetlands. Information from this study was used to update this Basin Plan.

Table 2-1. Beneficial Uses of Inland Surface Waters.

WATERSHED[a]	WBD No.	MUN	IND	PROC	AGR	GWR	FRSH	NAV	POW	COMM	AQUA	WARM	COLD	SAL	EST	MAR	WILD	BIOL	RARE	MIGR	SPWN	SHELL	WET[b]
LOS ANGELES RIVER WATERSHED (cont.)																							
ISOLATED LAKES AND RESERVOIRS:																							
Eagle Rock Reservoir	180701050402	E*										Pu											
Echo Lake	180701040200	P*										P					E						
El Dorado Lakes	180701060506	P*										P					E						E
Elysian Reservoir	180701050403	E*	E	E								P					E						
Encino Reservoir	180701050208	E*	E	E								P					E						
Ivanhoe Reservoir	180701040200	E*	E	E								P					E						
Lincoln Park Lake Silver Reservoir	180701050403	P*										P					E						
Silver Lake Reservoir	180701040200	E*	E	E								P					E						
Toluca Lake	180701050208	P*										P					E						
SAN GABRIEL RIVER WATERSHED																							
San Gabriel River Estuary [c,w]	180701060506		E					E		E					E	E	E		Ee	Ef	Ef	P	
Coyote Creek (San Gabriel River Estuary to La Canada Verde Creek)	180701060506	P*	P	P								P					P		E				
Coyote Creek (above La Canada Verde Creek)	180701060503	P*	P	P								P					P		E				
San Gabriel River Reach 1 (San Gabriel River Estuary to Firestone Blvd.)	180701060506	P*										P					P						
San Gabriel River Reach 2 (Firestone Blvd. to Whittier Narrows Dam)	180701060506	P*	P	P		I						I					E		E				
Whittier Narrows Flood Control Basin	180701060303	P*				E						E					E		P				
Legg Lake	180701060303	P*				E						E	E				E						E
San Gabriel River Reach 3 (Whittier Narrows Dam to San Jose Creek)	180701060506	P*				I						I					E						
San Gabriel River Reach 3 (San Jose Creek to Ramona Blvd.)	180701060501	P*				I						I					E						
San Jose Creek Reach 1 (San Gabriel River Reach 3 to Temple Ave.)	180701060402	P*				I						I					E						
San Jose Creek (Temple Ave. to Thompson Wash)	180701060401	P*				I						I					E						
Puente Creek	180701060402	P*				I						P					P						
Thompson Wash (San Jose Creek Reach 2 to Web Canyon)	180701060401	P*				I						I					E						
Thompson Creek (above Web Canyon)	180701060401	P*				I						I					E		E				
Thompson Creek Reservoir	180701060401	P*				I						I					E		E				
Walnut Creek Wash	180701060302	P*				I						I					E						E
Big Dalton Wash	180701060302	P*				I						P					P						
Big Dalton Canyon Creek	180701060302	P*				I						I					E						E
Mystic Canyon	180701060302	P*				I						I					E						
Big Dalton Reservoir	180701060302	P*				E						E					E						
Bell Canyon Creek	180701060302	P*				I						I					E						
Little Dalton Wash	180701060302	P*				I						P					P						
Little Dalton Canyon Creek	180701060302	P*				I						I					E						E
San Dimas Wash (lower) (Big Dalton wash to Ham Canyon)	180701060302	P*				I						I					E		E				
San Dimas Wash (upper) (above Ham Canyon)	180701060301	P*				E						I					E						
San Dimas Reservoir	180701060301	E*				E						E	E				E						
San Dimas Canyon Creek	180701060301	E*				E						E	E				E						E
West Fork San Dimas Canyon	180701060301	E*				E						E	P				E						E
Wolfskill Canyon	180701060301	E*				E						E	P				E		E				E
Puddingstone Reservoir	180701060302	E*			E	E						E	E				E		E				
Live Oak Wash	180701060302	E*				I	I					I					E						
Live Oak Creek	180701060302	E*				I	I					I					E						
Live Oak Reservoir	180701060302	E*				E	E					E					E						
Puddingstone Wash	180701060302	E*				I						I					E						
Marshall Creek and Wash	180701060302	E*				I						I					E						

E: Existing beneficial use

P: Potential beneficial use

I: Intermittent beneficial use

E, P, and I shall be protected as required.

* Asterisked MUN designations are designated under SB 88-63 and RB 89-03. Some designations may be considered for exemption at a later date (See pages 2-3, 4 for more details).

a Waterbodies are listed multiple times if they cross hydrologic area or subarea boundaries. Beneficial use designations apply to all tributaries to the indicated waterbody, if not listed separately.

b Waterbodies designated as WET may have wetlands habitat associated with only a portion of the waterbody. Any regulatory section would require a detailed analysis of the area.

c Coastal waterbodies which are also listed in Coastal Features Table (2-3) or in Wetlands Table (2-4).

e One or more rare species utilize all ocean, bays, estuaries, and coastal wetlands for foraging and/or nesting.

f Aquatic organisms utilize all bays, estuaries, lagoons and coastal wetlands, to a certain extent, for spawning and early development. This may include migration into areas which are heavily influenced by freshwater inputs.

w These areas are engineered channels. All references to Tidal Prisms in Regional Board documents are functionally equivalent to estuaries.

u This reservoir is covered and thus inaccessible.

Table 2-1. Beneficial Uses of Inland Surface Waters.

WATERSHED[a]	WBD No.	MUN	IND	PROC	AGR	GWR	FRSH	NAV	POW	COMM	AQUA	WARM	COLD	SAL	EST	MAR	WILD	BIOL	RARE	MIGR	SPWN	SHELL	WET[b]
SAN GABRIEL RIVER WATERSHED (cont.)																							
Marshall Creek and Wash	180701060302	E*				I	I					I					E		E				E
Emerald Creek And Wash	180701060302	E*				I	I					I					E						
San Gabriel River Reach 4	180701060501	P*				I						I					E						
Santa Fe Flood Control Basin	180701060501	P*				I						I					E						E
UPPER SAN GABRIEL RIVER TRIBUTARIES																							
San Gabriel River Reach 5 (Santa Fe Dam to Van Tassel Canyon)	180701060501	E	E	E	E	E						E	E				E			E			
San Gabriel River Reach 5 (Van Tassel canyon to San Gabriel Reservoir)	180701060501	E	E	E	E	E						E	E				E				E		
Bradbury Canyon Creek	180701060501	P*				I						I					E						
Sprinks Canyon Creek	180701060501	P*				I						I					E						
Maddock Canyon Creek	180701060501	P*				I						I					E						
Van Tassel Canyon	180701060501	P*				I						I					E		E				
Fish Canyon Creek	180701060501	P*	I			E						E					E		E		E		E
Roberts Canyon Creek	180701060501	P*				I						I					E		E				E
Morris Reservoir	180701060501	E	E	E	E	E			E			E	E				E				E		
San Gabriel Reservoir	180701060501	E	E	E	E	E			E			E	E				E						
East Fork San Gabriel River (San Gabriel Reservoir to Fish Fork)	180701060203	P*				E						E	E				E		E		E		E
East Fork San Gabriel River (above Fish Fork)	180701060201	P*				E						E	E				E		E		E		E
Cattle Canyon Creek	180701060202	P*				E						E	E				E		E		E		E
Coldwater Canyon Creek	180701060202	P*				E						E	E				E		E		E		E
Cow Canyon Creek	180701060202	P*				E						E	E				E		E		E		E
Allison Gulch	180701060203	P*				E						E	E				E				E		E
Fish Fork	180701060201	P*				E						E	E				E				E		E
West Fork San Gabriel River (San Gabriel Reservoir to Bear Creek)	180701060105	P*				E						E	E				E		E		E		E
West Fork San Gabriel River (above Bear Creek)	180701060102	P*				E						E	E				E		E		E		E
North Fork San Gabriel River	180701060104	P*				E						E	E				E		E		E		E
Bichota Canyon	180701060104	P*				E						E	E				E		P		E		
Coldbrook Creek	180701060104	P*				I						I					E				E		
Soldier Creek	180701060104	P*				I						I					E				E		
Cedar Creek	180701060104	P*				E						E	E				E		E		E		E
Crystal Lake	180701060104	P*										E	E				E				E		
Bear Creek	180701060103	P*				E						E	E				E		E		E		E
Cogswell Reservoir	180701060102	P*				E						E	E				E				E		
Devils Canyon Creek	180701060101	P*				E						E	E				E				E		E
ISLAND WATERCOURSES																							
Anacapa Island	180600140203	P*										P					E		E				
San Nicolas Island	180701070001	P*										P					E		Eaa				
Santa Barbara Island	180701070003	P*										P					E		E				
Santa Catalina Island	180701070002	E*				E						E					E		E				
Middle Ranch System	180701070003	P*				E						E					E		E				
San Clemente Island	180701070004	E*				E						E					E		E				
SAN ANTONIO CREEK WATERSHED [ab]																							
San Antonio Dam And Reservoir	180702030701	E*				E						E					E						
San Antonio Canyon Creek	180702030701	E		E	E	E			E			E	E				E				E		

E: Existing beneficial use

P: Potential beneficial use

I: Intermittent beneficial use

E, P, and I shall be protected as required.

* Asterisked MUN designations are designated under SB 88-63 and RB 89-03. Some designations may be considered for exemption at a later date (See pages 2-3, 4 for more details).

a	Waterbodies are listed multiple times if they cross hydrologic area or subarea boundaries. Beneficial use designations apply to all tributaries to the indicated waterbody, if not listed separately.
b	Waterbodies designated as WET may have wetlands habitat associated with only a portion of the waterbody. Any regulatory section would require a detailed analysis of the area.
	Coastal waterbodies which are also listed in Coastal Features Table (2-3) or in Wetlands Table (2-4).
aa	Habitat of the Channel Island Fox.
ab	This watershed is also in Region 8 (801.23).

Table 2-1a. Beneficial Uses of Inland Surface Waters.

WATERSHED[a]	WBD No.	REC1	LREC-1	REC2	High Flow Suspension
LOS ANGELES RIVER WATERSHED (cont.)					
ISOLATED LAKES AND RESERVOIRS:					
Eagle Rock Reservoir	180701050402	Pk,u			
Echo Lake	180701040200	P		E	
El Dorado Lakes	180701060506	E		E	
Elysian Reservoir	180701050403	Pk		E	
Encino Reservoir	180701050208	Pk		E	
Ivanhoe Reservoir	180701040200	Pk		E	
Lincoln Park Lake Silver Reservoir	180701050403	P		E	
Silver Lake Reservoir	180701040200	Pk		E	
Toluca Lake	180701050208	Pk		E	
SAN GABRIEL RIVER WATERSHED					
San Gabriel River Estuary [c,w]	180701060506	E		E	
Coyote Creek (San Gabriel River Estuary to La Canada Verde Creek)	180701060506	Pm		I	Yav
Coyote Creek (above La Canada Verde Creek)	180701060503	Pm		I	Yav
San Gabriel River Reach 1 (San Gabriel River Estuary to Firestone Blvd.)	180701060506	Em		E	Yav
San Gabriel River Reach 2 (Firestone Blvd. to Whittier Narrows Dam)	180701060506	Em		E	Yav
Whittier Narrows Flood Control Basin	180701060303	E		E	
Legg Lake	180701060303	E		E	
San Gabriel River Reach 3 (Whittier Narrows Dam to San Jose Creek)	180701060506	Im		I	
San Gabriel River Reach 3 (San Jose Creek to Ramona Blvd.)	180701060501	Im		I	
San Jose Creek Reach 1 (San Gabriel River Reach 3 to Temple Ave.)	180701060402	Pm		I	Yav
San Jose Creek (Temple Ave. to Thompson Wash)	180701060401	Pm		I	Yav
Puente Creek	180701060402	P		I	
Thompson Wash (San Jose Creek Reach 2 to Web Canyon)	180701060401	Im		I	Yav
Thompson Creek (above Web Canyon)	180701060401	I		I	
Thompson Creek Reservoir	180701060401	Px		I	
Walnut Creek Wash	180701060302	Im		I	
Big Dalton Wash	180701060302	Pm		I	Yav
Big Dalton Canyon Creek	180701060302	I		I	
Mystic Canyon	180701060302	I		I	
Big Dalton Reservoir	180701060302	Px		E	
Bell Canyon Creek	180701060302	I		I	
Little Dalton Wash	180701060302	Pm		I	
Little Dalton Canyon Creek	180701060302	I		I	
San Dimas Wash (lower) (Big Dalton wash to Ham Canyon)	180701060302	Im		I	Yav
San Dimas Wash (upper) (above Ham Canyon)	180701060301	Im		I	
San Dimas Reservoir	180701060301	Px		E	
San Dimas Canyon Creek	180701060301	E		E	
West Fork San Dimas Canyon	180701060301	E		E	
Wolfskill Canyon	180701060301	E		E	
Puddingstone Reservoir	180701060302	E		E	
Live Oak Wash	180701060302	I		I	
Live Oak Creek	180701060302	I		I	
Live Oak Reservoir	180701060302	E		E	
Puddingstone Wash	180701060302	Im		I	Yav
Marshall Creek and Wash	180701060302	Im		I	Yav

E: Existing beneficial use

P: Potential beneficial use

I: Intermittent beneficial use

E, P, and I shall be protected as required.

m Access prohibited by Los Angeles County Department in the concrete-channelized areas.

u This reservoir is covered and thus inaccessible.

x Owner prohibits entry.

w These areas are engineered channels. All references to Tidal Prisms in Regional Board documents are functionally equivalent to estuariers.

av: The High Flow Suspension only applies to water contact recreational activities associated with the swimmable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use, non-contact water recreation involving incidental water contact regulated under the REC-2 use, and the associated bacteriological objectives set to protect those activities Water quality objectives set to protect (1) other recreational uses associated with the fishable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use and (2) other REC-2 uses (e.g., uses involving the aesthetic aspects of water) shall remain in effect at all times for waters where the (ad) footnote appears.

Table 2-1a. Beneficial Uses of Inland Surface Waters.

WATERSHED[a]	WBD No.	REC1	LREC-1	REC2	High Flow Suspension
SAN GABRIEL RIVER WATERSHED (cont.)					
Marshall Creek and Wash	180701060302	Im		I	
Emerald Creek And Wash	180701060302	Im		I	Yav
San Gabriel River Reach 4	180701060501	Im		I	
Santa Fe Flood Control Basin	180701060501	P		I	
UPPER SAN GABRIEL RIVER TRIBUTARIES					
San Gabriel River Reach 5 (Santa Fe Dam to Van Tassel Canyon)	180701060501	E		E	
San Gabriel River Reach 5 (Van Tassel Canyon to San Gabriel Reservoir)	180701060501	E		E	
Bradbury Canyon Creek	180701060501	I		I	
Sprinks Canyon Creek	180701060501	I		I	
Maddock Canyon Creek	180701060501	I		I	
Van Tassel Canyon	180701060501	I		I	
Fish Canyon Creek	180701060501	E		E	
Roberts Canyon Creek	180701060501	I		I	
Morris Reservoir	180701060501	P		E	
San Gabriel Reservoir	180701060501	E		E	
East Fork San Gabriel River (San Gabriel Reservoir to Fish Fork)	180701060203	E		E	
East Fork San Gabriel River (above Fish Fork)	180701060201	E		E	
Cattle Canyon Creek	180701060202	E		E	
Coldwater Canyon Creek	180701060202	E		E	
Cow Canyon Creek	180701060202	E		E	
Allison Gulch	180701060203	E		E	
Fish Fork	180701060201	E		E	
West Fork San Gabriel River (San Gabriel Reservoir to Bear Creek)	180701060105	E		E	
West Fork San Gabriel River (above Bear Creek)	180701060102	E		E	
UPPER SAN GABRIEL RIVER TRIBUTARIES					
North Fork San Gabriel River	180701060104	E		E	
Bichota Canyon	180701060104	E		E	
Coldbrook Creek	180701060104	I		I	
Soldier Creek	180701060104	I		I	
Cedar Creek	180701060104	E		E	
Crystal Lake	180701060104	E		E	
Bear Creek	180701060103	E		E	
Cogswell Reservoir	180701060102	E		E	
Devils Canyon Creek	180701060101	E		E	
ISLAND WATERCOURSES					
Anacapa Island	180600140203	P			
San Nicolas Island	180701070001	P			
Santa Barbara Island	180701070003	E		E	
Santa Catalina Island	180701070002	E		E	
Middle Ranch System	180701070003	E		E	
San Clemente Island	180701070004	E		E	
SAN ANTONIO CREEK WATERSHED [ab]					
San Antonio Dam And Reservoir		E		E	
San Antonio Canyon Creek		E		E	

E: Existing beneficial use

P: Potential beneficial use

I: Intermittent beneficial use

E, P, and I shall be protected as required.

FOOTNOTES are consistent on all beneficial use tables.

a	Waterbodies are listed multiple times if they cross hydrologic area or subarea boundaries. Beneficial use designations apply to all tributaries to the indicated waterbody, if not listed separately.
m	Access prohibited by Los Angeles County Department in the concrete-channelized areas.
ab	This watershed is also in Region 8 (801.23).

av: The High Flow Suspension only applies to water contact recreational activities associated with the swimmable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use, non-contact water recreation involving incidental water contact regulated under the REC-2 use, and the associated bacteriological objectives set to protect those activities Water quality objectives set to protect (1) other recreational uses associated with the fishable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use and (2) other REC-2 uses (e.g., uses involving the aesthetic aspects of water) shall remain in effect at all times for waters where the (ad) footnote appears.

TABLE 2-2 BENEFICIAL USES OF GROUND WATERS.[ac]

DWR[ad] Basin No.	BASIN	MUN	IND	PROC	AGR	AQUA
	PITAS POINT AREA ae	E	E	P	E	
4-1	**UPPER OJAI VALLEY**	E	E	E	E	
4-2	**LOWER OJAI VALLEY**	E	E	E	E	
4-3	**VENTURA RIVER VALLEY**					
4-3.01	Upper Ventura	E	E	E	E	
4-3.02	Lower Ventura	P	E	P	E	
4-4	**SANTA CLARA RIVER VALLEY af**					
4-4.02	Oxnard					
4-4.02	Oxnard Forebay	E	E	E	E	
4-4.02	Confined aquifers	E	E	E	E	
4-4.02	Unconfined and perched aquifers	E	P		E	
4-4.03	Mound					
4-4.03	Confined aquifers	E	E	E	E	
4-4.03	Unconfined and perched aquifers	E	P		E	
4-4.04	Santa Paula					
4-4.04	East of Peck Road	E	E	E	E	
4-4.04	West of Peck Road	E	E	E	E	
4-4.05	Fillmore					
4-4.05	Pole Creek Fan area	E	E	E	E	
4-4.05	South side of Santa Clara River	E	E	E	E	
4-4.05	Remaining Fillmore area	E	E	E	E	E
4-4.05	Topa Topa (upper Sespe) area	P	E	P	E	
4-4.06	Piru					
4-4.06	Upper area (above Lake Piru)	P	E	E	E	
4-4.06	Lower area east of Piru Creek	E	E	E	E	
4-4.06	Lower area west of Piru Creek	E	E	E	E	
4-4.07	Santa Clara River East					
4-4.07	Mint Canyon	E	E	E	E	
4-4.07	South Fork	E	E	E	E	
4-4.07	Placerita Canyon	E	E	E	E	
4-4.07	Bouquet and San Francisquito Canyons	E	E	E	E	
4-4.07	Castaic Valley	E	E	E	E	
4-4.07	Saugus Aquifer	E				
4-5	**ACTON VALLEY af**					
4-5	Acton Valley	E	E	E	E	
4-5	Sierra Pelona Valley (Agua Dulce)	E	E		E	
4-5	Upper Mint Canyon	E	E	E	E	
4-5	Upper Bouquet Canyon	E	P	P	E	
4-5	Green Valley	E	P	P	E	
4-5	Lake Elizabeth - Lake Hughes area	E	P	P	E	
4-6	**PLEASANT VALLEY ag**					
4-6	Confined aquifers	E	E	E	E	
4-6	Unconfined and perched aquifers	P	E	E	E	
4-7	**ARROYO SANTA ROSA VALLEY ag**	E	E	E	E	
4-8	**LAS POSAS VALLEY ag**	E	E	E	E	
4-9	**SIMI VALLEY**					
	Simi Valley Basin					
	Confined aquifers	E	E	E	E	
	Unconfined aquifers	E	E	E	E	
	Gillibrand Basin	E	E	P	E	
4-10	**CONEJO VALLEY**	E	E	E	E	
4-11	**COASTAL PLAIN OF LOS ANGELES**					
4-11.01	Santa Monica	E	E	E	E	
4-11.02	Hollywood	E	E	E	E	
4-11.03	West Coast					
4-11.03	Underlying Ports of Los Angeles & Long Beach		E	E	E	
4-11.03	Underlying El Segundo, Seaward of Barrier		E	E	E	
4-11.03	Remainder of Basin	E	E	E	E	
4-11.04	Central	E	E	E	E	
4-12	**SAN FERNANDO VALLEY**	Eah	E	E	E	
4-13	**SAN GABRIEL VALLEY ai**	E	E	E	E	
4-15	**TIERRA REJADA**	E	P	P	E	
4-16	**HIDDEN VALLEY**	E	P		E	
4-17	**LOCKWOOD VALLEY**	E	E		E	
4-18	**HUNGRY VALLEY**	E	P	E	E	
4-19	**THOUSAND OAKS AREA aj**	P	P		E	
4-19	Triunfo Canyon area	P	P		E	
4-19	Lindero Canyon area	P	P		E	
4-19	Las Virgenes Canyon area	P	P		E	
4-20	**RUSSELL VALLEY**	E	P		E	
4-21	**CONEJO-TIERRA REJADA VOLCANIC ak**					
4-22	**MALIBU VALLEY al**					
4-22	Camarillo area	E	P		E	
4-22	Point Dume area	E	P		E	
4-22	Malibu Valley	P	P		E	
4-22	Topanga Canyon area	P	P		E	
4-23	**RAYMOND**	E	E	E	E	
	SAN PEDRO CHANNEL ISLANDS am					
	Anacapa Island	P	P			
	San Nicolas Island	E	P			
	Santa Catalina Island	E	P		E	
	San Clemente Island	P	P			
	Santa Barbara Island	P	P			

E: Existing beneficial use
P: Potential beneficial use
See pages 2-1 to 2-3 for
description of beneficial use

FOOTNOTES are consistent for all beneficial use tables.

ac: Beneficial uses for ground waters outside of the major basins listed on this table and outlined in Fig 1-9 have not been specifically listed. However, ground waters outside of the major basins are, in many cases, significant sources of water. Furthor existing sources of water for downgradient basins, and such, beneficial uses in the downgradient basins shall apply to these areas.

ad: Basins are numbered according to DWR Bulletin No. 118-Update 2003 (DWR, 2003).

ae: Ground waters in the Pitas Point area (between the lower Ventura River and Rincon Point) are not considered to comprise a major basin and, accordingly, have not been designated a basin number by the DWR or outlined on Fig. 1-9.

af: Santa Clara River Valley Basin was formerly Ventura Central Basin and Acton Valley Basin was formerly Upper Santa Clara Basin (DWR, 1980).

ag: Pleasant Valley, Arroyo Santa Rosa Valley, and Las Posas Valley Basins were formerly subbasins of Ventura Central (DWR, 1980).

ah: Nitrite pollution in the groundwater of the Sunland-Tujunga area currently precludes direct MUN uses. Since the ground water in this area can be treated or blended (or both), it retains the MUN designation.

ai: Raymond Basin was formerly a subbasin of San Gabriel Valley and Monk Hill subbasin is now part of San Fernando Valley Basin (DWR, 2003). The Main San Gabriel Basin was formerly separated into Eastern and Western areas. Since these areas had the same beneficial uses as Puente Basin all three areas have been combined into San Gabriel Valley. Any ground water upgradient of these areas is subject to downgradient beneficial uses and objectives, as explained in Footnote ac.

aj: These areas were formerly part of the Russell Valley Basin (DWR, 1980).

ak: Ground water in the Conejo-Tierra Rejada Volcanic Area occurs primarily in fractured volcanic rocks in the western Santa Monica Mountains and Conejo Mountain areas. These areas have not been delineated on Fig. 1-9.

al: With the exception of ground water in Malibu Valley (DWR Basin No. 4-22) ground waters along the southern slopes of the Santa Monica Mountains are not considered to comprise a major basin and accordingly have not been designated a basin number by DWR

am: DWR has not designated basins for ground waters on the San Pedro Channel Islands.

ATTACHMENT B

ANECDOTAL EVIDENCE OF RECREATIONAL USES OF THE SAN GABRIEL RIVER SUBMITTED BY BELINDA FAUSTINOS, EXECUTIVE DIRECTOR OF NATURE FOR ALL

Recreational Uses in the San Gabriel River

Signatories to this letter have witnessed the following recreational uses in and around the San Gabriel River. The following observations have been made by Belinda Faustinos, Executive Director of Nature for All, over the past thirty years of her living in the region and touring the area by foot and bike on the San Gabriel River Bike Path:

- Fishing in the river below the LACSD outflow at San Jose Creek
- Wading and sunbathing near the waterfall at the Whittier Narrows dam
- Children playing in the river bed, particularly in the area of the San Jose Creek confluence with the San Gabriel River, and down to the dam
- Equestrian activities along the river, particularly in the area of the San Jose Creek confluence with the San Gabriel River. There is an equestrian community between the River and the 605 Freeway with several homes along the river with backyard stalls.

From: Margot Eiser <coppmontebello@gmail.com>
Sent: Monday, March 11, 2019 2:56 PM
To: Lanza, Jodie
Subject: Recycled Water Scoping Comments
Attachments: COPP Scoping Comments.doc; COPP Technical Appendices Sanitatin District comments.doc; niac-water-resilience-final-report-508.pdf; CalTrans ARS Spectrums.doc; Montebello Blvd project.doc

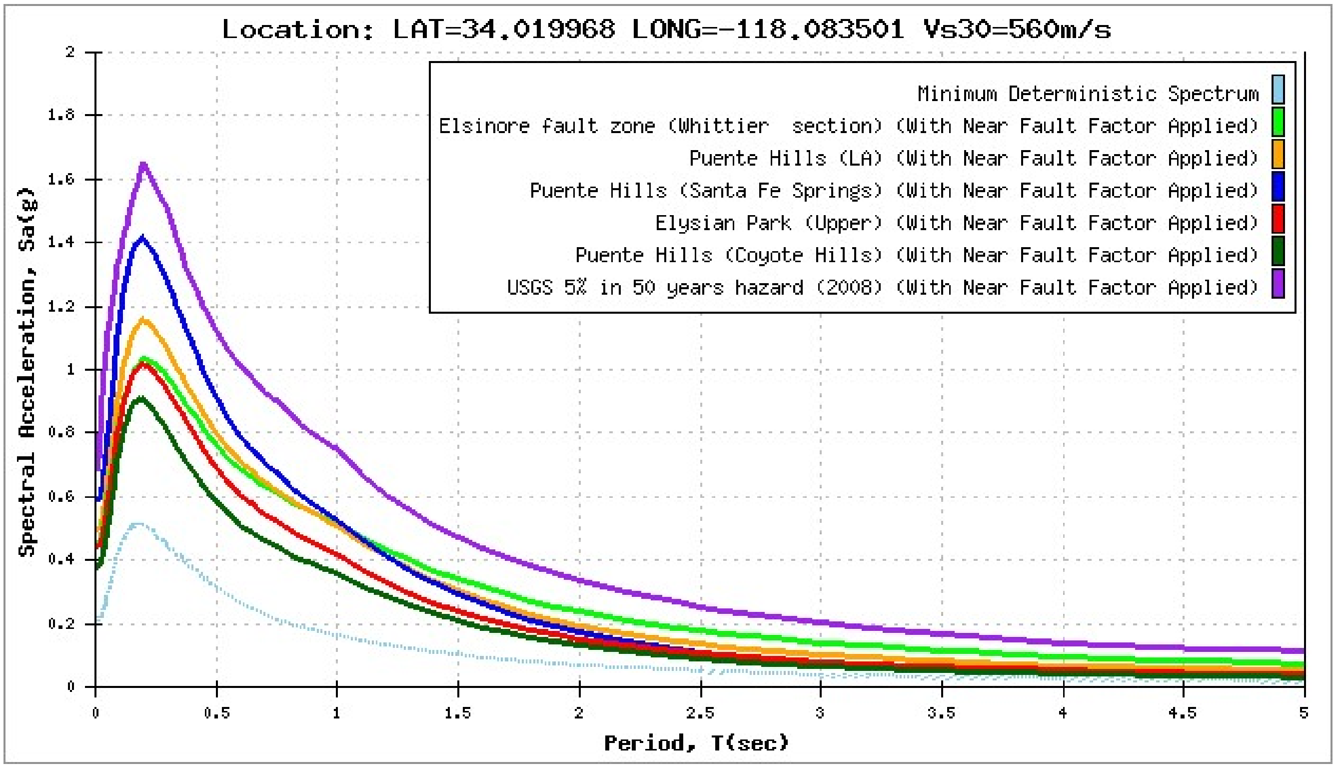
Jodie Lanza, Supervising Engineer Sanitation Districts of Los Angeles County 1955 Workman Mill Road Whittier, CA 90601 (562) 908-4288, extension 2707

Not picking on CBMWD or City of Montebello or SGVWCO just using them of examples of Bad projects with no supervision.
Montebello/ CBMWD project has no geotechnical report for proposed pumping station or pipeline, access to the MHSP project as been moved from the East side (SGVWCO) of the project to the West up Montebello blvd, Project has dropped vital cross connections and recycled water tank shown in the City's EIR without further Environmental Review.
CBMWD for some reason is pushing this project that does not meet environmental standards or cost/ benefits standards.
There is bait and switch as the originally proposed 10,000 foot system that was supposed to supply schools and parks as been reduced to 2000 feet serving only a big dollar private developer.
The Sanitation district must rescind their December approval of an allotment for this unwise project till this EIR process is completed.
We understand that CBMWD is moving allotments from two schools to support this project.
We do not think recycled water should prematurely be allocated for this project

See also the USGS Shakeout report
let us know how we can help on this vital project

Citizens for Open and Public Participation
Margot Eiser
Chair

Copy to Phillip.J.*Serpa@usace*.army. (213) 452-3402
Dams and Corps Project areas Whittier Narrows, Santa Fe
Ricky "R.D." James, assistant secretary of the Army for Civil Works,
CAL TRANS ARS ONLINE

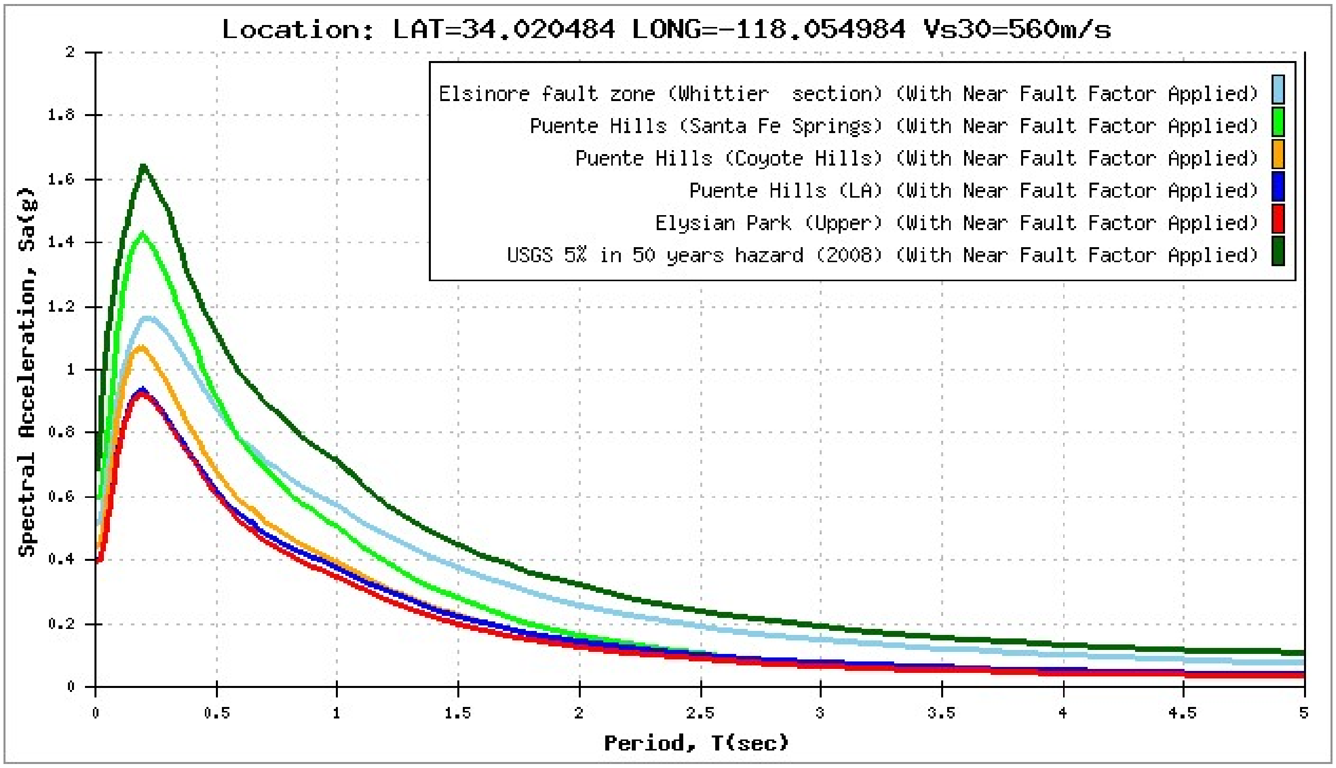


Whittier Narrows Rio Hondo Gates Area near Lincoln Blvd

3.37	Km Elsinore fault zone (Whittier section) actually crosses under dam about 1km no directivity
6.41	Km Puente Hills Thrust (LA) to fault plane hanging wall effects
7.78	Km Puente Hills Thrust (Santa Fe Springs)
6.37	Km Elysian Park Thrust (Upper) to center of fault plane actual is closer no directivity
10.92	Km Puente Hills Thrust (Coyote Hills)

Whittier-Elsinore could rupture in multiple segments as could Puente Hills Thrust
Whittier-Elsinore runs under dam- May be responsible for some piping
Whittier-Elsinore goes to base of seismicity – 10 miles and is much older than other faults shown and much older than Puente Hills- Montebello Hills
Whittier is considered here 6.8 by Caltrans from their old map
actually when designing Rosemead's Garvey ave bridge and Montebello Beverly blvd bridge over the Rio Hondo they used 7.5 and recently they found evidence of the fault up by Huntington Drive in South Pasadena / San Marino Area making it much longer.
DPW also got a consulting report from URS corp
This was before hazard of Southern San Andreas Was appreciated, unfortunately.
The basin traps waves resulting in basin excitement- the bowl of jello effect making much more duration for events and greater ground motions. Maybe two minuets – long after the shaking has stopped on rock sites
We think that Whittier-Elsinore, PHT and San Andreas all have the capability of exciting Whittier Narrows but two with short-period- short duration Strong Shaking and San Andreas with long period- long duration- Major events on Whittier and PHT are not probable- San Andreas is very Probable

Whittier Narrows San Gabriel Spillway   VS30 560

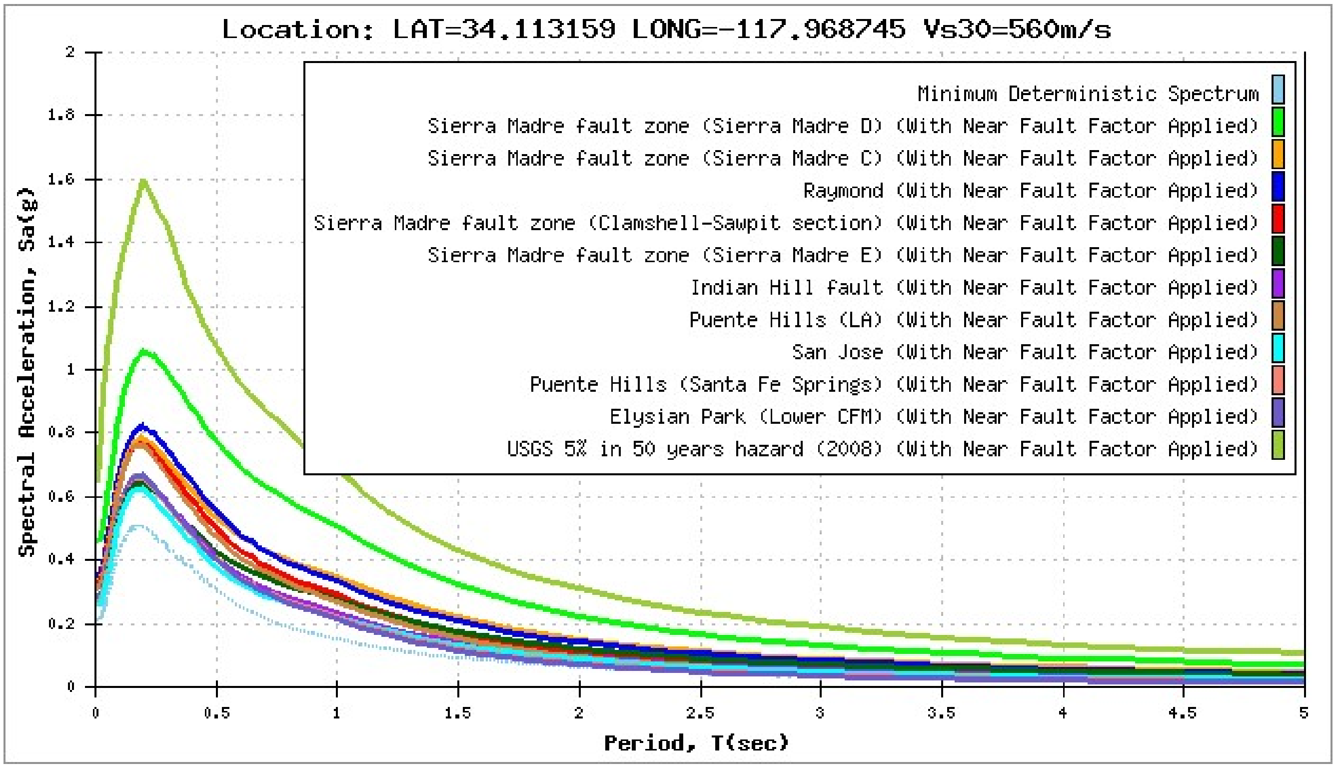


2.17	Km Elsinore fault zone (Whittier section) fault runs under dam actually < 1 km
7.52	Km Puente Hills (Santa Fe Springs) dist to fault plane
9.69	Km Puente Hills (Coyote Hills)
8.49	Km Puente Hills (LA)
7.43	Km Elysian Park (Upper)

Does not include basin depth amplification, directivity
also does not include Long period, long duration Southern San Andreas
Vertical must be considered
IDK about Hanging Wall for PHT or Footwall for Elysian Park
Two or Three Puente Hills could rupture together
Puente Hills could trigger Whittier-Elsinore
Whittier-Elsinore could have multi segment rupture
no directivity or basin effects but a great start

for San Andreas just start at the.06 g line and draw straight across till you get site specific data
multipliers show about 3x at 3 sec   .2 x 3 = .6
and 5- 8X at 10 sec .1 x 5 = .5g   I do not want to think about .05 X 8x = .4 g for 3 minuets at T=10 sec

Santa Fe Dam Spillway



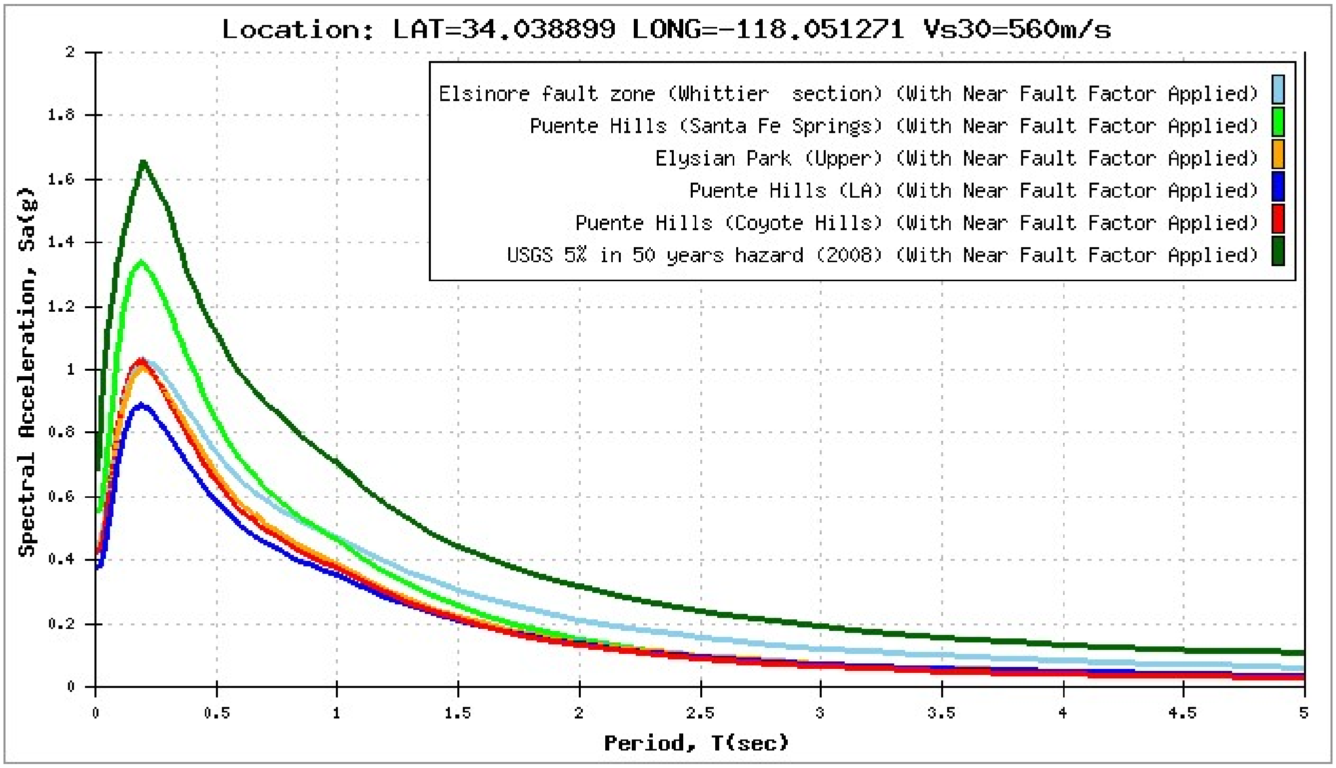
Deterministic Spectrum Using

4.26	Km Sierra Madre fault zone (Sierra Madre D)
8.75	Km Sierra Madre fault zone (Sierra Madre C)
5.91	Km Raymond
7.17	Km Sierra Madre fault zone (Clamshell-Sawpit section)
12.05	Km Sierra Madre fault zone (Sierra Madre E)
7.63	Km Indian Hill fault
16.07	Km Puente Hills (LA)
11.18	Km San Jose
15.17	Km Puente Hills (Santa Fe Springs)
17.76	Km Elysian Park (Lower CFM)

Sierra Madre could have multiple segment event thrust fault
Puente Hills could have multiple segment event- hanging wall
faults are ranked by hazard magnitude and distance

San Andreas is not shown but is most probabilistic and most likely greatest hazard

METRO GOLD LINE Santa Anita Station Area along 60 freeway



4.18	Esinore fault zone (Whittier section)
8.44	Punte Hills (Santa Fe Springs)
6.37	Km Elysian Park (Upper)
9.52	Km Puente Hills (LA)
10.59	Km Puente Hills (Coyote Hills)

Whittier Fault is actually Just across the Rio Hondo let's say 2Km
Whittier-Elsinore could have multi segment break
Puente Hills could have multi segment break
hanging Wall on PHT Santa Fe Springs
Elysian Park Upper is controlled to the East by the Whittier-Elsinore Fault -closer than CalTrans Shows footwall

Basin Depth Amplification is not shown

For Puente Hills thrust Rob Graves SCEC Simulation could be used Graves is now at USGS Pasadena
For San Andreas contact Steve Day or Kim Bak Olsen at San Diego State University
there is no way that GMPE, AR, NGA, CGS, USGS work in Whittier Narrows

Since METRO Gold Line is projected across Corps property I would insist that they use latest methods not only for ground motion but for liquefaction and to see if their little trolleys would be tossed off the tracks.
There is also the County's Whittier Narrows Nature Center/ Discovery Center along the line south of of 60 freeway from the WNGC data point (from the other document) to San Gabriel River

Get Metro to Provide some studies

Los Coyotes Cerritos
Cerritos is in Hazardous Deep LA Basin

Apply Near Fault Adjustment To:
NOTE: Caltrans SDC requires application of a Near Fault Adjustment factor for sites less than 25 km (Rrup) from the causative fault.

Deterministic Spectrum Using

4.48	Km Puente Hills (Santa Fe Springs)
10.62	Km Compton
6.38	Km Puente Hills (Coyote Hills)
4.91	Km Anaheim
10.53	Km Newport Inglewood fault zone (S. Los Angeles Basin section-southern)
10.28	Km Puente Hills (LA)
12.63	Km Newport Inglewood fault zone (N. Los Angeles Basin section)
11.91	Km Elysian Park (Lower CFM)
13.71	Km Elsinore fault zone (Whittier section)
20.99	Km Palos Verdes

Shear Wave Velocity, *VS*30:250 m/s
Latitude:33.880187
Longitude:-118.104433
Depth to Vs = 1.0 km/s:800 m
Depth to Vs = 2.5 km/s:5.48 km

Notes on Cal Trans
listings are in hazard order not Mw or distance
Multiple segment breaks are shown by CGS but not on CalTrans Ap
Whittier-Elsinore
Puente Hills Thrusts
Sierra Madre
Newport Inglewood
Palos Verdes

San Andreas is largest hazard and not shown

ARS is CalTrans for Acceleration (the source) Rock (the path) and Soil (the site)
as you can surmise Acceleration does not include directional effects or “super shear”\
Rock for path does not account for Velocities of the Path which greatly affect ground motion
Site does not do Basin Modeling, reflection, etc just Vs-30 as an approximation

Suggest you also contact the SCEC Cybershake Program and the Cal State San Diego Terrashake/Shakeout program Chris Day, Kim Bak Olsen in the geology department and Dr Lucy Jones SCAG earthquake program and USGS Pasadena office Robert Graves

The basically good programs by Robert Blake also must be heavily hand tuned for data adequacy, IDK if it can handle PATH effects and long duration, distant PATH effects which takes the SCEC Community Velocity Model – contact SCEC once you determine the critical periods of your structures

San Jose

Apply Near Fault Adjustment To:
NOTE: Caltrans SDC requires application of a Near Fault Adjustment factor for sites less than 25 km (Rrup) from the causative fault.

Deterministic Spectrum Using

4.79	Km Elsinore fault zone (Whittier section)
9.97	Km Puente Hills (Coyote Hills)
8.53	Km Puente Hills (Santa Fe Springs)
8.15	Km Elysian Park (Upper)
13.91	Km Sierra Madre fault zone (Sierra Madre D)
11.39	Km Puente Hills (LA)
14.86	Km Sierra Madre fault zone (Sierra Madre C)
13.67	Km Elysian Park (Lower CFM)
11.31	Km Raymond
13.00	Km Verdugo-Eagle Rock

San Jose ??? shows on Pomona but not here

Notes on Cal Trans
listings are in hazard order not Mw or distance
Multiple segment breaks are shown by CGS but not on CalTrans Ap
Whittier-Elsinore
Puente Hills Thrusts
Sierra Madre

San Andreas is largest and most probable hazard and not shown

POMONA
Apply Near Fault Adjustment To:
NOTE: Caltrans SDC requires application of a Near Fault Adjustment factor for sites less than 25 km (Rrup) from the causative fault.

Deterministic Spectrum Using

1.61	Km San Jose directivity must be calculated -site is near midpoint
8.03	Km Sierra Madre fault zone (Sierra Madre E) thrust fault
11.87	Km Sierra Madre fault zone (Sierra Madre D)
5.85	Km Indian Hill fault
13.94	Km Elsinore fault zone (Whittier section)
15.70	Km Puente Hills (Coyote Hills) on hanging wall of thrust fault
23.64	Km Elsinore fault zone(Glen Ivy) rev
11.89	Km Elsinore fault zone (Chino section)
36.18	Km San Andreas (San Bernardino S)
12.45	Km San Antonio fault (splay)

Notes on Cal Trans
listings are in hazard order not Mw or distance
Multiple segment breaks are shown by CGS but not on CalTrans Ap
Whittier-Elsinore-Chino
Puente Hills Thrusts
Sierra Madre thrusts
San Jacinto }
San Andreas} chain of basins along foothills accelerations not included
San Andreas is largest and most probable hazard Distance/ Magnitude relations (GMPE)(NGA), etc.
u
n
d
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r
e

COPP Scoping comments .doc
Citizens for Open and Public Participation
c/o 548 N Darlington St So San Gabriel CA 91770

jlanza@lacsd.org.

LA County Sanitation Districts
Comments on Recycled Water Scoping
(hopefully not required to be repeated on a draft)

Recycled water is a valuable public commodity directly linked to potable water, usages and land use. We consider over-pumping of the aquifers by what we'll call “pumping suckers” to be the major problem that must be addressed. There is no cushion left for the next drought and low water tables cause additional migration of super-fund plumes.
We suggest that historic artesian flows (springs) and water tables be restored and habitat decimated by low water tables be restored prior to commercial water recycle projects. It's not just as simple as diverting water at the end of the outfalls.

After water flow for saltwater intrusion barriers and flurishment of wetlands and other habitat recycled water may be reused.
As an Alternative we suggest that the District consider recycle/ reuse systems with pumping stations in the lower reaches and pipelines to the upper- Say Santa Fe Dam where water could replenish all the aquifers. Water suckers to pay for. (Minimizing purchases from MWD)
Water suckers must pay for the pumping of this recycled water. They have already pumped all of “their” water rights without replenishment to the detriment of the public. (Empower the watermasters.

Once the aquifers are restored, providing a cushion for the next drought and replenishing habitat reclaimed water over the amount needed to maintain the water tables may be used for the public good.

The district must develop maintain and enforce best use policies upon it's member agencies.
Environmental Justice demands that water not just be allowed to be sold to the highest commercial bidder or whatever makes the most profit for the agency.
Many agencies consider themselves in the water sales business and do not get involved (turn a blind eye) tp the land use and entitlements. The agencies must abide by the District's and County's standards.
To that effect Low Impact Development Standards must be considered. Best Practices
Waterwise plantings, preferably with native plants (as only native plants support native species)
Deprecation of foreign lush plantings, especially of foreign invasives.
Besides landscaping recycled water could be utilized for other non potable uses such as sanitary systems.
Projects and Developments that do not minimize total water use would be ineligible.
Promoting and Enabling water waste is to be avoided.

To be eligible projects must also utilize best practices for minimization of Storm Water Runoff- Recycle/ Reuse.
Does the County require low flow toilets, shower-heads, faucets, etc. when a property Is sold? Why not?

The District's premature allotment of recycled water to the CBMWD is the poster child of a big money deal to a very bad project. CBMWD insiders must be planning on a fast buck from “project management” or a Credit Moblier project as the return on investment is way too long and risky if it is abandoned...

We are also concerned that over 10 years after the USGS “Shakeout” we still do not see much evidence on replacement (or lining) of concrete, asbestos-concrete (transite) Cast Iron, Clay (Vitreous china) or gas welded steel pipe in Storm Drain, Sewer, Potable water or recycled water lines.

San District must require agencies to provide maps showing modern and non ductile piping for all of their systems and a plan to repair/ reline or replace. The public cannot be out of water for 6 months or have sewerage spilling into the streets. We understand that the San District may have a program- we would like to see it and like to see a comprehensive program mandated for all providers.

In addition to pipelines Tanks are especially vulnerable as none are designed for a Southern San Andreas event. Long period- long duration earthshaking is currently not required to be considered. Tanks have recently been installed with the same foundations and hold-downs that failed in the Northridge earthquake in Topanga Canyon.
Evidently AWA 100 does not meet current ASCE-7 standards. Much less recent Japanese or New Zealand findings.

If San District is going to supply water it must be into a fully ductile/ hardened system which must meet the Districts standards

An example:
The sewer under the CBMWD project on Montebello Blvd is clay pipe
We do not have any data from the City on Potable Water or Storm drains

We do not want a project that “kicks the can down the alley” or passes the buck.

Attachments for the use of your consultants

compiled from working group by J Flournoy for Margot Eiser, Chair

COPP Technical Appendices and Support for Sanitation District Scoping Comments
plus some we hope helpful comments on the Pico Rivera project FYI

COPP Montebello CA
Margot Eiser Chair
James Flournoy Secretary and compiler

cc
Central Basin Kevin Hunt P.E.
kevinh@centralbasin.org

https://www.whittierdailynews.com/2019/02/12/montebello-to-utilities-dont-tear-up-our-newly-paved-roads/

MHSP EIR Geotechnical report 2008 was invalidated by the RDEIR additions in 2014
The much greater seismicity found in Appendices I-1 and I-2 render landslide analysis/ seismic settlement/ grading recommendations of 2008 EIR invalid and must not be used for Central Basin Project.
IF ANY SAN DISTRICT PIPELINES run near Montebello Oilfild note that Army Corps has found settlement attributed to oil field operations. We expect more in event of major earthquake.

In addition even the well intended RDEIR 2014 Appendices I analysis did not include the Upper Elysian Park Thrust, and while they got Whittier-Elsinore close to right they were still way off on the Puente Hills Thrust, The Montbello Thrust (backthrust off the Puente Hills Thrust see later in this Technical supplement) was not considered)
Neither was the hazard of the Southern San Andreas which was just being realized in 2008 with the CSUSD Terrashake and USGS Shakeout" programs.
Therefore long duration strong long period shaking was not considered

We are concerned about ground waves, heave, fling, ground motion which could ruin new pipelines and any Lincoln Avenue pipelines.

We are concerned about the affect on pumps and tanks not only shaking but deep landslides, on the currently active Montebello Hills Anticline.
The American Water Works (AWWA) standard for tanks has not been upgraded to the latest CBC or ASCE 7-16- it does not meet the current Caqlifornia building code.

Example
Hold-downs on at least one of the new tanks at the North end of Lincoln Ave near Schurr High were built using the same holdowns as the ones that failed in Topanga canyon during the moderate Northridge earthquake. (pulling the hold-downs through the sides of the tanks)
Tanks are especially vulnerable to long period-long duration Southern San Andreas events.

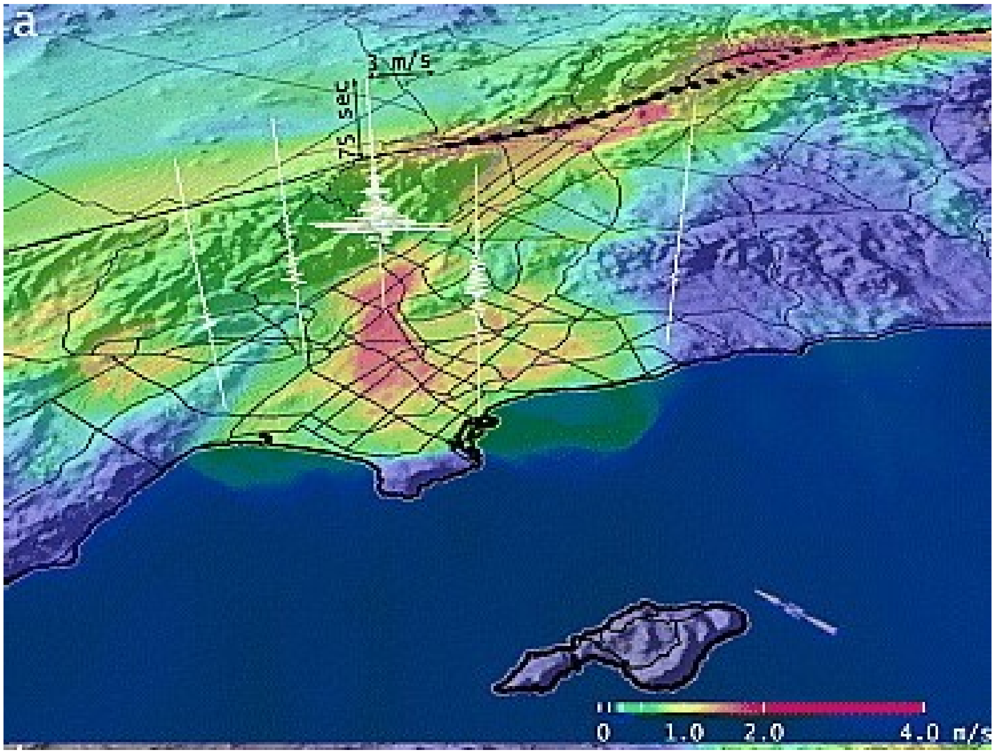
Details must be specified for tanks and distribution systems and pumps, ductility and break away valves for pipelines

What is the flow to fully recharge the groundwater? Can San District provide or must MWD water be

purchased?
Is removal of groundwater recharge water in favor of a water wasting private project in the public interest and a beneficial use of water.

Hazards to Distribution, Pumps, Tanks also Wells and the San District facilities

First and we think the largest Hazard is the Southern San Andreas Fault
Notice how the largest seismogram is centered on Whittier Narrows making Whittier Narrows the most hazardous location that is not directly on the fault line.
Also notice along the 210 freeway that Santa Fe Dam is also in the Red zone.
Notice the Ground Velocity in the 3-4 Meters/ second range.
These long period-long duration ground waves have a great effect on Liquefaction and landslide requiring custom analysis. And Dynamic analyses like Newmark



How does the "Bowl of Jello" effect affect the Infrastructure and underlying alluvium?
There have been several simulations since this one with very different results but our experts think that with only a few hindered years between major events all could happen over the planning period.
We mentioned that Dr. Lucy Jones and both Steve Day and Kim Back Olsen of San Diego State University Geology department are the experts on this hazard,

"Whittier Narrows Depth = 4.1 km from SCEC CVM 3.0 to 2.5Kn/sec isosurface (rock) 61Km from nearest San Andreas rupture" (CVM is SCEC Community Velocity Model)

" the level of ground velocity in the LA basin almost equals the level near the fault in spite of the fact that the main trough of the basin is about 60 km from the fault."

"Thus, theTeraShake1 and TeraShake2 results indicate that such sedimentary wave-guide effects, where they exist, may have a large systematic impact on long-period shaking levels"

CBC surface Vs 30 set to 360 m/sec for NGA PGV calculation

Terrashake is S>N rupture; TS2 is S>N but different speed rupture velocity and TS3 is >middle<

http://www-rohan.sdsu.edu/~kbolsen/PUBL_dir/ts2bssapub.pdf from table 4 see fig 6 site 3

For ex-ample, the band of amplification extending from the San Gabriel basin through Whittier–Narrows into the Los Angeles basin, for the southeast –northwest rupture scenarios TS2.1–2.2 (see Fig. 7), is similar to the pattern found in the TeraShake1 southeast–northwest simulations (Olsen et al., 2006).

SECOND WAVE GUIDE DEEP LA BASIN and along 5 and 710 affecting SEWERS and plants in LA Basin (recall that 605 x 5 was heavily damaged in Mild 1987 Whittier earthquake, closed and had to be shored up)(we use interference and perfect-storm for multipathing)

“ Moreover, a second wave guide, although less effective in channeling the surface waves, generates the multipathing effect discussed earlier and causes increased amplification in the southern part of the Los Angeles basin (see Fig. 8) for both sets of TeraShake simulations.”

SOUTH MONTEBELLO

(site 6 may better capture south Montebello and there are more recent simulations but the hazards are still hazards)

Thus, theTeraShake1 and TeraShake2 results indicate that such sedimentary wave-guide effects, where they exist, may have a large systematic impact on long-period shaking levels

In particular, the very localized extremes in PGV predicted near Whittier–Narrows, (water supply, dam, flooding from Santa Fe Dam) due to focusing of channeled waves, are up to a **factor of 5 above the median prediction** of the current generation of Ars (attenuation relationships e.g. NGA, USGS, CBC) (median 20 compared to 104, 105 above)

.The same channeling effect leads to pervasive amplifications in the deep parts of Los Angeles basin that are a factor of 2–4 above the median AR (along the 5)
(even when, as in the C&B06AR, a correction for local basin depth Is included).

“Although we have modeled these effects for a specific set of scenarios, they are sufficiently strong for some sites to influence predictions from ensemble averages of sources, and **therefore should be considered in probabilistic seismic hazard analysis (PSHA).”**

Component Ground Motion Parameter

118 deg Peak particle velocity (m/s) 1.741.37
28 deg Peak particle velocity (m/s) 2.490.70
Vertical Peak particle velocity (m/s) 0.910.54

	Near Fault	Basin
118 deg Cumulative kinetic energy (J-s)	11408	11408
28 deg Cumulative kinetic energy (J-s)	12353	2341
Vertical Cumulative kinetic energy (J-s)	1616	1131

“The maximum PGVs away from the fault for TS2.1–2.2 were similar (153–154 cm=sec) and were both generated by the northern wave guide, near Whittier–Narrows for TS2.1 “

The maximum PGV for Landers Kinematic in the Whittier–Narrows region associated with the waveguide effects previously discussed is 2:6 m=sec

“Moreover, the long duration of shaking exceeding 1 min is a concern at many sites,
The extended durations are primarily a problem at basin locations”

So how to do Magnitude Scaling factors for Liquefaction Studies for these longer period long duration much stronger than expected events?

A computer simulation put together by the Southern California Earthquake Center shows shaking from a 7.7-magnitude quake that strikes at the southern tip of the San Andreas fault lasting 30 to 45 seconds in the Inland Empire and nearly 1 minute and 30 seconds in Los Angeles. (More in Whittier Narrows)

PGVs obtained for a linear viscoelastic medium (Figure 2b) exceed 1 $m{\cdot}s^{-1}$ inside a large area along the main waveguide connecting the San Bernardino Basin (SBB) and the LAB,
with PGVs above 2 $m{\cdot}s^{-1}$ in isolated patches (e.g., Whittier Narrows, site **rus**).
\(location RUS is north of the Dam along the 60 Freeway)

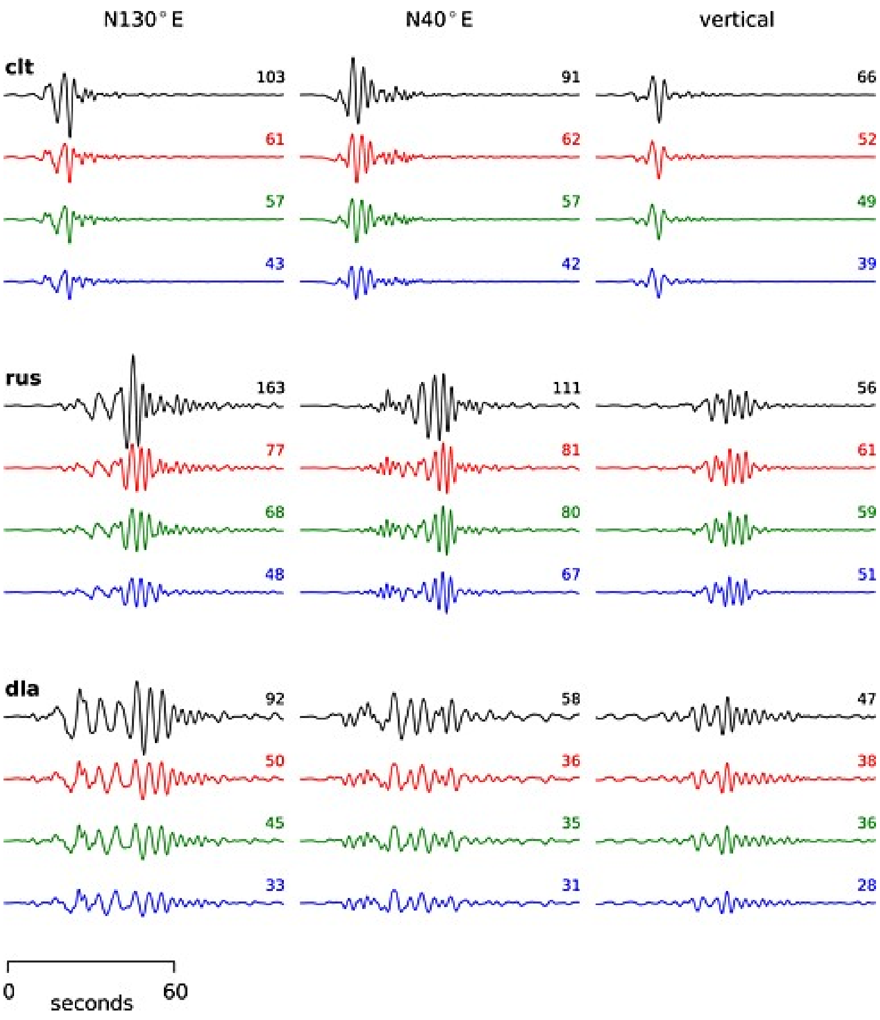
https://pubs.usgs.gov/of/2008/1150/of2008-1150.pdf PG 3
We validated our modeling results through comparison of multiple methods, use of distinct velocity models,
and comparison with empirically based attenuation relations.
In all, four teams were engaged to make independent models of the ground motions.
Several features of the ShakeOut earthquake ground motions are consistent across all the models including: …
Pockets of very strong shaking (≥1.5 m/sec) with long durations (45-60 sec) in areas of the San Gabriel Valley and East Los Angeles.

Duration of strong shaking will be an important contributor to damage in any earthquake as large as the ShakeOut Scenario earthquake.
(which is not the largest possible)

All San District facilities are impacted by the Southern San Andreas.
Pomona, even though closer, does not get the duration of San Jose and Whittier Narrows which also get reflections from the Puente and Montebello Hills and the Whittier Narrows Dam area. (Perfect Storm/ Clash/ Interference effects)

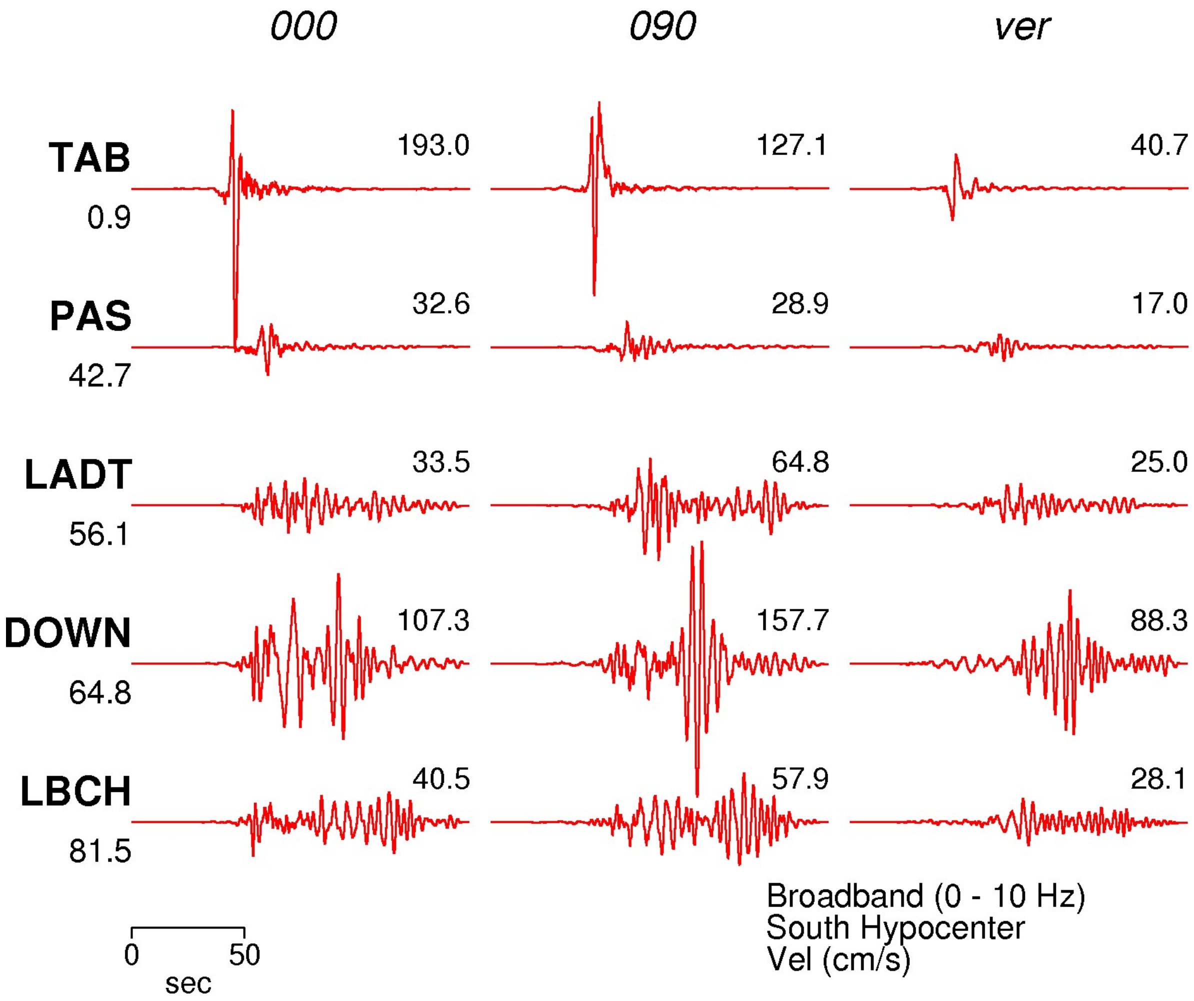
Station RUS Minimums for Whittier Narrows and San Jose
Station RUS is near 60 Freeway

Expected seismic shaking in Los Angeles reduced by San Andreas



Geophysical Research Letters Volume 41, Issue 8, pages 2769-2777, 23 APR 2014 DOI: 10.1002/2014GL059411 http://onlinelibrary.wiley.com/doi/10.1002/2014GL059411/full#grl51582-fig-0004

see DOWNEY Below for Whittier Narrows to Long Beach
1015_Graves_gmsims-v1.opd   Graves is USGS Pasadena
We strongly suggest that you contact Robert Graves USGS Pasadena and have him re-run his Puente Hills Thrust Simulation
Dr. Rob Graves US Geological Survey525 S Wilson Ave Pasadena, CA 91106-3212
Phone 626-583-7239 Fax 626-583-7827 Email Rob Graves



Second Hazard from Puente Hills Blind-Thrust System,
Bulletin of the Seismological Society of America, Vol. 92, No. 8, pp. 2946–2960, December 2002

Puente Hills Blind-Thrust System, Los Angeles, California

J. H. Shaw, A. Plesch, J. F. Dolan, T. L. Pratt, and P. Fiore (Montebello Thrust shown in this paper and subsequent

many subsequent papers Mostly involving Shaw and Dolan

Note the “Montebello thrust” which the MHSP EIR ignored and then said did not exist

Montebello backthrust or something very similar has to exist to create the folds in the Montebello Hills

Puente Hills Blind-Thrust System, Los Angeles, California 2951

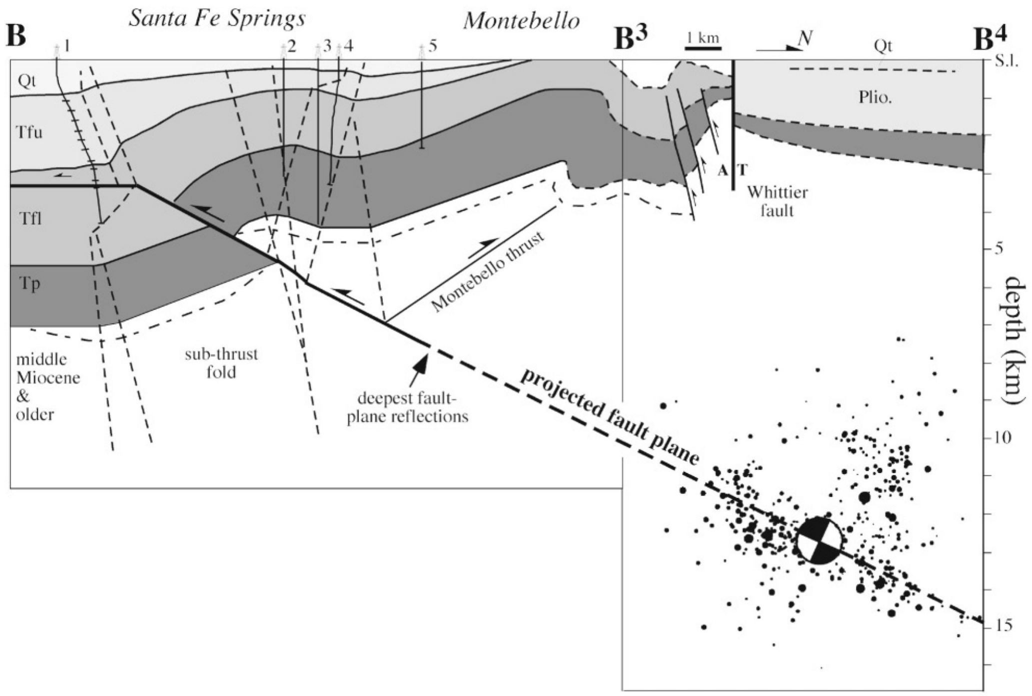


Figure 5. Geologic cross section showing relation of the Santa Fe Springs segment of the PHT to the hypocenters of the 1987 Whittier Narrows (M_w 6) earthquake and aftershocks after Shaw and Shearer (1999). The hypocenters were relocated by Shaw and Shearer (1999) using L-1 norm waveform cross-correlation techniques (Shearer, 1997) and velocity control from nearby oil wells. Profile trace is shown in Figure 1.

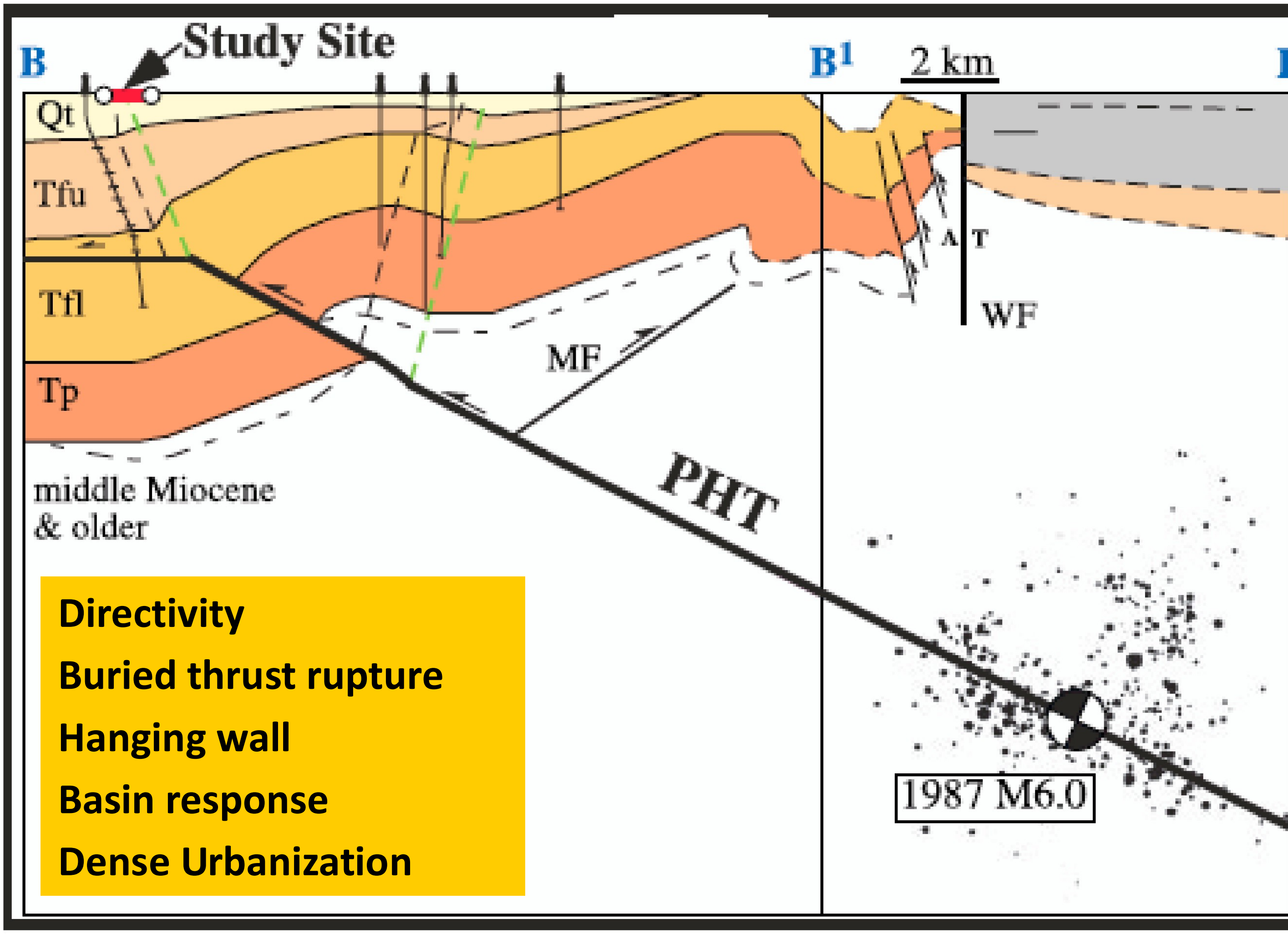
https://profile.usgs.gov/myscience/upload_folder/ci2015Jun0923284642591Shaw_BSSA_2002.pdf

(Beachball is essentially near Whittier Narrows Golf Course (WNGC) or Rosemead x 60 rfreeeway

Two considerations must be examined
First: Without the “Montebello Thrust

(not to be confused with the “Montebello Fault” East-West the Montebello Hills
Squeezing of the LA Basin North South requires shortening which causes the Puente Hills thrust faults
Many papers on this
See Dolan and USC and John Shaw at Harvard

South



- Directivity
- Buried thrust rupture
- Hanging wall
- Basin response
- Dense Urbanization

James Dolan (USC) John Shaw (Harvard)

Where the thrust itself causes uplift and the Project's Whittier Narrows and San Jose are on the "Hanging Wall" requiring that and "near fault effects it does not show the shape of the Montebello-Puente Hills

Second Consideration- With Shaw's "Montebello Thrust"
which can be derived by Geomphography- what makes the shapes and folds of the hills,
Which is closer to the Project areas and directed towards the projects.

Notice how the Montebello Thrust points directly at the Project area., Whittier Narrows and San Jose Plants and outfall pipelines and settling basins.
There will be a strong "directivity" hazard, the Doppler effect, as well as a near "near fault" hazard although in a vertical plane. Considering a multi-segment break of the PHT system 7.5 is a reasonable Mw to consider.

A single segment break could be larger than Northridge as the fault slopes up toward the projects from depth whereas Northridge sloped down burying energy. (also for Upper Elysian Park, below)

" The Montebello thrust must intersect the Santa Fe Springs thrust ramp at depth
and is either offset by the PHT or merges with it, forming a structural wedge" (similar to Medwedeff, 1992).

In the latter scenario, slip on the PHT is partitioned between the southdipping

Montebello thrust fault and the north-dipping Santa Fe Springs ramp (Fig. 5). (above)

Thus, slip on the Santa Fe Springs ramp that we measured could be less than slip on the deeper portion of the PHT that lies north of its intersection with the Montebello thrust. As the Montebello backthrust is limited...

(The spectrums of First and Second considerations will be different but both are critical in analyzing the hazard to Whittier Narrows Dam)

Medwedeff, D. A. (1992). Geometry and kinematics of an active, laterally propagating wedge thrust, Wheeler Ridge, California, in Structural Geology of Fold and Thrust Belts, S. Mitra and G. Fisher (Eds.) John Hopkins University Press, Baltimore, 3–28.

Earthquakes of moderate to large magnitude commonly produce permanent deformation of the ground surface.
(Usually shown as PGD, Fling, Heave, Co-seismic deformation)
Common displacement features include open cracks and fissures, various combinations of horizontal and vertical dislocations across surface fractures or zones of shearing, and buckling or heaving of the ground surface. Ground deformation features produced by an earthquake are highly localized and affect a small region when compared to the area affected by shaking. Nevertheless, even small amounts of ground displacement can be devastating to

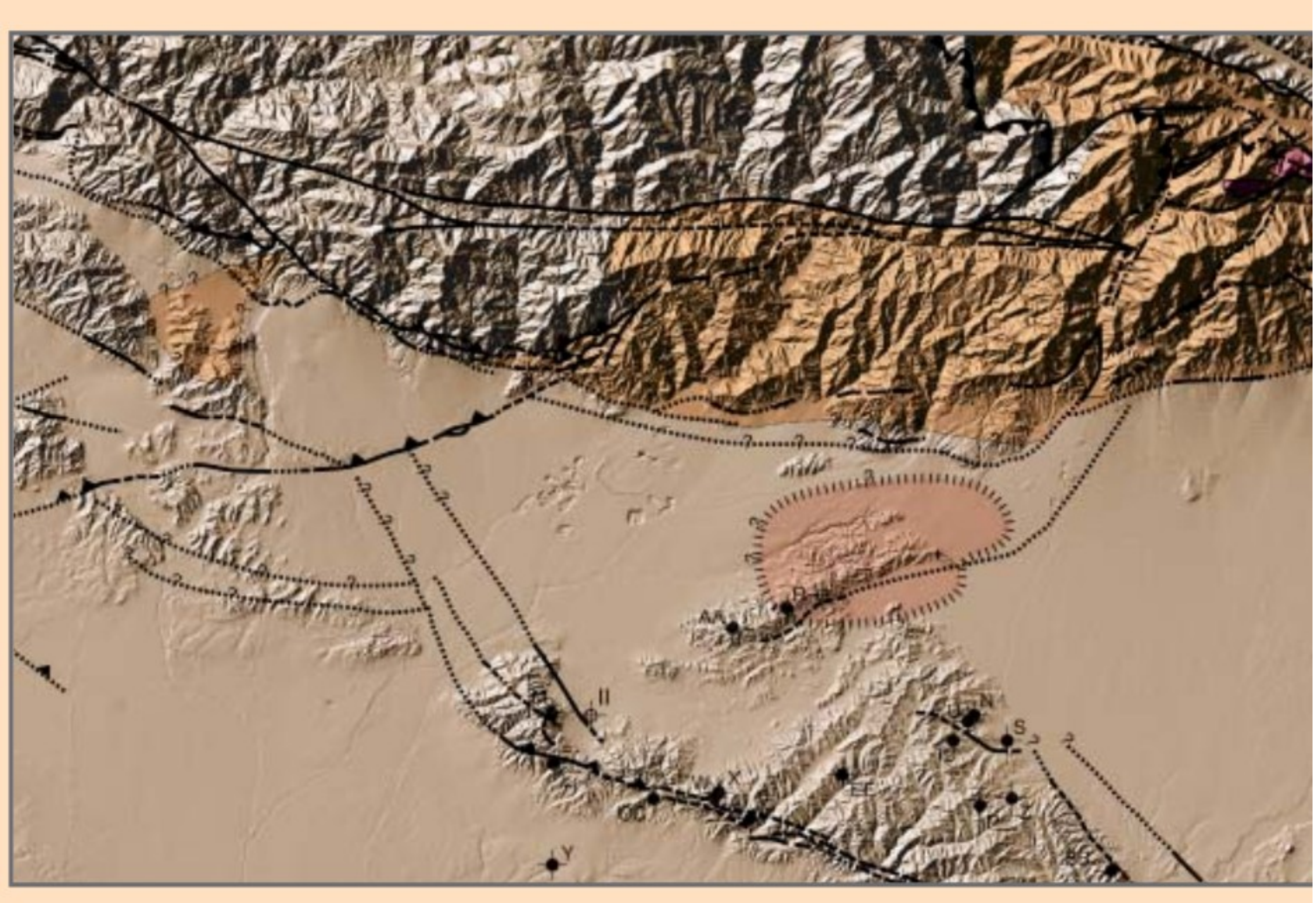
structures and **buried utility systems** and may produce significant casualties. Therefore, where ground deformation occurs, the impacts can significantly increase losses and damages from those produced by shaking alone.

http://scecinfo.usc.edu/research/special/SCEC001activefaultsLA.pdf
Whittier Narrows earthquake source fault. The fault-plane solution for the 1987 Whittier Narrows (Mainshock) earthquake showed a moderately dipping fault plane with an east-west strike (Hauksson and Jones, 1989). Re-leveling after the earthquake showed an uplifted area extending from the Santa Fe Springs anticline northward across the intervening La Habra syncline to the Montebello anticline (Lin and Stein, 1989). Shaw and Shearer (1999) relocated the mainshock and aftershocks of the earthquake, illuminating a fault plane dipping about 25° north, a dip consistent with fault-plane reflections on a seismic profile west of the crest of the Santa Fe Springs anticline between -3 and -7 km below sea level.
The fault tip is located beneath the south side of the Santa Fe Springs anticline based on a trishear kinematic model (Allmendinger and Shaw, 2000). (Near Bellflower)
The long-term slip rate was estimated as 0.5 to 2.0 mm/yr, with the faster limit based on GPS evidence (Argus et al., 1999); a minimum long-term slip rate is 0.5-0.9 mm/yr (Shaw et al., 2000).
High-resolution seismic profiles across the updip projection of the active axial surface between the Santa Fe Springs anticline and low-dipping strata to the south provide structural data within 15 m of the surface, with south dips of 20° to 25° north of the axial surface and horizontal dips to the south (Williams et al., 2000; Christofferson et al., 2000 and in prep.).
If these dipping sediments can be dated through borehole traverses and trench excavations, a short-term slip rate could be calculated.
The fault is part of the Puente Hills thrust of Shaw and Shearer (1999), with the Santa Fe Springs segment stepped to the right from their Los Angeles segment farther west. The cloud of aftershocks of the 1987 earthquake is limited to the Santa Fe Springs segment (Hauksson and Jones, 1989).

The Montebello anticline to the north is a separate structure from the Las Cienegas, Elysian Park, or Santa Fe Springs structure. How do co-seismic effects affect the project, distribution system, pipelines, tanks, pumping stations?

Third Major Hazard is the Whittier-Elsinore fault system.

Shown here from the cover of USGS Paper “Mt Meadows Dacite”
The bend location is exactly not known and could be further out in Whittier Narrows
But it is somewhere near the Central Basins Pico Rivera Project and definitely crosses the Central Basins recycled water Pipeline and the districts discharge/ replenishment pipelines and sewer outfall pipelines. It is adjacent to the Whittier Narrows reclamation plant along the Rio Hondo
Bullard and Lettis (1993) branch could be one of the lines heading West
One of the Westward lines could be the tip of the Upper Elysian Park fault
Also sometimes called the Monterey Park Fault
The shorter line parallel to Whittier is the Workman Hill fault and the longer parallel is the Whittier Heights Fault. Handorf Fault is not shown,
Montebello fault not shown- it runs in the Montebello hills below the two parallel faults to the W of Whittier.
Notice how Whittier-Elsinore (as the Alhambra Wash Fault terminates the Elysian Park system on the East. (not a minor local falt)



McCulloh and Larry Beyers Mt Meadows Dacite (cover is close to what I think fault traces are)

McCulloh USGS PP1669 Figure 1 note Whittier W and East Montebello EM

note San Jose Fault running through the pink hashed circle

San Jose effects Pomona and San Jose, near fault and directivity effects

Coming in from the Lower Right is the Chino branch of Whittier Elsinore which affect Pomona- use data for Whittier-Elsinore

CalTrans 710 project
“Based on our review of data collected during this study (in particular seismic reflection lines Z4-G2 and Z5-G2, see Appendix C.2), the buried trace of the Alhambra Wash fault (AWF) likely trends northwest through the western portions of Zones 4 and 5.
Extensive fault trench investigations by Gath et al. (1994), Ehlig (1999), Schell and Hushmand (2002) revealed faults generally dipping to the northeast, with the northeast side down (normal separation).
Gath et al. (1994) postulated that the fractures in their trenches were due to three or four fault rupture events in latest Quaternary time with the latest event occurring about 1,000 years ago.
The (AWF) fault appears to have right-lateral, normal oblique slip with a lateral slip rate of about 0.1 to 0.2 mm/yr and a vertical slip rate of about 0.8 mm/yr (Gath et al., 1994).
Although there is no compelling direct geological evidence, several investigators have considered the fault to project to the northwest approximately coincident with the Alhambra Wash, which originates in the Raymond Hill region of South Pasadena.
Tan (MAP-2000b) shows several short, widely scattered fault segments extending northwesterly into the City of Alhambra.
Dibblee considers the fault to be an extension of the Workman Hill fault and infers the fault to continue northwesterly well beyond Valley Boulevard into the city of Alhambra
(Many older maps show this (example: from Wright, 1991 and earlier))

“Contours of the historically highest groundwater in the southwest San Gabriel valley change direction quite abruptly at the northwesterly projection of the Alhambra Wash fault (CDMG, 1998b) suggesting that the fault forms a groundwater barrier in Quaternary-age sediments. T
The edge of the groundwater barrier extends beyond I-10 approximately to Mission Road in central Alhambra. “ (There is a clear trend of elevation separations for example along New ave north of Valley blvd where one can look east over the homes below)
“Seismic reflection lines Z4-G2 and Z5-G2 from this investigation across the fault projection appear to have revealed faults within Quaternary sediments in line with the northwesterly projection
(see Sections 10 and 11 and Plate 2). “
Elsewhere it is stated that AWF breaks in conjunction with Whittier-Elsinore so could have a much larger event than a local break on AWF alone
There are no oil wells along the AWF NNW of the East Montebello Fault segment of Whittier-Elsinore, (cited by Bob Yeats)
Yeats writes
http://scecinfo.usc.edu/research/special/SCEC001activefaultsLA.pdf Pg 25

“At the Whittier Narrows of the San Gabriel River, the Whittier fault turns more northerly to become the East Montebello fault. At Alhambra Wash in Rosemead, Gath et al. (1994) and Gath and Gonzalez (1995) trenched a strand of the East Montebello fault (here AWF) and found a slip rate of only 0.2 +/- 0.1 mm/yr;
a second, larger scarp to the west was not investigated. “ (This is the scarp cited by Bullard and Lettis starting just north of the San Gabriel river bridge over the Rio Hondo), this fault may also be the repository of “missing slip”) “**((and may continue s the “Highland Park fault”))**

Active Faults in the Los Angeles Metropolitan Region

Southern California Earthquake Center Group C* Robert S. Yeats (compiler)

“This suggests a lower slip rate than that measured at Olinda Creek, which could be accounted for by growth of the Montebello anticline, which is truncated on the east by the East Montebello fault.
The Montebello anticline was not uplifted separately from the Santa Fe Springs anticline during the 1987 Whittier Narrows earthquake (Lin and Stein, 1989), suggesting that its uplift history is controlled by strike slip on the Whittier fault instead of (or in addition to) reverse slip on the blind Santa Fe Springs segment of the Puente Hills thrust “ (we prefer “in addition to” and attribute uplift to the Montebello thrust of Shaw, Whittier being much older than the uplift or the PHT)

It is important to remember that the larger than AWF scarf of Bullard and Lettis is still unexplored.

Prospects for Larger or More Frequent Earthquakes in the Los Angeles Metropolitan Region
Dolan Sieh, Rockwell, Yeats, Shaw, Suppe, Huftile, Gath Sci Vol 267 13 Jan 1995 P203
“Similarly, paleo-seismologic data from the Whittier fault suggest that this fault has ruptured in combination with other faults in the past. These data reveal a recurrence interval of approximately 1700 years for surface-rupturing earthquakes, considerably longer than the repeat time that we calculate for a Mw 7.1 earthquake generated by rupture of only the Whittier fault. -
Either the Northern Elsinore fault or the Elysian Park blind thrust
T Rockwell, 1988,, E Gath 1992

All these separate seismic hazards can produce liquefaction and strong shaking landslides however Whittier can produce a wide area of fissures through and under the dam and pipelines .
- Tectonic deformation
Tectonic deformation is highly localized along the surface fault trace or along the surface projection of the fault.
Shakeout p48
Tectonic deformation produces direct movement along the earthquake fault, and this displacement can reach the surface as the fault rupture propagates from depth.
Even where the fault rupture does not reach all the way to the surface, faulting to shallow depths can cause strain concentrations that result in fissures or buckling of the ground surface.
Tectonic deformation is highly localized along the surface fault trace or along the surface projection of the fault.
Fault rupture that breaks through to the surface is commonly referred to as primary surface faulting...”
Whittier can produce primary surface faulting
we estimate oblique faulting 1 foot vertical for 3 feet horizontal.
We **think shortening of SGV N-S (which causes PHT) squeezes and locks Whittier resulting in longer repeat times but stronger events)**

“...(The) modern Whittier fault reactivated a Miocene normal fault with the north side down “(Yeats and Beall, 1991; Bjorklund and Burke, in review). McCulloh et al. (2000) (Yeats was on Tom Bjorklunds committee)

Bjorklund, Tom, Burke, Kevin, Zhou, Hua-Wei, and Yeats, R. S., 2002, Miocene rifting in the Los Angeles basin; evidence from the Puente Hills half-graben, volcanic rocks, and P-wave tomography: Geology, v. 30, p. 451-454

see also: Yeats Tectonics of the San Gabriel Valley

CalTrans Geophysical is here

http://libraryarchives.metro.net/DPGTL/710_Tunnel/SR-710_Vol_3_Appendix_C2_Seismic_Reflection_Data.pdf

look for

Z4-G2 Huntington Drive (SW/O N. Granada Ave.) Alhambra Alhambra Wash Fault

Z5-G2 East Shorb Street (E/O S. Hildalgo St.) Alhambra Alhambra Wash Fault

http://www.dot.ca.gov/dist07/710study/pdfs/Section%2016-2%20SR-710%20Tunnel%20Draft%20Geotechnical%20Summary%20Report-19-2%20pg8.pdf

shows trace In South Pasadena approaching Raymond Hill fault

but compare with

http://www.dot.ca.gov/dist07/710study/pdfs/SC%20Mtg4%20Presentation%20Part2.pdf

starting pdf pg 15 marked 35 on Document where Alhambra wash is a water barrier

both show their line of investigation Z4-G2 horizontal in purple parallel to Huntington Drive but this one no dots for fault trace

The Fourth Hazard is the Upper Elysian Park Thrust Fault (UEP)
The Whittier Fault (here as AWF)controls (terminates) the East side of the Elysian Park Thrust in Rosemead and San Gabriel
More evidence along with the control of the Montebello Oil Field that Whittier-Elsinore is not a minor local fault- It is Seismogenic- (goes way deep)

https://www.montereypark.ca.gov/DocumentCenter/View/1070/Figure-SCS-2?bidId=

shows the location of the Upper Elysian Park Thrust (with diagonal lines over Monterey Park)

UEP can be compared with Northridge and can generate a Northridge type event
see ; Oskin et al., 2000 and Oskin's CalTech thesis (online at CalTech) see also Bullard and Lettis, 1993
Parameters
Projects are not directly above the UEP so no "Hanging Wall" Parameter needed
It is however "near fault"
it slopes down to the north as does the Puente Hills thrust
it has "upslope" directivity- TOWARD "sensitive receptors"
(Northridge had downslope directivity AWAY from "sensitive receptors")
Hazard to the project is certainly the San Districts Whittier Narrows Plant and the Water Tanks on the North End of Lincoln Ave and all the water infrastructure in Rosemead
(like the Monterey Park , Montebello, and San Gabriel Valley Water Company tanks and wells).
The shaking will be directed directly at the Montebello Hills and the Central Basins Recycling Project, and the San District's Whittier Narrows Plant.

The CGS, following the lead of Oskin et al. (2000), models the Upper Elysian Park Thrust as a feature about 11 miles (18 kilometers) long and dipping 50 degrees northeasterly with a slip rate estimate of approximately 1.3 ± 0.4 mm/yr. (Cal Trans 710 description)

http://www.dot.ca.gov/dist07/710study/pdfs/Section%204%20SR-710%20Tunnel%20Draft%20Geotechnical%20Summary%20Report-6.pdf

http://www.dot.ca.gov/dist07/710study/pdfs/Section%2011%20SR-710%20Tunnel%20Draft%20Geotechnical%20Summary%20Report-14.pdf p11-3

http://www.dot.ca.gov/dist07/resources/envdocs/docs/710study/draft_eir-eis/Geologic%20Hazard%20Evaluation/SR%20710%20Geologic%20Hazard%20Evaluation.pdf

Here is a later version from Dec 2012

Appendix T Geotechnical Study technical Memorandum from Alternatives Analysis report

http://www.dot.ca.gov/dist07/resources/envdocs/docs/710study/docs/appendices/Appendix%20T%20Geotechnical%20Study%20Technical%20Memorandum.pdf

AWF..."**it likely ruptures in larger events with the Whittier fault."**

Illustration 4-1 shows the upper fault tip of the UEP along Potrero Grande Syncline between Repetto Hills and the Montebello Hills and terminating on the Alhambra Wash Fault Segment of Whittier-Elsinore

Shaw and Suppe (1996) estimated earthquake magnitudes associated with these thrust faults ranging from 6.6 to 7.3, with recurrence intervals in the 340 to 1,000 years range. (updated by Oskin 2000)

Active parasitic folds on the Elysian Park anticline: Implications for seismic hazard in Central Los Angeles, California

Geological Society of America Bulletin 112(5):693-707 · May 2000

“the Elysian Park fault could produce a nominal M 6.2 w to 6.7 earthquake every 500 to 1300 yr, on average. Although this Elysian Park earth quake would recur infrequently, its size and recurrence interval may be similar to those estimated for the sources of the destructive 1971 San Fernando and 1994 Northridge earthquakes. “

LA Convention center EIR
“The Upper Elysian Park Blind Thrust is a blind thrust fault that overlies the Los Angeles and Santa Fe Springs segments of the Puente Hills Blind Thrust.
The eastern edge of the Upper Elysian Park Blind Thrust is defined by the northwest-trending Whittier Fault. “

https://phys.org/news/2005-05-los-angeles-big-straining-earthquake.html Thrust Faults

Three-dimensional simulation of earthquakes on the Los Angeles fault system

Kim B. Olsen and Ralph J. Archuleta
http://www.bssaonline.org/content/86/3/575.short Elysian Park fault

There is no question that Whitter-Elsinore-EMB-AWF runs somewhere under the Dam and across Whittier Narrows. Where.? What infrastructure does it cut?

Whittier-Elsinore "controls" the Eastward limits of the East Montebello Oil field and is called the East Montebello Fault in Oil Field literature (and by Yeats)- same fault also called the Alhambra Wash Fault to the NNE where it controls the Eastern edge of the Upper Elysian Park Thrust.

Analysis of Well cores and electric logs in the East Montebello Oil Field can be used and Geophysics.
Then maybe some deep borings.
Recall that the Miocene Whittier fault had / has thousands of feet of vertical separation, geology on each side is quite different.

Gath and Gonzales Trenched Whittier both NNE of the Dam in Rosemead and SE of the Dam in Whittier's Turnbull canyon (as well as Brea, Olinda, and elsewhere).
The two closest investigations to the projects

In Rosemead the fault (with two subsequent investigations) was found to be around 100 feet wide in the alluvium
The unanswered question is how a 100-150 foot wide disturbance would affect the dam and adjacent projects.
Writing of the 1987 "Whittier" aftershock
"**Its focal mechanism defines a northwest trending, steeply southwest dipping fault plane characterized by right lateral strike-slip ruptur [Hauksson and Jones, 1989"]]**
The trend of aftershcocks associated with this event is nearly coincident with the northwest trending escarpment Bullard and Lettis 1993 pg8367

Remember that PHT and Whittier intersect all along the Whittier Trace in the Whittier Narrows.

Whittier can be compared with Landers as to strike-slip hazard and near fault effects.
Wheras 20 years ago East Montebello and Alhambra Wash were considered minor local faults that has been proven not to be the case.
Minor local faults do not controll major thrust faults , anticlines, and miles of oil fields.
Whittier is Seismogenic

Another complication with Right lateral (destral) Whittier is that it bends from the Axis along the front of the Puente Hills to the Axis of the Alhambra Wash (or an axis along the large scarp of Bullard and Lettis pointed to the Freemont Ave -10 freeway area))
This bend must be somewhere in Whittier Narrows- but where? Under the Dam?, Under the Central basins Pico Rivera Project?, near or under their recycled water Pumping plant?

There could be pull apart structue- releasing bend pull apart basin, sag ponds

There could be Flower Structures , Psalms (reverse flower structue) or Tulips
There could be a Restraining bend (compression bend) with local uplift and thickened crust- Pressure ridges
Step overs, fissures
All CO-SEISMIC surface features would have been washed away by the river and/or be burried under more recent alluvium (800 feet thick under the damsite, deeper elsewhere, much deeper under San Jose and along San Gabriel River).

McCulloh and Beyer

aligns Whittier with Verdugo on each side of Raymond Figure 1 Mid -Tertiary Isopach and Lithofacies Map

We consider Alhambra Wash to be the Minor branch starting in Rosemead (near 60 freewayx Rio Hondo river bridge) similar to the Chino/ Whittier branching- The much larger yet uninvestigated Bullard and Lettis branch to be the major branch

Rosemead has included both in their General Plan (Safety elemement by Tanya Gonzlez, Eartrh Consultants International Santa Ana CA; Maps from Ken Wilson- Wilson geototechnical Altadena CA

CalTrans 710 investigation summary

“ seismic-reflection data (line Z5-G2, Appendix C.2) with a much deeper zone of investigation revealed deformed Quaternary sediments along the projection of this fault. Therefore, it is assumed that the Alhambra Wash fault is projected to intersect Zone 5 San Marino-South Pasadena Area) and is considered to be active fault.

The potential for surface displacement on the Alhambra Wash fault is poorly known but unpublished work has confirmed multiple late Pleistocene to Holocene ruptures.

The maximum magnitude of an event on the Alhambra Wash fault could be about 6.25 if it ruptures separately, **but it likely ruptures in larger events with the Whittier fault. “**

The additional length from the old Whittier terminous is what caused the change to 7.5 and now 7.85

On the Upper Elysian Park Fault Oskin writes

“The Elysian Park anticline is structurally and physiographically separate from

adjacent structural and geomorphic domains (Fig. 9.2). The axis terminates at

both ends against surficially expressed, strike-slip (AWF/Whittier) and oblique-slip faults that cut

Quaternary alluvium (Fig. 9.3). The Alhambra Wash fault separates the southeastern

end of the Repetto Hills (Montebello Hills) from the Whittier Narrows, a topographic and structural

low point, where drainage from the north is constricted (Damsite) [Davis et al. , 1989].”

“The Los Angeles and San Gabriel Valley basins are separated by the (active) Whittier fault and an uplifted block of igneous and metamorphic rocks “(Yerkes, 1972).

Larry Beyer writes: http://certmapper.cr.usgs.gov/data/noga95/prov14/text/prov14.pdf
“The western play boundary is the approximate eastern extent of the structural imprint of the Santa Monica Fault System in the Neogene section.
From west to east, the northern play boundary is drawn just north of the Hollywood-Raymond Hill Fault Zones and slightly northeast of the East Montebello Fault and its northwest projection (Wright, 1991) that separates Wright's subsurface "Alhambra high" from the Elysian Park Anticline. “

http://pubs.usgs.gov/pp/1759/pp1759.pdf 2009 Fig 1 shows Whittier branches approaching Raymond

LARSE-1 Gary Fuis USGS Golden CO
The San Gabriel Valley basin reaches a maximum depth of 5 km (Fig. 2, B and C; see loose insert),;
2 km deeper than the estimate of Wright (1991).
One oil well penetrates granitoid basement (5.3–5.5km/s) at 3.7 km depth in the southern San Gabriel Valley (Fig. 2C; see loose insert).
Note that the steeply north dipping Whittier fault forms the south boundary of this basement block,
beneath the Puente Hills;the dip of the fault (708) is consistent with that seen in oil wells (Yerkes, 1972)

The San Gabriel River Channel/ Syncline is deeper under the Damsite and reclamation plants than assumed at construction giving more basin depth amplification

Larry Beyer (USGS Menlo Park) writes http://certmapper.cr.usgs.gov/data/noga95/prov14/text/prov14.pdf

The western play boundary is the approximate eastern extent of the structural imprint of the Santa Monica Fault System in the Neogene section.
From west to east, the northern play boundary is drawn just north of the Hollywood-Raymond Hill Fault Zones and

slightly northeast of the East Montebello Fault and its northwest projection (Wright, 1991) that separates Wright's subsurface "Alhambra high" from the Elysian Park Anticline.

http://pubs.usgs.gov/pp/1759/pp1759.pdf 2009 Fig 1 shows Whittier branches approaching Raymond
McCulloh, T. H., Beyer, L. A., and Enrico, R. J., 2000, Paleocene strata of the eastern Los Angeles basin, California; paleogeography and constraints on Neogene structural evolution:
Geological Society of America Bulletin, v. 112, p. 1155-1178

McCulloh and Beyer PP 1690 aligns Whittier with Verdugo on each side of Raymond
Figure 1 Mid -Tertiary Isopach and Lithofacies Map

Fig 5 MP is most likely now UEP of OSKIN 2000 but McCulloh and Beyer reference Oskin but shed no light on the two faults one with ???
Fig 5 does show termination of the two faults against W

"Although ground motion characteristics due to near fault effects and rupture directivity have not been incorporated into the USGS PSHA studies inspection of the M-R plots and tables will help to identify situations where these effects should be included in seismic analysis."

https://theses.lib.vt.edu/theses/available/etd-219182249741411/unrestricted/Chp07.pdf

"Note that simplified ground motion amplification factors are commonly used during the early stages of analysis to facilitate preliminary assessment and screening.
They are not recommended for final analysis and design (Dickenson et al, 2002; Youd et al, 2000). "

Directivity, a phenomenon that produces enhanced ground motion (and in particular long-period motions) ahead of a propagating rupture also appears to play a role in controlling both the occurrence and severity of liquefaction-related ground failures,
as observed in the 1989 Loma Prieta, 1994 Northridge, and 2003 San Simeon earthquakes
(Holzer, 1998; Holzer and others, 1999; Holzer and others, 2005).
T. L. Holzer Tom tholzer@usgs.gov

Dr Lucy Jones has stated that Duration is extremely important

Terrashake vs NGA (Next generation attenuation used in CBC)

	PGV, TS2.1 (cm=sec)			PGV, C&B 06 AR (cm=sec)			
Terra Shake simulation	2.1	2.2	2.3	**Median**	16% POE	2% POE	0.13% POE
L3 Wave-guide maximum	**104**	**105**	36	**20**	33	58	95

In particular, the very localized extremes in PGV predicted near Whittier–Narrows, (water supply, dam, flooding from Santa Fe Dam) due to focusing of channeled waves,

are up to a **factor of 5 above the median prediction** of the current generation of ARS (attenuation relationships erg NGA, USGS, CBC) (median 20 compared to 104, 105 above)

The mean 3s-SA for ShakeOut-D is between two and three σs above the CB08 median (i.e. between the 0.1–0.2% and 2% probability of exceedance, POE) at WN near the junction between Los Angeles and San Gabriel basins and at the deep basin site Downey.

USGS participants pointed out that ground motion values based on 3-D simulation models could result in additional significant change from the current USGS/CGS map values.

site-specific criteria of Section 11.4.7 are contained in Proposal PUC IT11-008.

Potentially

Non-conservative

– When peak MCER
response spectral velocity occurs at periods greater than 1.0s for the site of interest
(erg, soil sites whose seismic hazard is dominated by large magnitude events)

The presentation discusses reasons why the traditional
site amplification factors for softer soils at the longer period ranges are UN-conservative
and justifies the use of site specific analysis to address this
J Stewart v (UCLA)

ShakeOut Scenario Appendix B:

Factors for Correcting Ground Motions at Large Distance from Empirical Models to be Compatible with Simulated Motions

By Lisa M. Star and Jonathan P. Stewart

https://pubs.usgs.gov/of/2008/1150/appendixes/of2008-1150_appendix_b.pdf

(much new in this area since 2008)

see end of document for additional

Liquefaction

Shakeout p 49
The second type of earthquake-induced permanent ground deformation is ground failure, a secondary effect of earthquake ground motions that occurs where shaking is sufficiently strong to cause masses of earth material to move under the influence of gravitational forces as well as inertial forces from the earthquake shaking.
The two principal kinds of earthquake ground failure mechanisms are landsliding and liquefaction.

Liquefaction occurs where strong ground motions produce a rise in pore-water pressures that in turn causes granular material to briefly lose strength and liquefy. This can lead to settlement and a special type of earthquake-induced landslide known as a lateral spread.
The likelihood that an earthquake-induced ground failure will occur at any given location depends on the intensity of ground shaking and the overall susceptibility of near-surface materials at that location. “

All Four Fault Hazards can produce ground failure, landslides, and liquefaction.

Current Liquefaction analysis mixes duration with distance and magnitude instead on analyzing with individual factors.

“The soil's CRR is dependent on the duration of shaking (which is expressed through an earthquake magnitude scaling factor, MSF) and effective overburden stress (expressed through a K□ factor). “

Cetin, K. O., and Bilge, H. T. (2012). "Performance-based assessment of magnitude (duration) scaling factors."
Journal of Geotechnical and Geoenvironmental Engineering, ASCE, 138: 324-334.

There needs to be a method to analyise magnitude and duration for strong distant events especially where wave guides and basin amplification must be considered
So to get past the Magnitude scaling factor maybe velocity based analysis or another method is needed

At the end of Casablanca Captain Louis Renault said
“Round up the usual suspects”
perhaps the following could help in the liquefaction analysis for the project

Robb Moss Cal Poly SLO rmoss@calpoly.edu
Ray Seed UC Berkeley seed@ce.berkeley.edu
Tadahiro Kishida UC Berkeley (Equivalent Cycles)

Jonathan Bray UC Berkeley
Robert Kayen USGS Menlo Park-Monterey UCLA
Jonathan Stewart UCLA
Boulanger and Idriss at UC Davis rwboulanger at ucdavis.edu
T L Youd BYU
S L Kramer U of Washington kramer@uw.edu
R D Andrus Clemson U
T.D. O'Rourke 607 255 6470 Cornell University TDO1@cornell.edu

http://www.oregon.gov/odot/hwy/bridge/docs/bddm/pdfs/psha.pdf
"The evaluation of liquefaction triggering and ground deformation is more involved than most seismic analysis in that both the intensity and the duration of the ground motions are needed. "

"The Magnitude Scaling Factor (MSF) used in the procedure relates the relative duration of earthquake motions as a function of magnitude"
This may not be appropriate for distant sources that are larger than the would appear to distance-magnitude approaches.

For the dam the hazard is dominated by multiple events liquefaction hazard evaluations should be conducted for all predominant M-R combinations

Kayen, R., Moss, R. E. S., Thompson, E. M., Seed, R. B., Cetin, K. O., Kiureghian, A. D., Tanaka, Y., & Tokimatsu, K. (2013).
Shear-Wave Velocity–Based Probabilistic and Deterministic Assessment of Seismic Soil Liquefaction Potential.
Journal of Geotechnical and GeoenvironmentalEngineering, 139(3), 407-419

Shakeout p 59
"Expected Deformation Due to Liquefaction
During liquefaction, formerly solid ground is transformed temporarily to a softened or liquefied state that can no longer support the built environment. Effects of liquefaction commonly are observed following moderate to great earthquakes throughout the world and can produce significant damage (fig. 3-24) over and beyond what might be expected from ground shaking alone.

The occurrence of liquefaction during a specific earthquake is restricted chiefly to certain geologic and hydrologic settings that experience relatively high levels of ground shaking.
In general, areas susceptible to liquefaction are underlain by water-saturated, cohesionless granular sediment within less than 50 feet of the ground surface."
However Whittier-Elsinore can rend the ground down through the bedrock
"Four types of ground failure commonly result from liquefaction. These are: 1)

lateral spread, 2) ground oscillation, 3) loss of bearing strength, and 4) flow failure."
Flow failure is not expected in Whittier Narrows
"Table 3-5 shows that River channel Despositional Environment Liquefaction Susceptibility is Very High to High throughout recent and Holocene deposits"
Youd and Perkins, 1978

Liquefaction methodologies changed ca 2014 and may have changed again.
As stated earlier long distance/ long period evaluation needs some site specific analysis

Landslide analysis must use dynamic analysis not just static or pseudo-static
Landslide analysis must consider the long-period, long duration of the Southern San Andres as well as the severe but shorter duration shaking from the other three faults.

Groundwater- Recycled Water

Identifying possible vulnerabilities of infrastructure, especially due to interactions among systems that are usually considered separately

Theft of Groundwater in the Whittier Narrows

https://www.highlandnews.net/.../lawsuit...san-gabriel-valley-water-company.../articl...

https://www.fontanaheraldnews.com/news/lawsuit-is-filed-against-fontana-water-company/article_c489362b-9f1e-5792-8962-570dd182056c.html

https://www.sbsun.com/2014/11/05/cucamonga-valley-water-district-surfaces-as-new-defendant-in-water-pumping-lawsuit/

http://sbcsentinel.com/2015/03/judge-cuts-fontana-water-company-off-from-access-to-rialto-colton-water-basin/
"Nobody is exempt from the drought and Fontana Water Company can no longer take everyone else's water in violation of established water rights agreements."

Montebello, Sale of the Montebello Water System Measure, Measure ...

https://ballotpedia.org/Montebello,_Sale_of_the_Montebello_Water_System_Measu...

A no vote was a vote against selling the Montebello Water System to *San Gabriel Valley Water Company*, maintaining city ownership of the system.
San Gabriel Valley Water Company wishes to obtain Montebello Water Companies Water Rights and some infrastructure- they certainly do not plan on upgrading the customers infrastructure which suffers from years of deferred maintenance and underfunding by the City.

https://www.rkmlaw.net/.../Contaminated-Groundwater-in-San-Gabriel-Valley-Poses...
https://caselaw.findlaw.com/ca-court-of-appeal/1402695.html

Recycled Water
https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/orders/1990/wro90-01.pdf

Water System, Distribution, Wells, and Tanks in Whittier Narrows are extremely vulnerable
AFIK there is no map or compilation (except ours) of the non-ductile-brittle pipelines in the Whittier Narrows must be required as failures impact the waters of the United States
https://pubs.usgs.gov/of/2008/1150/
pg 7

replacement of cast iron pipes mean that many utilities will be able to restore function much more quickly after the earthquake.

*Pipes of concrete a*nd iron are brittle and break in many places in an 7+ earthquake. The number of pipe breaks will be large enough that recreating the water system will be necessary in the hardest hit areas. Because this earthquake affects such a large area, there will not be enough pipe and connectors or trained manpower to repair all the breaks quickly. The worst hit areas may not have water in the taps for 6 months.
This damage to the water system will also greatly increase the problems in fighting the fires that will follow the earthquake. The cost to repair water and sewer lines will be $1 billion.

Pg 11
The ShakeOut Scenario also found that previous efforts to reduce
losses through mitigation before the event have been successful.
There are dozens more actions and policies that could be undertaken at the individual and community levels to further reduce these losses.

For instance, actions to improve the resiliency of our water delivery system would reduce the loss from business interruption, as well as reduce the risk of catastrophic conflagrations

pg 14
Many buildings and other structures that were able to withstand the 7 to 15 seconds of shaking during the Northridge earthquake, will not withstand the nearly 2 minutes of shaking in an earthquake the size of that in the ShakeOut Scenario

Sewers and Water treatment Plants

“It is posited that damage to sewer pipelines and equipment at wastewater treatment plants throughout the study area results in five to ten million gallons per hour of untreated sewage spilling onto streets in 50 to 100 locations throughout the study region. Although sanitation districts attempt to relieve flow by routing untreated sewage directly to the ocean through dedicated pipelines, most or all water treatment plants are forced to dump untreated, raw sewage into nearby creeks (which flow by gravity to the ocean), “ shakeout p 132

WE consider all the reclamation plants in Whittier Narrows extremely vulnerable as well as all non ductile sewer and storm drains.
Presenting a major hazard to the waters of the United States
Advocate seismic evaluation of critical (structures) , equipment,
and pipelines.

Worldwide, buried pipelines have been damaged by earthquake shaking and by permanent ground deformation, which can include fault rupture, earthquake-induced landslides, and liquefaction with associated lateral spreading or settlement. P147
With widespread damage to water conveyance systems, the effort to find and repair the numerous individual leaks in many places is so slow and expensive a process that it is cheaper and faster replace the entire system. P150 (however material is not available)

If regulatory and water quality issues can be resolved, consider filling up groundwater basins for earthquake recovery purposes.
Caveats: would need to provide on-site power for pumps; p 150

Whittier Narrows ground water is at historic lows due to unrestricted over pumping by Water Companies-- see below

Shake Out Scenario Appendix C 2008
: Characteristics of Earthquake-Induced Permanent Ground Deformation and Examples from Past Earthquakes
https://pubs.usgs.gov/of/2008/1150/appendixes/of2008-1150_appendix_c.pdf

ARKSTORM, HYDROLOGY, FLOODING

ARkStorm: California's Other "Big One" - USGS Sound Waves

https://soundwaves.usgs.gov/2011/01/research2.html

https://www.esrl.noaa.gov/research/review/2010/posters/4-12-Cox.pdf *https://snowbrains.com/noaa-what-are-atmospheric-rivers-in-more-scientific-terms/*

*Stockpile materials on-site th*at will be needed to make repairs quickly; develop a plan for repairs

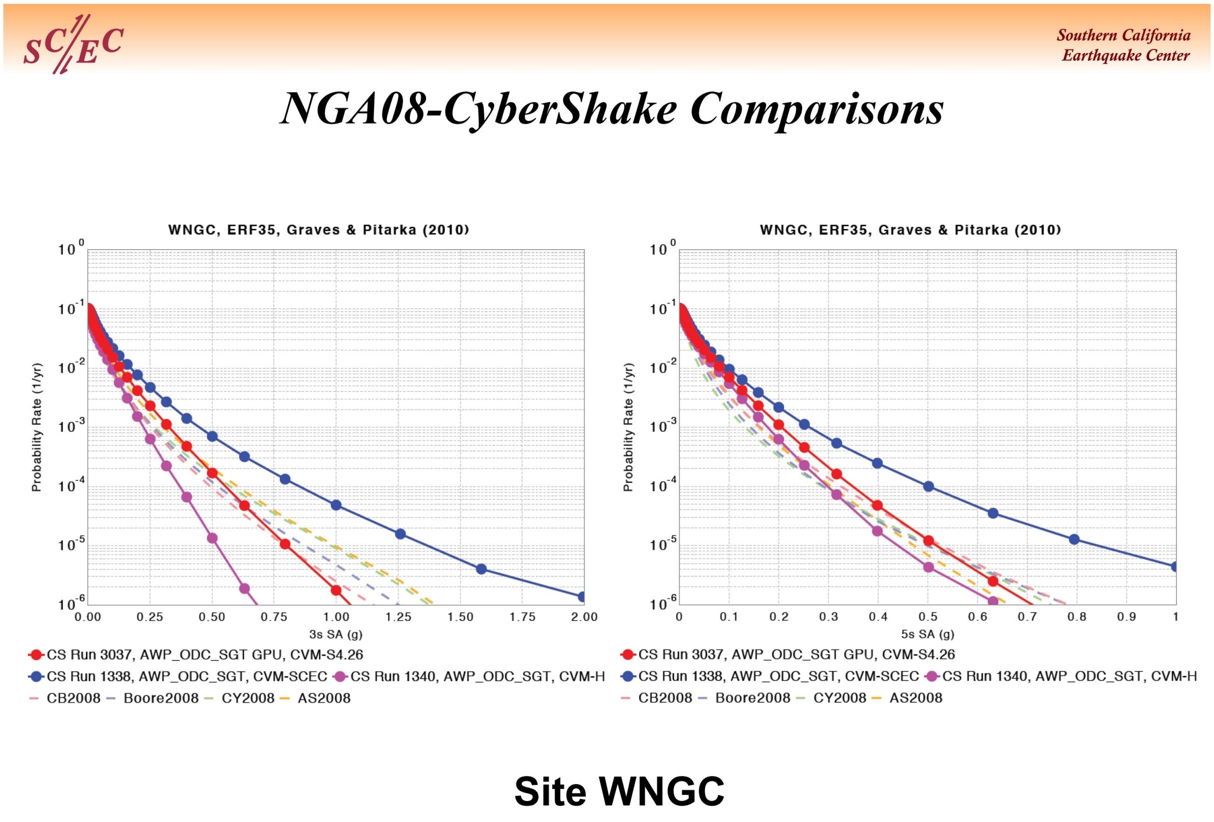
'You can pay me now, or you can pay me later..

Ken Hudnut USGS SoSafe Project

http://www.caltech-era.org/pdf/May07Presentations/HudnutScenarioOverview.pdf

Highways in the ACOE Whittier Narrows area
We expect the 10 and 60 freeways and SR 19 to fail as well as local bridges.
"Highway segments affected by bridge damage are located in ...the vicinity of Baldwin Park along the I-210, I-10, I-605, and California Highway 60" Shakeout p 117

Site WNGC or Whittier Narrows Golf Course is actually near 60 frwy SR19 interchange.
This is a 2014 comparison of Next Generation Attenuation 2008 vs 2014 SCEC Cybershake Simulation
Left is 3 second Spectral Acceleration in g
Right is 5 second
Blue shows Basin Modeling and use of the Community Velocity Model to refine results
I'm sure the Cybershake team has newer results and could give data along the dam
The building code/ USGS map method leaves much to be desired
IDK if Cybershake includes directivity and other refinements but certainly a better start than simple distance-magnitude relationships



Southern California
Earthquake Center

NGA08-CyberShake Comparisons

Site WNGC

Hazard-curves-derived-from -different-methods-WNGC

pink C&B 2008
Green Chiou & Youngs 2008
Orange Abrahamson & Silva 2008
Lt Blue Boore & Atkinson 2008

WNGC (Whittier Narrows)	

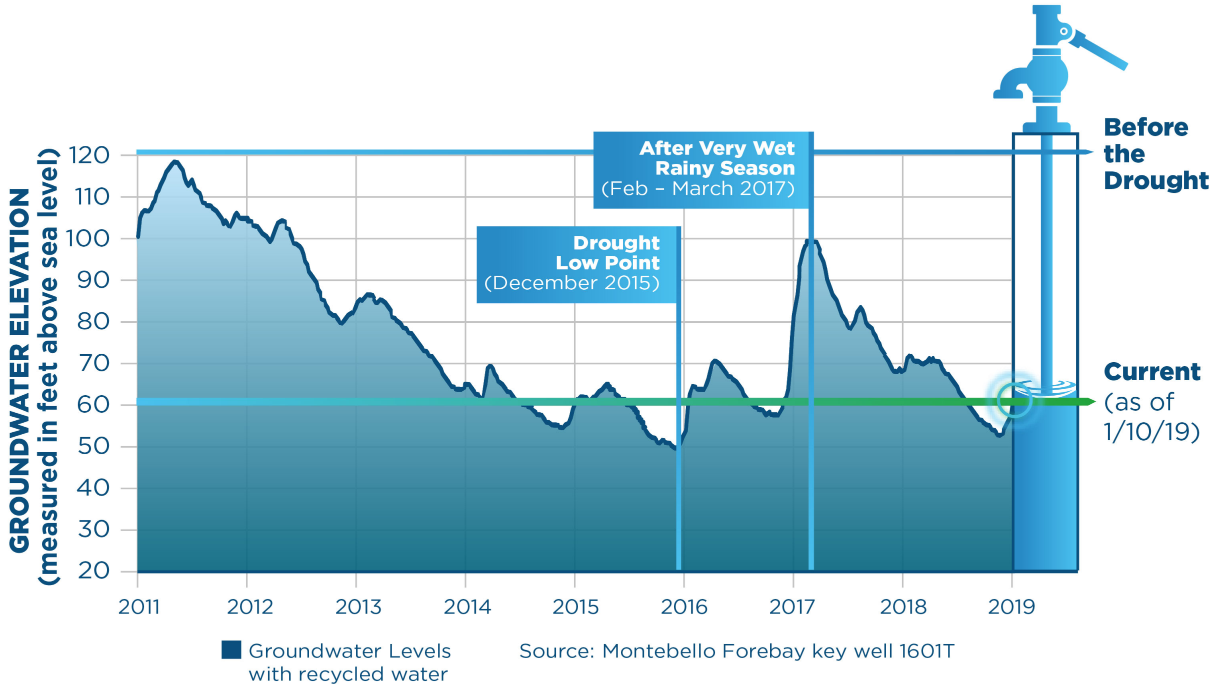
Dark Blue is Cybershake ca 2014 3second SA g. horizontal-- probability rate Vertical

5- 10 second SA should also be considered for Whitier Narrows Dam Analysis
NGA 2 has been out for some time now difference with Prediction equation equations is greater at longer periods
WNGC is the site of the Terrashake seismogram shown at the top of these pages and is used as a control for most simulations-Coupling of basin and directivity, located in "wave guide"
Note that TERRASHAKE is Deterministic and Cybershake is Probabilistic- Compare
Terrashake data is available from Olsen and Day at CSUSD (San Diego State) or through Robert Graves at USGS Pasadena or Dr. Lucy Jones

Day, S. M., et al., Model for Basin Effects on Long-Period Response Spectra in Southern California; Pacific Earthquake Engineering Research (PEER) Center Lifelines Program (Tasks 1A01, 1A02, and 1A03), the NSF/SCEC Community Modeling Environment Project (Grant EAR-0122464; Cooperative Agreement EAR-0106924 and USGS Cooperative Agreement 02HQAG0008, published by SCEC paper 1101.

Cummulative effects of the project must be considered
Raising Lincoln blvd 15 feet- how does this affect the recycled water pipeline?, other pipelines, storm drains, sewers, Whittier Narrows Plant?

UPDATE ON THE BASINS



Before the Drought

After Very Wet Rainy Season (Feb – March 2017)

Drought Low Point (December 2015)

Current (as of 1/10/19)

Source: Montebello Forebay key well 1601T

https://www.wrd.org/sites/pr/files/WRD_ESR_Report_March_3_2016_Final_For_Web.pdf

https://www.wrd.org/content/albert-robles-center-water-recycling-environmental-learning

County of Los Angeles, Department of Public Works, Land Development Division, Stormwater Best Management Practice Design and Maintenance Manual, dated 2009.
http://dpw.lacounty.gov/ldd/publications/Stormwater BMP Design and Maintenance Manual.pdf

https://dpw.lacounty.gov/ldd/lib/fp/Hydrology/Low%20Impact%20Development%20Standards%20Manual.pdf

Graywater
https://dpw.lacounty.gov/wwd/web/Documents/Graywater%20System.pdf

https://greywateraction.org/requirements-for-no-permit-systems-in-california/

Graywater is untreated waste water which has not come into contact with toilet waste. Graywater includes waste water from bathtubs, showers, bathroom wash basins, clothes washing machine, laundry tubs, or an equivalent discharge as defined by the Department of Public Health. It does not include wastewater from kitchen sinks, photo lab sinks, dishwashers, or laundry water from soiled diapers. LACOUNTY DPH

https://www.scpr.org/news/2015/07/15/53091/graywater-s-future-brightening-with-help-from-home/

This manual presents the requirements for geotechnical work for development projects within the County of Los Angeles (County). Many civil engineering projects require geotechnical investigations with input from both an engineering geologist and a geotechnical/ soils engineer.

Charles Nestle (Engineering Geology) at cnestle@dpw.lacounty.gov or (626) 458-4923, or to Brian Smith (Soils Engineering) at bsmith@dpw.lacounty.gov or (626) 458-4925.

REFERENCES Elysian Park Anticline

Elysian Park Thrust completely left out of Walmart EIR by Hushmand, GPI, DRC, Wildan, ARROYO

Reese, R.G., 1940, Montebello Area of the Montebello Oil Field, California Department of Natural Resources, Division of Mines, Bulletin No. 118, p.340-342, published in March 1943.

1961
Department of Water Resources, 1961, Planned utilization of ground water basins of the coastal plain of Los Angeles County: Department of Water Resources Bull. 104, Appendix A, Ground water geology.

1965
Yerkes, R.F., McCulloh, T.H., Schoellhamer, J.E., and Vedder, J.G., 1965, Geology of the Los Angeles basin, California__An introduction: U.S. Geol. Survey Prof. Paper 420-A. 57 p
Calls what he calls MP the Elysian Park (anticline) Fig 3
and second anticline N La Habra Sycline (22k deep) terminates N on Whittier-Elsinore A49-50

The Elysian Park anticline with its steep southwest flank is analogous, in many respects, to the faulted anticlinal ridge adjacentto the Whittier fault zone in the Puente Hills.
Figs 2 & 3 shows W crossing Rio Hondo

1966
Department of Water Resources, 1966, Planned utilization of ground water basins, San Gabriel Valley: Department of Water Resources Bull. 104-2, Appendix A, Geohydrology.

1970
Lamar, D. L., Geology of the Elysian Park-Repetto Hills area, Los Angeles County, California, California Division of Mines Special Report, 101 , 45, 1970
“**Numerous additional faults are mapped (Lamar, 1970) in the southwestern part of the study area, forming a complicated region of intersecting faults and fault-bounded blocks.**

The largest of these faults corresponds to the trace of the northwest-trending Highland Park fault. The Highland Park fault trends for approximately 6.5 miles from Monterey Park through Alhambra and El Sereno to Highland Park. “ comment by CalTrans in 710 study Highland Park may be connected to Bullard And Lettis 1993 in Monterey Park and thus to Whittier Elsinore in S Rosemead.

The Highland Park fault appears to terminate against the western continuation of the Raymond fault in the vicinity of York Boulevard. The Highland Park fault is not considered by the CGS (2002) and California Division of Mines and Geology (1977) as active. “
?was there a Miocene conntection? (before hills uplifted)?

Active Faults in the Los Angeles Metropolitan Region Southern California Earthquake Center Group
*James F. Dolan, Eldon M. Gath, Lisa B. Grant, Mark Legg, Scott Lindvall, Karl Mueller, Michael Oskin, Daniel F. Ponti, Charles M. Rubin, Thomas K. Rockwell, John H, Shaw, Jerome A. Treiman, Chris Walls, and Robert S. Yeats (compiler)
http://scecinfo.usc.edu/research/special/SCEC001activefaultsLA.pdf

1972
Yerkes, R.F., 1972, Geology and Oil Resources of the Western Puente Hills Area, Southern California, US Geological Survey Professional Paper 420-C.
“The Los Angeles and San Gabriel Valley basins are separated by the (active) Whittier fault and an uplifted block of igneous and metamorphic rocks (Yerkes, 1972).”

Wang, W. (1984). “Earthquake Damages to Earth Dams and Levees in Relation to Soil Liquefaction”.Proc., Int. Conf on Case Histories in Geotechnical Eng.(pp. 512-522). Rolla: University of Missouri = number of uniform cycles to reach 3% axial strain ;; cyclic softening

1987
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Levine, M.B., et al., 1988, Accelerograms Recorded at Cal Tech During the Whittier Narrows Earthquakes of October 1 and 4, 1987; a Preliminary Report; National Science Foundation Report No. EERL 88-01.

1989
Davis, T. L., J. Namson, and R. F. Yerkes (1989). A cross section of the Los Angeles area: seismically active fold-and-thrust belt, the 1987 Whittier Narrows Earthquake and earthquake hazard, J. Geophys. Res. 94, 9644–9664
cited as Davis et al. (July 10, 1989)
“The Alhambra Wash fault separates the southeastern end of the Repetto Hills from the Whittier Narrows, a topographic and structural low point, where drainage from the north is constricted .”

Researchers also believe that folds can grow suddenly during an earthquake event, rather than by steady progressive deformation (Hauksson, 1989).

Huang, M.J., et al., 1989, Processed Strong-Motion Data from the Whittier, California Earthquake of 1 October 1987; Strong Motion Instrumentations Program, Report No. OSMS 89-03.

Vidale, J.E., 1989, Influence of the Focal Mechanism on Peak Accelerations of Strong Motions of the Whittier Narrows, California, Earthquake and Aftershock, in Journal of Geophysical Research, Vol. 94, No. B7, Pages 9607-9613, July 10, 1989.

Lin, J. and Stein, R.S., 1989, Co-seismic Folding, Earthquake Recurrence, and the 1987 Source Mechanism at Whittier Narrows, Los Angeles Basin, California, in Journal of Geophysical Research, Vol. 94, No. B7, Pages 9614-9632, July 10, 1989
“The 1987 Whittier Narrows earthquake uplifted the 1.5 km high Quaternary Santa Monica Mountains (SMM) anticlinorium by 20 mm to a maximum of 50 mm”

Bent, A.L. and Helmberger, D.V., 1989, Source Complexity of the October 1, 1987, Whittier Narrows Earthquake, in Journal of Geophysical Research, Vol. 94, No. B7, Pages 95489556, July 10, 1989.

Bolt, B.A., Lomax A. and Uhrhammer, R.A., 1989, Analysis of Regional Broadband Recordings of the 1987 Whittier Narrows, California, Earthquake, in Journal of Geophysical Research, Vol. 94, No. B7, Pages 9557-9568, July 10, 1989.

Hauksson, E. and Jones, L.M., 1989, The 1987 Whittier Narrows Earthquake Sequence in Los Angeles, Southern California: Seismological and Tectonic Analysis, in Journal of Geophysical Research, Vol. 94, No. B7, Pages 9569-9589, July 10, 1989.
“**"Its focal mechanism defines a northwest trending, steeply southwest dipping fault plane characterized by right lateral strike-slip ruptur [Hauksson and Jones, 1989"]**
The trend of aftershcocks associated with this event is nearly coincident with the northwest trending escarpment (writing on 1987 aftershock)
1990
Hauksson, E., 1990, Earthquakes, faulting and stress in the Los Angeles basin: Journal of Geophysical Research, v. 95, p. 15,365-15,394.

Leighton and Associates, Inc., 1990, Technical Appendix to the Safety Element of the Los Angeles County General Plan Hazard Reduction in Los Angeles County, dated December 1990. (Eldon Gath)

1991

Treiman, J. A., 1991a, Whittier Fault Zone, Los Angeles and Orange Counties, California; CDMG Fault Evaluation Report FER-222, dated February 1, 1991.

Treiman, J. A., 1991b, Part of the Raymond Fault on the El Monte Quadrangle, Los Angeles County, California; CDMG Fault Evaluation Report FER-27, dated February 5, 1991.

1993
Bullard, T.F., and Lettis, W.R., 1993, Quaternary fold deformation associated with blind thrust faulting, Los Angeles Basin, California: Jour. Geophysical Research 98:8349-8369. May 10, 1993
Bullard and Lettis Fig 11 shows the large unexplored 20 m fault

Plate 1- (after p8362) slide it over and look at NE corner Here we can see both the 20 m fault and the AWF and their intersection with East Montebello Fault where the "20" is where San Gabriel blvd turns Walnut Grove Ave runs North and is about where your B1-B2

N-S line runs through the 87 Epicenter somewhere near where the Q4,5 is

The 1987 aftershock was near where the "G" in Garvey ave is

Saikia, C. K. (1993, June). Estimated ground motions in Los Angeles due to Mw = 7 earthquake on the Elysian thrust fault. Bulletin of the Seismological Society of America 83(3), 780-810.

1994

The Northridge earthquake was a 6.7 magnitude event that occurred on January 17, 1994 along a buried thrust fault underlying the Pico anticline in the Santa Susana Mountains. Although there was no primary surface rupture identified, there was secondary ground-rupture, in the form of bedding plane slip, along steeply dipping (40 to 60 degrees) sheared clay beds in the Saugus Formation (Treiman, 1994).

Hummon, C., C. L. Schneider, R. S. Yeats, J. F. Dolan, K. E. Sieh, and G. F. Huftile, 1994, Wilshire fault: earthquakes in Hollywood?: Geology, 22, 291-294.

Eurocode 8. 1994, Design Provisions for Earthquake Resistance of Structures-Park 5: Foundations, Retaining Structures and Geotechnical Aspects. ENV 1998-5 CEN European Committee for Standardization, Brussels, 1994.

1995
Finn, W.D. Liam, Ventura, Carlos E., Schuster, Norman D., 1995, Ground Motions during the 1994 Northridge Earthquake, in Canadian Journal of Civil Engineering, Vol. 22, Pages 300-315, January 5, 1995 (hillside amplification)
Treiman, J. A., 1994, Flexural-Slip Faulting Near Pico Canyon, Los Angeles County, California; CDMG Fault Evaluation Report FER-242, dated October 3, 1994.
Treiman, J. A., 1995, Flexural Slip Faulting Near Pico Canyon, Los Angeles County, California; CDMG Fault Evaluation Report FER-242 Supplement No. 1, dated May 17, 1995.

Possibly located at the northwest end of the Whittier Fault
“Prospects for Larger or More Frequent Earthquakes in the Los Angeles Metropolitan Region,” published in Science (13 January 1995, Volume 267, pp. 199-205) by SCEC scientists James Dolan (University of Southern California), Kerry Sieh (California Institute of Technology), Thomas Rockwell (San Diego State University), Robert Yeats (Oregon State University), John Shaw (E&P Technology Dept., Texaco, Houston, TX), Eldon Gath (Leighton and Associates, Irvine, CA), and John Suppe (Princeton University),
suggests that the Elysian Park Fault could produce a M7.1 earthquake.

1996

Shaw, J.H., and Suppe, J., 1996, Earthquake hazards of active blind-thrust faults under the central Los Angeles Basin, California: Journal of Geophysical Research, v. 101, p. 8623-8642.
Shaw and Suppe (1996) estimated earthquake magnitudes associated with these thrust faults ranging from 6.6 to 7.3, with recurrence intervals in the 340 to 1,000 years range.

Three-dimensional simulation of earthquakes on the Los Angeles fault system Kim B. Olsen **and** **Ralph J. Archuleta** **Bulletin of the Seismological Society of America** **June 1996** 86:575-596

http://www.bssaonline.org/content/86/3/575.short

The Elysian Park Thrust (Kerry Sieh CalTch SCEC Geology Working Group Leader) comments on what may (or may not) be Los Angeles' biggest seismic hazard.
http://scecinfo.usc.edu/news/newsletter/issue22.pdf Pg 12 Summer 1996 V2 #2

Imaging the Elysian Park Thrust, L.A. Basin, with SCSN Data John N. Louie Seismological Laboratory (174), University of Nevada, Reno pre 1998
http://crack.seismo.unr.edu/ftp/pub/louie/proposals/nr/eqimageprop.pdf

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East of downtown Los Angeles, between the Interstate 10 Freeway and Highway 60, are two major anticlines and a couple of minor anticlines and synclines.
They all appear to have been active in the last 60,000 years. In that period of time they have vertically risen tens of meters.
The tectonics of the Los Angeles area are more active than geologists would have guessed twenty years ago. ♦

1996 California Geological Survey California Fault Parameters OFR 96-08
http://www.conservation.ca.gov/cgs/rghm/psha/ofr9608/Pages/a_faults.aspx
is where the official method of determining Fault hazard is found
OFR-96-08 does not include thrust faults leaving those up to the consultant- a problem that persists to this day
Peterson OFR 96-08 contains the methodology for performing Probabilistic Seismic Hazard Analysis (PHSA) in California

For class A faults we use characteristic earthquakes to describe the magnitude-frequency distribution along the faults. In addition to independent fault segment ruptures,
we allow multiple contiguous segments to rupture together in larger events,
comparable to large historical events on the San Andreas Fault System (Table 1).
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Fig 8.11 Map of 2001 clearly shows the Monterey Park Mountain Front- this is the Hinge of the Upper Elysian Park Thrust "Each of the "hills" is bounded on its south margin by a blind or emergent thrust fault" Modified after Bullard and Lettis 1993

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http://resolver.caltech.edu/CaltechETD:etd-11252001-103911

Elysian Park fault could fail in conjunction with neighboring structures, such as the Las Cienegas fault, **the Whittier fault** or the Hollywood fault, to generate a significantly larger and more damaging earthquake.

Upper Elysian Park Source replaces Elysian Park (Lower) blind thrust.
2002 CALIFORNIA FAULT PARAMETERS APPENDIX A – California Geological Survey
http://www.conservation.ca.gov/cgs/rghm/psha/fault_parameters/pdf/Documents/a_flt.pdf
Slip rate and fault geometry from **Oskin, et al (2000).** (Next revision reinstates both)
2002 fault parameters incorporate the second of three fault models of Upper Elysian Park blind thrust proposed by Oskin and others (2000). This model infers a 50° NE dip, a rupture top of 3 km and rupture bottom of 15 km. Folded late Quaternary deposits across the Coyote Pass escarpment and related structures allowed Oskin and others (2000) to estimate a contraction rate of 0.6 -1.1 mm/yr.
The 50° dip and the 0.6 -1.1 mm/yr contraction rate infers a late Quaternary slip rate of 0.9 - 1.7 mm/yr.

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EP-AH is the Elysian Park- Monterey Park- Alhambra structural High discussed in text
EM Wright (1991 p 49-52, 89) Seperates Plutonic granitoid rocks East from Phyllitic metasedeiments west
shows end of MP at Riskis Rosemead 1 34.0513 x 118.0704
and other south of Humble SSG Unit 1 34.0703 x 118.0944 and
point toward Humble Rosemead 1 34.0677 x 118.0699
W Yerkes 1972, Wright 1991 pp47-52

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NMG Geotechnical Addendum to Update Faulting and Seismicity Portion of the Referenced Geotechnical Investigation and Review of Updated Conceptual Grading Plan, Montebello Hills Development, City of Montebello, California May 24, 2013 MHSP RDEIR Appendix U-1

NMG Addendum Geotechnical Update to Faulting and Seismicity Portion of the Referenced Geotechnical Investigation and Preliminary Grading Plan Review for the Northerly and Southerly Water Tank Sites, Montebello Hills Development, City of Montebello, California May 23, 2013 MHSP RDEIR Appendix U-2

Reports not independently peer reviewed, see purported reviews by EIR prepares P&D (which were not incorporated in any case- P&D did NOT approve these reports. These two reports used 2010 California Building Code (CBC) (when 2013 was then current)and the American Society of Civil Engineers (ASCE) Standard 7-05 (2010 was then current) for site specific seismic hazard analysis. (distance selected excluded San Jacinto and San Andreas)
PHT is under-specified and distance to fault "to south" is wrong- Whittier is correct. UEP is measured to center of fault-plane not nearest. Average distance to both tank sites means neither is site specific and borings are not cited and not recalculated using even these new greater data. (AWA 100 does not meet ASCE 7) There is no (long) critical period given for the tanks and no long period ground motion given.

Oskin writes in his Thesis (online at CalTech)

"The Elysian Park anticline is structurally and physiographically separate from adjacent structural and geomorphic domains (Fig. 9.2). The axis terminates at both ends against surficially expressed, strike-slip and oblique-slip faults that cut Quaternary alluvium (Fig. 9.3). (Whittier) The Alhambra Wash fault separates the southeastern end of the Repetto Hills from the Whittier Narrows, a topographic and structural low point, where drainage from the north is constricted [Davis et al. , 1989]."

commment

If the AWF-Whittier controls the East Edge of the UEP there may be more to it than usually ascribed.

Tanya Gonzalez wrote that the Geology on either side of the AWF is quite different

http://www.cityofrosemead.org/Modules/ShowDocument.aspx?documentid=1100

Fig 5.4 approx. pg pdf 137 Shows Tanya Gonalez and Robert Yeats contribution to Rosemead's General Plan (based on an earlier map by Geologist Ken Wilson CEG who was retained by the General Plan consultant after we "complained") note also the allignment of Workman Hill with Rubio wash (purple dots)

Our community group had filed a lawsuit against the City for lack of enforcement of the Seismic Hazards Mapping Act. Settlement entailed resignation of City Engineering and Geologist firms who paid all costs including the "review" by Gath and Gonzalez (ECI) (including a seismologist Dr. Dilek Gurler and a co-ordinated Geotechnical Review of the bogus "liquefaction" studies) (

ECI did additional trenching) which resulted in a much better General Plan- findings next resulted in a major revision to the new bridge design on Garvey over the Rio Hondo near where purple dots cross the rio hondo... additional borings coupled with ECI's Seismology found much worse liquefaction hazard-

we missed long duration long period San Andreas effects though Terrashake was reported shortly thereafter- would like to rerun the data with them...

Today what is missing is a more resonable characterization of the San Andreas Hazard which is why we are focusing on the Water distribution and Tanks un the Whittier narrows area, we just missed Terrashake/ Shakeout

Elysian Park Fold and Thrust Belt
The Elysian Park Fold and Thrust Belt (EPFT) was initially described by Davis et al. (1989) who postulated that the Los Angeles area is underlain by a deep master detachment fault and that most of the uplift in the region is caused by slip along the detachment that results in folding and blind-thrust faulting at bends and kinks in the detachment fault.
The detachment/blind-thrust model was initially embraced primarily because the 1987 Whittier earthquake occurred near one of the postulated thrust ramps beneath the EPFT.
Subsequent work (for example, Shaw and Suppe, 1996; Oskin et al., 2000; Bullard and Lettis, 1993; Shaw and Shearer, 1999; Shaw et al., 2002) has highly modified the original model, and currently most seismic hazard analyses recognize only the Upper Elysian Park Thrust (shown in Figure 4-1).
Shaw and Suppe (1996) estimated earthquake magnitudes associated with these thrust faults ranging from 6.6 to 7.3, with recurrence intervals in the 340 to 1,000 years range.

Elysian Park anticlinorium (SCEC)

The Elysian Park anticlinorium sensu stricto is a southward-verging anticline 20 km long with a curved, southward-convex axis, lying between the left-lateral(?) Hollywood fault on the northwest through the Silver Lake district and the cities of South Pasadena and Alhambra to the right-lateral East Montebello fault on the east in the city of San Gabriel. Uplift of the structure has produced

the Elysian, Repetto, and Monterey Park Hills. From the Los Angeles River eastward, the southern range front of the hills is formed by the active axial surface between the south limb of the anticlinorium and the nearly-flat dips of the Las Cienegas structural shelf (R.S. Yeats and G.J. Huftile, work in progress).

Oskin et al. (2000) studied parasitic minor folds in the vicinity of the axial surface, the largest being the Coyote Pass escarpment and monocline close to the range front.

Bullard and Lettis (1993) concluded that these folds provide evidence for a southward migration of deformation. Deformed late Quaternary deposits across the Coyote Pass escarpment and related structures allowed Oskin et al. (2000) to estimate a contraction rate across the structure of 0.6-1.1 mm/yr and a late Quaternary slip rate on the blind Elysian Park reverse fault of 0.8-2.2 mm/yr. 2 1 The dip of the blind fault was determined by analysis of growth strata, similar to the method of Schneider et al. (1996). The late Quaternary slip rate on the Elysian Park fault is similar to the long-term slip rate on the Las Cienegas fault, suggesting that convergence is shifting northeastward from the Las Cienegas fault to the Elysian Park fault (Yeats et al., 1999). Unlike the Las Cienegas fault, with structural growth taking place throughout the Pliocene and early Pleistocene, the Elysian Park anticlinorium shows no significant decrease in thickness of the Repetto and early Pico members of the Fernando Formation between the structural shelf and the south limb of the anticlinorium, based on oil-well data. However, Soper and Grant (1932), based on surface geology, concluded that this structure was active in the Pliocene based on an unconformity between the Pico and Repetto members of the Fernando Formation. A possible western continuation of the Elysian Park fault in downtown Los Angeles, the San Vicente fault of Schneider et al. (1996) has relatively small reverse separation superposed on a much larger normal separation during the Miocene. However, the San Vicente fault north of East Beverly Hills Oil Field shows evidence of Pliocene growth, earlier than that at the Elysian Park axial surface (Schneider et al., 1996, their fig. 4) and consistent with observations of Soper and Grant (1932).

An unresolved problem is the origin of the MacArthur Park escarpment southwest of the Hollywood Freeway and several minor folds in alluvium on the crest of the Wilshire arch mapped by Dolan et al. (1997) along Wilshire Boulevard and La Brea Avenue to the north. The MacArthur Park lineament is the northwest-trending range front between southwest-dipping strata of the Elysian Park anticlinorium and Quaternary deposits atop the Wilshire arch, which are cut off at the range front. Oskin et al. (2000) show the MacArthur Park escarpment as the continuation of the Coyote Pass escarpment, based on uplifted fluvial terraces. However, the MacArthur Park escarpment does not correspond to the same axial surface between low-dipping strata of the Las Cienegas structural shelf and southwest-dipping strata of the anticlinorium. Cross sections constructed by R.S. Yeats and G.J. Huftile across the Los Angeles Downtown Oil Field and the Jefferson pool of the Las Cienegas Oil Field (see R.S. Yeats website) show that the range front is northeast of the active axial surface.

Upper Elysian Park Thrust was in the CGS 2002 Fault Map and Database as a Type B fault

The Upper Elysian Park thrust is directly adjacent to or partially under the project.

The UEP is within 2km requiring near fault adjustments according to the 1997 CBC

pg 37 40 41 42 Regional fault map by NMG

Date

COPP
Margot Address

Kenneth Hunt
Central Basin
San District
Army Corps

We request that environmental review be accomplished for any recycled water project
THERE IS NO EIR FOR ANY RECYCLED WATER PIPELINE
Please be advised that, while recycled water is mentioned in the Montebello Hills Specific Plan (MHSP) EIR and one drawing shows a tentative tank location, there was no substantive discussion of recycled water which was dismissed with a sham reason that "recycled water was not currently available"

Of course Recycled Water was just as available then as it is now. (Recent Pipeline down Lincoln)
Cook Hill, the former developer, did not want to commit to the necessary infrastructure to provide recycled water to the residents where it would be valuable or as an alternative fire main, or for the Gnatcatcher reserve.

The alternative of providing recycled water from the East Side of the project, where the main pipeline is directly adjacent to the project along Lincoln Ave, was not considered. (Would require the developer to completely pay for the infrastructure.) We request that this alternative be considered.

The developer wanted recycled water but wanted someone else, anyone-else, to pay for it.
Redevelopment agency, City backed bonds, Central Basin, Shopping Centers, anyone-else..
Another reason water from the east side through the oilfield was not considered.

There are no Conditions of Approval (COA) regarding recycled water in the Project documents approved by the City. There are also are no legally enforceable commitments to provide recycled water or utilize recycled water at the completed project.

Any consideration of any pipeline is premature. Just because the developer however this does not make an emergency for CBMWD, the Sanitation district and other Stakeholders.

The City, Central Basin, San District, Army Corps, County Flood , Water Board , the Public, The groundwater Aquifers, and others are stakeholders.

Given the long term water shortages, when a recycled water project is done, it must be designed for the maximum benefit.
Unless all potential users have access there is no benefit.
The project itself is of no economic benefit to the City. Permit fees are inadequate, subsidised by the City to attract business. Property taxes to the City are inadquate to support required city services.
a net medium and long term looser.
The gnatcatcher reserve has not shown itself to yet be independent of irrigation and during the dimise of Cook-Hill was neglected. Ravaged by several fires and re-invaded by -yes- invsives.

There is an interest in minimizing grading water (dust suppression) sources, however this is a short term use, the long term interest in in minimizing the water usage of any completed project.
Areas which must be considered Include Low Impact Development (LID) Gray Water, permeable pavement, storm water runoff recycle/ reuse and keeping storm-water out of the Waters of the United States.

Additional important concers include seismic issues. The New water tanks on North Lincoln ave
There is no Geotechnical report supporting any recycled water project. (and no peer reviewed report for ANY project) The Project EIR and later reports on tanks (RDEIR Appendices I) were not site specific but a generalized location.
There are no Borings under any proposed tanks or pumping stations.

The seismic analysis in the RDEIR, while still deficient ,is better that the one in the DEIR.
The RDEIR addressed several additional problems (took a good first look at hillside amplification) and brought the Seismicity of the Whittier fault to current standards (7.85 Mw) however leave the Puente Hills Thrust (PHT) severely underestimated as with the Upper Elysian Park thrust (which is directed directly at the project)
The long Period , long duration hazard of the Southern San Andres is not addressed (all calculations much be accomplished with both short duration, high Mw events and long duration moderate Mw seismicity. Vertical as well as horizontal must be considered

Fatal problem (deliberate oversight) is that none of the Project Geotechnical reports were "independently peer reviewed" as required by State Law.
see attached letter from Linda Strong for Chapter and Verse.
This issue has not been adjudicated

It is well know that AWWA standards for tanks do not meet current ASCE-7
Current Standards require borings for pipelines which have not been accomplished

The proposed Pipeline has to cross the Montebello Hills Fault ("Potentially Active" according to So Cal Gas PUC documents)
It's not the recency of activity that is of concern but the fact that there are thousands of feet of Vertical offset which give very different geology on each side of the fault (periods of vibration and VS-30)
The later Puente Hills thrust cuts the older Montebello fault and the Montebello fault evidently terminates Eastward against the Whittier Fault.
This weak crack in the earth creates a "wave guide" from these fault into the Project

The hills are an active uplifting anticline which may be being raised by both the Whitter (plate tectonics)and Puente Hills thrust (basin North South shortening). There has been no geomorphocical stucy)

The Hills are junk rock, steeply sloped layers with slippery clay beds. (Adverse Bedding)
Deep Borings are required for all critical infrastructure such as tanks and pumping stations and once bedding (bedding planes, slopes) is established dynamic landslid analysis is required (Newmark or better) utilizing all seismic sources. Near fault and directivity effects must be considered as well as Path effects for San Andreas, and Hanging wall effects for PHT) (recall that Northridge was sloped away from the population whereas Upper Elysian Park (UEP) is sloped toward the project and all the water main breaks which ensued- UEP could easily have the same size event as Northridge, Whittier

and PHT worse)
Duration of Shaking (repetitive cycles) is a major concern (San Andreas)

We do not see how these four related seismic sources can be analyzed without a Seismologist report, which must be accomplished before any Geotechnical analysis.

James Flournoy, Secretary

We strongly suggest that you ask the City of Montebello for a copy of any Peer Review of the MHSP geotecinal report (s) as required by the Seismic Hazards Mapping Act
they have indicated to me that none exists

Note 1
Recycled water for Resurrection Cemetery, Potrero Heights School and Park,Don Bosco, Shops at Montebello, must be considered and capacity provided in any pipeline.

More important is replenishment of the groundwater basin behind Whittier Narrows Dam

The artesian flows must be restored
The Rio Hondo is one of the few UN-channeled streams and habitat is in grave condition.
There is a ZERO sum game as far as available water both domestic and recycled. There is no additional water for any condo project without taking from other users which should have higher priority.

Note 2
As an example on the Montebello Hills EIR it states that there is no subsidence whereas Army Corps clams Whittier Narrow dam has subsided due to oil pumping.
This is in the vicinity of the projects “Scenic Promenaded” which is a marketing name for a huge series of retaining walls.
As with the proposed water tanks here are no borings under the proposed retaining wall site.

Note 3
The new water tanks on North Lincoln Ave at least one has the same kind of hold downs that failed in Topanga Canyon over 20 years ago during the Northridge earthquake. Just building to the obsolescent AWA guidelines is completely insufficient in the Montebello Hills.
The connections also do not appear to be fully ductile which would allow the loss of contents above
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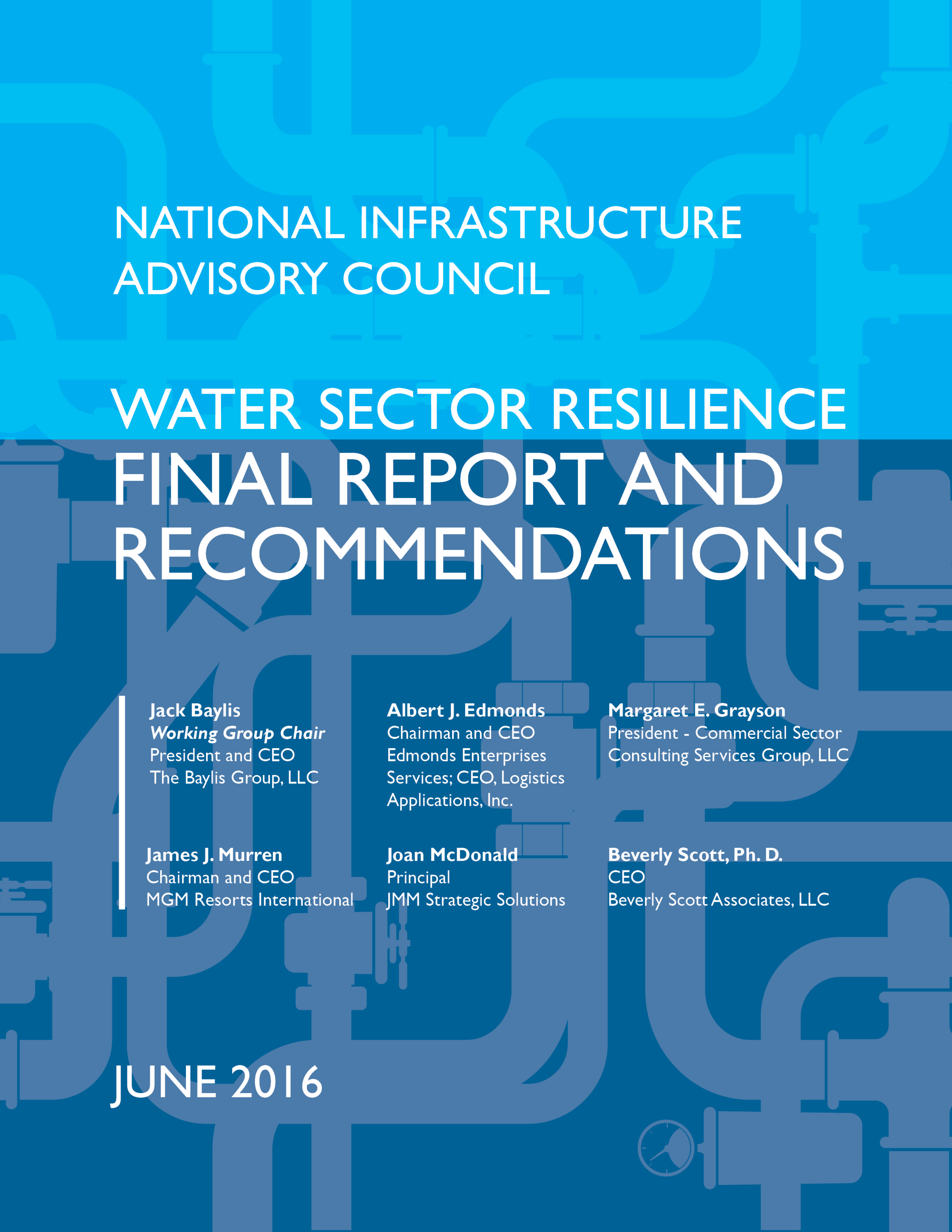

NATIONAL INFRASTRUCTURE ADVISORY COUNCIL

WATER SECTOR RESILIENCE

FINAL REPORT AND RECOMMENDATIONS

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JUNE 2016

ABOUT THE NIAC

The National Infrastructure Advisory Council (NIAC) provides the President of the United States with advice on the security and resilience of the critical infrastructure sectors and their functional systems, physical assets, and cyber networks. These critical infrastructure sectors span the U.S. economy and include the Water; Chemical; Commercial Facilities; Communications; Critical Manufacturing; Dams; Defense Industrial Base; Emergency Services; Energy; Financial Services; Food and Agriculture; Government Facilities; Healthcare and Public Health; Information Technology; Nuclear Reactors, Materials, and Waste; and Transportation Systems Sectors. The NIAC also advises the lead Federal agencies that have critical infrastructure responsibilities. Specifically, the Council has been charged with making recommendations to:

- Enhance the partnership of the public and private sectors in securing and enhancing the security and resilience of critical infrastructure and their functional systems, physical assets, and cyber networks, and provide reports on this issue to the President through the Secretary of Homeland Security, as appropriate.
- Propose and develop ways to encourage private industry to perform periodic risk assessments and implement risk-reduction programs.
- Monitor the development and operations of critical infrastructure sector coordinating councils and their information-sharing mechanisms, and provide recommendations to the President through the Secretary of Homeland Security on how these organizations can best foster improved cooperation among the sectors, the U.S. Department of Homeland Security, and other Federal Government entities.
- Report to the President through the Secretary of Homeland Security, who shall ensure appropriate coordination with the Assistant to the President for Homeland Security and Counterterrorism, the Assistant to the President for Economic Policy, and the Assistant to the President for National Security Affairs.
- Advise Sector-Specific agencies with critical infrastructure responsibilities, to include issues pertaining to sector and government coordinating councils and their information-sharing mechanisms.

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EXECUTIVE SUMMARY

Water is often called our most precious resource, and with good reason— clean drinking water and wastewater treatment services[1] sustain core functions of critical infrastructure, communities, and human life itself. Without water services, factories shut down, hospitals close, communities are disrupted, and most hotels, restaurants, and businesses cease operations. Water is a lifeline sector that serves businesses and communities on a daily basis and brings them back to normal after a disaster, which makes maintaining water services and quickly restoring them a priority. Because the sector has a track record of reliable service with few major disruptions, the infrastructure that delivers water often goes unnoticed and undervalued by decision-makers and the public-at-large.

The National Infrastructure Advisory Council (NIAC) was asked to 1) assess security and resilience in the Water Sector, 2) uncover key water resilience issues, and 3) identify potential opportunities to address these issues. The Council formed a NIAC Working Group to examine water resilience using the framework developed in the NIAC's 2010 study on establishing resilience goals. This six-member group of NIAC members examined national-level issues related to water infrastructure systems based upon each of their own unique experience from across a myriad of sectors, numerous specific interviews with subject matter experts, and valuable input from the Study Group, support the findings and recommendations in the report.

The crisis in Flint, Michigan reveals how a loss of safe drinking water in a compromised water infrastructure can devastate a community. Yet this tragedy belies another critical risk: the loss of water services can cripple other critical infrastructures and trigger additional disruptions. An analysis of vulnerability assessments conducted by the U.S. Department of Homeland Security (DHS) Office of Cyber and Infrastructure Analysis (OCIA) revealed that among surveyed critical infrastructure that depend upon water for core operations, services are degraded 50 percent or more within eight hours of losing drinking water services (Exhibit ES-1).[2] The same holds true for a loss of wastewater treatment services. For example, the OCIA analysis noted that nearly all hospital functions could be degraded within two hours due to a loss of external wastewater discharge services. Yet, many infrastructure owners and operators do not have alternative sources of water or wastewater services. As a result, the full consequences of cascading failures from extended water service disruptions in critical sectors are not well understood.

> “What happened here is just an extreme example, an extreme and tragic case of what's happening in a lot of places around the country. We've seen unacceptably high levels of lead in townships along the Jersey Shore and in North Carolina's major cities. We've seen it in the capitals of South Carolina and Mississippi. And even, not long ago, lead-contaminated drinking water was found right down the street from the United States Capitol. So Flint is just a tip of the iceberg in terms of us reinvesting in our communities.”
>
> *President Barack Obama, May 4, 2016 in Flint, Michigan*

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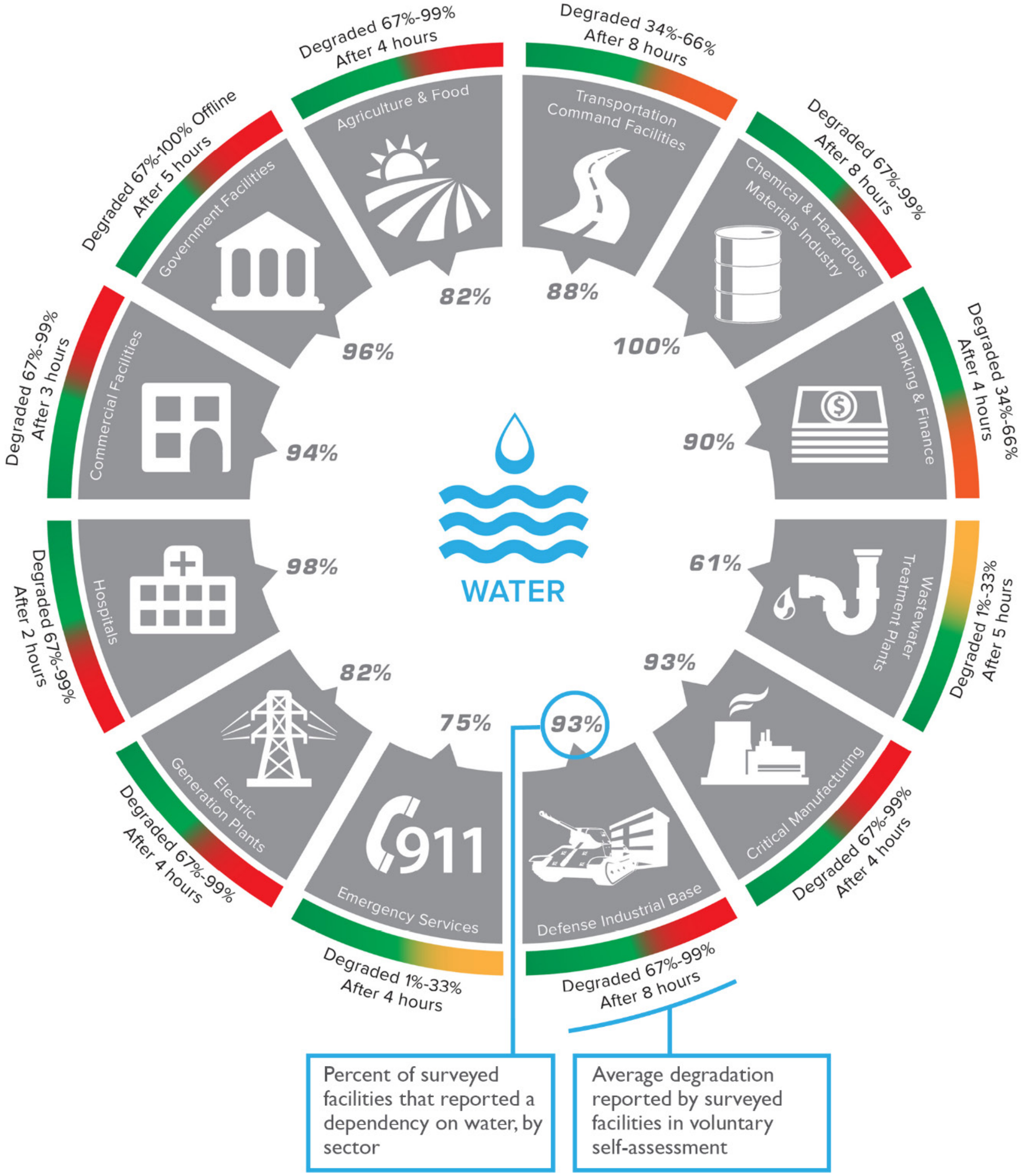
[1] "Water services" are used throughout this report to refer to both drinking water and wastewater treatment services. It does not include upstream water resources and separate storm water systems. Chapter I. Introduction, Section A. Framing the Study describes the scope of this study in detail.

[2] DHS OCIA, *Sector Resilience Report*, 2014.

Exhibit ES-1. Critical Infrastructure Dependence on Water and Potential Function Degradation Following Loss of Water Services[3]



Percent of surveyed facilities that reported a dependency on water, by sector

Average degradation reported by surveyed facilities in voluntary self-assessment

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[3] The information provided in the graphic is based on a limited sample of 2,661 voluntary facility assessments conducted between January 2011 and April 2014 (DHS OCIA, *Sector Resilience Report*, 2014). (See pages 19-20 for more information.)

This study builds on the insights gained in our previous studies of resilience in the lifeline sectors of electricity and transportation. Although the Council found many similarities in the challenges, root causes, and opportunities facing these sectors, we also uncovered distinct challenges that the Nation's water infrastructure faces in building a more resilient sector:

- Community water systems are not typically connected to adjacent systems, unlike electricity and transportation infrastructure, which are interconnected into national networks.
- Roughly 85 percent of all water and wastewater systems are publicly owned and operated by municipalities and most are small; more than 80 percent of community water systems and publicly owned treatment works serve populations of less than 3,300.
- Most State and municipal decision-makers are constrained by long-held expectations by customers for water as a low-cost, affordable service that does not account for true life-cycle costs.
- Nearly all water infrastructure assets are out of sight and historically reliable, leading to an underappreciation of the criticality of water services and the infrastructure that deliver them.
- Like other sectors, water has an aging infrastructure that requires massive reinvestment to upgrade pipes, mains, and equipment. Many assets are nearing or beyond their expected lifespan, leading to roughly 240,000 water main breaks and between 23,000 and 75,000 sanitary sewage overflows per year in the United States. The estimated investment gap ranges from about $400 billion to nearly $1 trillion to maintain current levels of water service.
- Unlike the Energy and Transportation Sectors, which each have a Federal department and Cabinet position dedicated to their sectors and infrastructure, water has no corresponding Federal department dedicated to its sector. The U.S. Environmental Protection Agency (EPA), which serves as the Sector-Specific Agency (SSA) for the Water Sector, regulates and enforces the Clean Water Act and the Safe Water Drinking Act. While it has programs designed to improve the security and resilience of the Nation's drinking water and wastewater infrastructure, its primary mission is ensuring water quality.

WHAT WE FOUND

The affordability of systems—the ability of providers and their ratepayers to develop and maintain needed capabilities—is a cornerstone resilience issue. Too many jurisdictions do not account for the full life-cycle cost of building, maintaining, upgrading, and replacing systems; or are unable or unwilling to raise rates to pay for needed investment. Rates may simply reflect the least-cost path of patch and repair, ignoring longer-term problems and consequences, even under nonstressed conditions.

Over the course of this study, the importance of water services was underscored by the crisis that unfolded in Flint, Michigan. While the contamination of the Flint water supply was not the direct result of a failure in infrastructure resilience—and therefore beyond the direct scope of this study—it reveals the impact that compromised water services can have on communities, government, and families, and the breakdown in trust that Americans have placed in our water infrastructure.

Our findings highlight the criticality of water services, the need to address emerging risks, and the significant challenge of funding needed improvements to water and wastewater infrastructure.

- **Poor Understanding of the Criticality of the Water Sector**: The Water Sector is facing a dynamic and complex risk environment in which the full impacts of water disruptions and the potential cascading impacts are not fully understood among critical infrastructure operators, local and State leaders, and water service customers. As such, water and wastewater services are receiving inadequate attention in disaster planning, prevention, and response among public officials and dependent sectors.
- **Inadequate Valuation of Water Services**: Water services are often taken for granted because they have been highly reliable, inexpensive, and hidden from view. This makes it difficult to gain public support for needed upgrades and for decision-makers to justify rate increases needed to fund infrastructure improvements.
- **Wide Disparity of Capabilities and Resources**: Water utilities face a challenging risk environment for which many lack the required technical and financial capabilities to address all emerging risks, such as cyber risks. Utilities, especially small municipal agencies, often lack sufficient resources—including qualified staff, tools, and access to technical expertise and reliable information—to manage new risks.
- **Significant Underinvestment in Water Sector Resilience**: The large portion of public ownership within the sector and the current regulatory structure hinders long-term investment in resilient water infrastructure. Decaying infrastructure is mostly unseen, and problems are not elevated in the public eye until there are major failures.
- **Fragmented and Weak Federal Support for Water Resilience**: Resilience has not been substantially integrated into the actions of Federal agencies and resilient outcomes are typically not part of Federal programs and resources.
- **Regional Collaboration Not Broadly Applied:** Poor cross-jurisdictional collaboration can lead to stovepiped decisions that can be counterproductive to effective emergency response and recovery.

RECOMMENDATIONS

The Council recommends the following steps to improve resilience in the Water Sector. For each recommendation, we have identified specific actions that the Federal Government should take to implement these recommendations. (Chapter V. Findings and Recommendations, starting on page 35, includes a complete description of the recommendations and specific actions.)

Recommendation 1 **Analyze and map the complex risks of major water disruptions and develop mitigations.**

The Federal Government should assist owners and operators in the Water Sector to uncover emerging cross-sector risks and develop mitigations for disruptions that could cascade into other sectors and regions or have the potential for national consequences. The Federal Government should commit funding and expert resources to help identify, analyze, and map hidden risks that result from complex sector interdependencies, regional interconnections, and increased convergence of physical-cyber systems.

Recommendation 2 Fortify Water Sector response and recovery capabilities.

The Water Sector has a good track record of maintaining continuity of service and rapid response and recovery. However, because of the criticality of water and wastewater services, the Federal Government should take immediate actions to formalize and improve the response and recovery capabilities at every level of the Water Sector. The Federal Government should increase planning for extreme events, consolidate Federal response responsibilities, and increase funding for successful sector mutual aid efforts.

Recommendation 3 Increase Federal funding, investment, and incentives to improve water infrastructure resilience.

The Federal Government should establish new funding mechanisms, structures, and incentives to increase investment in resilience at the regional and local levels to counter historic underinvestment in infrastructure, and to remove obstacles that public agencies face in increasing rates, particularly when it impacts low-income communities.

Recommendation 4 Increase technical and financial resources and expertise available to the Water Sector.

The Federal Government should work with larger, well-resourced utilities to improve the technical and financial capabilities of smaller and less-resourced utilities by creating programs that link regional technical resources to local water utilities, and leverage established programs, expertise, and capabilities of universities. The Federal Government should also assist national and regional water associations to expand outreach to utilities to improve access to valuable tools and models. These efforts should emphasize improving the cybersecurity capabilities of water utilities that have limited cyber capacity.

Recommendation 5 Strengthen Federal leadership, coordination, and support for Water Sector resilience.

The President should strengthen Federal leadership on water infrastructure issues by directing a coordinated effort across Federal agencies to raise awareness about the importance of water, leveraging investment to create job opportunities and inclusion for local communities, and identifying and removing legal, regulatory, and policy barriers that impede investment and implementation of resilient measures.

MOVING FORWARD

The Council confirms what we found in our four previous studies of resilience: much of our most critical national infrastructure is crumbling and in major need of renewal and increased investment. The Water Sector is no different. Flint provides a stark example of what can happen to distort decision-making when resources are inadequate to do the job. But the same holds true for almost every major infrastructure failure in recent years—New Orleans levee breaches, Minnesota bridge collapse, Washington Metro fires; they were all exacerbated by a lack of investment in system preservation.

Simply put, we have failed to make reinvestment in our infrastructure a top national priority. The condition of our infrastructure seriously lags behind in an increasingly competitive global economy, but we have been unable to generate the overall public interest, support, and political will to reinvigorate it. We have failed to recognize that investment in our infrastructure is also an investment in our people, our communities, and our economy. Cities and communities across the country face chronic unemployment and under employment, inequality, and affordability challenges that require urgent national action. Special attention must also be given to our most vulnerable populations in high needs communities. The weak levees in New Orleans and the corroding lead pipes in Flint drive home important lessons about the need for public/community engagement, greater accountability/transparency, and expanded partnerships in building and operating critical infrastructures.

New investments in smart, sustainable, resilient infrastructure is a catalyst for job creation, economic competitiveness, and an equitable and shared prosperity. To be sure, the risks are complex, the investments required are massive, and the task exceeds the capabilities of any one company, sector, or government agency. But we are beginning to see local support for ballot measures for major infrastructure investments, and projects at the local level that actively engage local communities, including a host of partners—business, government, community advocates, education, labor, and philanthropic organizations.

A great deal needs to be done to strengthen the security and resilience of critical infrastructure. Although much of the responsibility rests with the owners and operators who design, build, operate, maintain, and repair the infrastructure, the Federal and State governments are critical partners in this endeavor. Federal and State governments must make it easier for the owners and operators to invest in infrastructure improvements; they must identify and remove regulatory barriers that inhibit resilient behavior; they must help to identify and mitigate cross-sector risks that hide between the seams of interdependent sectors and regions; they must develop measurable standards and best practices to guide water agencies in their resilience efforts; they must leverage the science and engineering resources of national laboratories and universities to develop innovative technologies and bring them to market; and they must strengthen leadership and coordination among agencies across all levels of government. We believe this study, along with our previous ones, provides a practical template for action that can help ensure the long-term security and economic prosperity of the Nation’s critical infrastructure.

I. INTRODUCTION

The National Infrastructure Advisory Council (NIAC)—a Federal advisory committee that advises the President on issues relating to the security and resilience of the Nation's critical infrastructure sectors and their supporting information systems—was charged with examining the resilience of the Water Sector in September 2015. Specifically, the NIAC was asked to 1) assess security and resilience in the Water Sector, 2) uncover key water resilience issues, and 3) identify potential opportunities to address these issues. The study found that many security measures—as defined in *Presidential Policy Directive 21 (PPD-21): Critical Infrastructure Security and Resilience*—are embedded in good resilience practices. Accordingly, the resilience focus of the report encompasses many aspects of security, defined in PPD-21 as "reducing the risk to critical infrastructure by physical means or defined cyber measures."[4]

This report presents the Council's findings and recommendations to the President, highlighting opportunities for the Federal Government to address key water resilience issues. Over the past seven years, the NIAC has examined resilience in four previous studies. In this work, the Council defined infrastructure resilience as "the ability to reduce the magnitude and/or duration of disruptive events" as determined by the "ability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially disruptive event." This definition directly parallels the definition in PPD-21: "the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions."[5] Simply put, resilient systems lose fewer functions during a disruption and require less time and resources to recover to normal operations.

NIAC AND RESILIENCE: A FOUNDATION FOR COLLABORATIVE SUCCESS

The NIAC examined resilience needs and practices, developing distinct recommendations in four studies:

- *Critical Infrastructure Resilience* (October 2009) examined steps government and industry should take to best integrate resilience and protection into a comprehensive risk-management strategy.
- *A Framework for Establishing Critical Infrastructure Resilience Goals* (October 2010) developed a process framework for setting, testing, and improving resilience goals in the Electricity Sector that can be broadly applied to all lifeline sectors.
- *Strengthening Regional Resilience* (October 2013) examined the characteristics of critical infrastructure resilience in mitigating regional disruptions, finding that resilience in the lifeline sectors—energy, communication, water, and transportation—is particularly critical.
- *Transportation Sector Resilience* (July 2015) identified key actions that the Federal Government should take to strengthen the resilience of the Transportation Sector.

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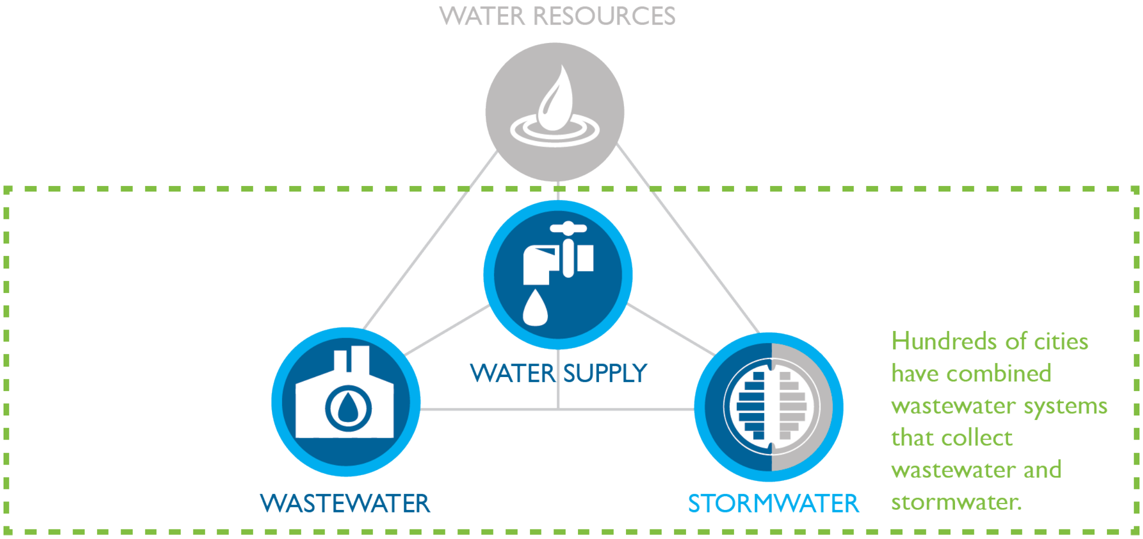
[4] The White House, PPD-21, 2013.

[5] Ibid.

A. FRAMING THE STUDY

Water infrastructure consists of the physical and cyber assets of drinking water and wastewater systems, as defined by Homeland Security Presidential Directive 7 (HSPD-7), the *2013 National Infrastructure Protection Plan* (NIPP 2013), and the *2015 Water and Wastewater Systems Sector-Specific Plan* (2015 SSP).[6] Exhibit I-1 illustrates the scope of the study, limiting the focus to water supply and wastewater, and indirectly stormwater as it affects combined wastewater treatment.

Exhibit I-1. Scope of NIAC Water Resilience Study



Hundreds of cities have combined wastewater systems that collect wastewater and stormwater.

While water resources are critical, this study focused on the resilience of the Nation's water delivery infrastructure, rather than on the sufficiency of water resources. The Nation faces many water resource issues, including the drought in California, potential water shortages in the Southwest, and balancing flood control and water needs. These are all critical issues that impact the Water Sector, but are outside the direct scope of this study.

B. STUDY RESOURCES AND ACTIVITIES

To conduct this study, the Council formed the Water Resilience Working Group, consisting of NIAC members, to examine water resilience using the framework developed in our 2010 study on establishing resilience goals in the Electricity Sector. This six-member group of NIAC members convened to examine national-level issues related to water infrastructure systems based upon each of their own unique experience from across a myriad of sectors. The collective insights gained from the Working Group's expertise, extensive subject matter expert interviews, literature reviews, and findings and conclusions provided to the Working Group by a supporting Study Group—convened by the Working Group to look at specific technical, financial, and operational issues—provides the confidence that the Council's findings and recommendations are well grounded.

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[6] The White House, HSPD-7, 2003; DHS, *NIPP 2013*, 2013; and EPA, *2015 SSP,* 2016.

More than 70 subject matter experts (SMEs) were interviewed as part of the study, representing a mix of utilities of different sizes, geographic locations, water association staff and members, consultants and academics, and representatives from government agencies with a role in in the Water Sector. These SMEs contributed knowledge about utility operations, sector risks, dependencies, planning and investments, severe weather, emergency management, cybersecurity, next-generation resilience, and financial solutions. Additional information can be found in appendices at the end of the report:

- Appendix A. Acknowledgements — A list of all study contributors and subject matter experts interviewed.
- Appendix B. Compendium of Information from Subject Matter Experts — A synopsis of the information provided during interviews.
- Appendix C. Disruption Scenario Case Study — An overview of the five disruptions evaluated by the Study Group.
- Appendix D. Study Group Findings and Conclusions — A list of the findings and conclusions developed by the Study Group.
- Appendix E. Compendium of Prior Recommendations — A review of prior recommendations and other sources most relevant to this study.

> “Water challenges are facing communities and regions across the United States, impacting millions of lives and costing billions of dollars in damages. Recent events, including record-breaking drought in the West, severe flooding in the Southeast, and the water-quality crisis in Flint, MI, have elevated a national dialogue on the state of our Nation’s water resources and infrastructure. This dialogue is increasingly important as a growing population and changing climate continue to exacerbate water challenges.”
>
> *The Executive Office of the President, Commitments to Action on Building a Sustainable Water Future, March 22, 2016*

II. WATER SECTOR OPERATIONAL SNAPSHOT

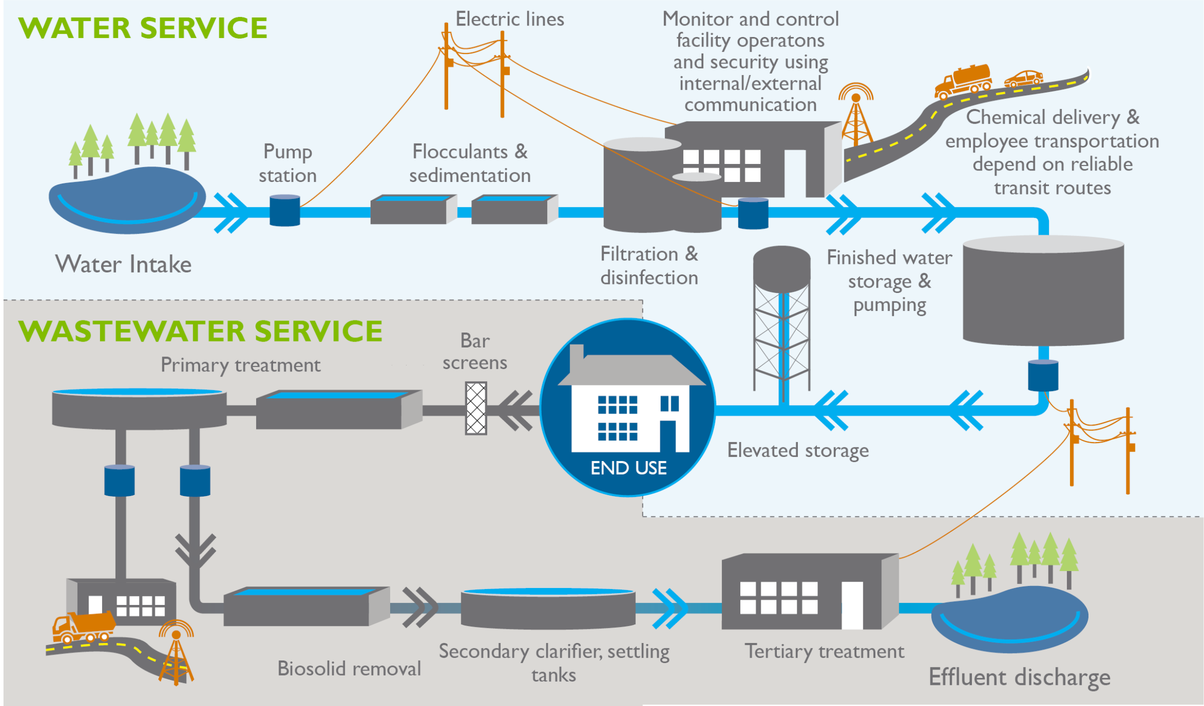
Most people do not think about what it takes for them to have clean water flow from their tap and wastewater removed. But these water and wastewater services rely on a vast network of infrastructure and assets from the pipes, water mains, and treatment plants; skilled facility employees; and information and technology networks that enable monitoring and communication. This Chapter provides a brief overview of the Water Sector.

A. KEY ASPECTS OF THE WATER SECTOR

There are thousands of water and wastewater treatment facilities in the United States, but the majority of the population is served by a small percentage of mostly large or very large systems. While individual utilities vary widely in size and complexity, Exhibit II-1 shows a typical design of both water and wastewater systems under normal operations.

Water and wastewater systems are predominantly owned and operated by municipal entities. In 2014, public entities provided water service to about 87 percent of people served by piped water.[7] This is consistent with surveys done by the U.S. Environmental Protection Agency (EPA) that found that most people receive their water from large, publicly owned community water systems.

Exhibit II-1. Typical Water and Wastewater Services Operation



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[7] Food and Water Watch, *State of Public Water*, 2016.

WATER SECTOR SNAPSHOT

ASSETS & INFRASTRUCTURE

Water Supply

There are approximately **153,000 Public Water Systems** (PWSs) in the United States. PWSs provide **water for human consumption** through pipes and other constructed conveyances.

Community Water Systems (CWS)

A CWS is a PWS that provides residential water. **Less than 20% of CWSs serve 92% of the population that receive water from CWSs.** The remaining 8% of the population are served by CWSs that serve less than 3,300 people. The majority of CWSs are publicly owned. About 16% are privately owned and about 2,000 government entities contract with private companies. **There are more than 51,000 CWSs in the United States.**

Non-Transient Non-Community Water Systems

Schools, factories, office buildings, and hospitals that have their own water systems fall under this category. There are more than 18,000 of these systems.

Transient Non-Community Water Systems

Gas stations, campgrounds, or other places where people do not remain for long periods of time. There are approximately 84,000 of these systems.

Wastewater

Wastewater is predominantly treated by publicly owned treatment works. There are a small number of private facilities such as industrial plants.

Publicly Owned Treatment Works (POTW)

There are more than 16,500 POTWs in the United States. These systems provide wastewater service and treatment to more than 227 million people. POTWs are generally designed to treat domestic sewage, but some receive wastewater from industrial users. 79% of POTWs treat less than 1 million gallons per day and provide treatment to less than 23 million people (approximately 10% of the population served by POTWs).

Combined Sewer Systems (CSSs)

CSSs collect stormwater, domestic sewage, and industrial wastewater in the same pipe to transport it to a wastewater treatment facility. In general, CSSs have not been constructed since the mid-20th century and many existing CSSs are looking for ways to separate stormwater and wastewater. **CSSs serve approximately 40 million people in 772 communities.**

ELEMENTS OF WATER SERVICES

Water and wastewater utility assets can be characterized as physical, cyber, and human. The extent of these assets varies dramatically by utilities.

Physical

- Pipes and Related Components for Collection and Conveyance
- Treatment Facilities
- Distribution/Discharge Systems
- Sensors and Monitoring Systems

Cyber

- Industrial Control Systems
- Process Systems and Operational Controls
- Enterprise Systems

Note: Individual drinking water utilities will differ in the types of components used;

Human

- Personnel Availability and Capabilities
- Workforce Training and Education
- Vendors and Contractors

Source: EPA, 2015 Water and Wastewater Systems Sector-Specific Plan, (2015 SSP), 2016.

AFFORDABLE RATES DISGUISE CHRONIC UNDERINVESTMENT

The affordability of systems—the ability of providers and their ratepayers to develop and maintain needed capabilities—is a cornerstone resilience issue for the sector. Utilities use a variety of rate structures to recover the costs of operating systems, including charging a flat fee regardless of the amount of water used, block rates based on usage, and seasonal rates.[8] For utilities, there are several factors that come into play when setting rates: revenue, conservation, and affordability.[9] The rates charged must bring in enough revenue to maintain the system; however more and more customers are reducing the amount of water they use, decreasing revenue if rates are set based on usage.[10] Finally, utilities have to ensure that rates are affordable for disadvantaged customers, but do not encourage wasting of water.[11] In response, utilities are experimenting with different rate structures to try to balance these three factors.[12]

In general, too many jurisdictions do not account for the full life-cycle cost of building, maintaining, upgrading, and replacing systems (whose life cycles can span decades). Moreover, it appears from our research and discussions that some utilities are diverting money collected as water fees for general revenue purposes. This was found to be true in Flint, when half of the collected fees were diverted in this manner.[13] As a result, aging U.S. water infrastructure has suffered from generations of underinvestment and is now prone to failure. In its *2013 Report Card for the Nation's infrastructure*, the American Society of Civil Engineers (ASCE) gives both water and wastewater systems a "D" rating on an A to F report card scale.

State and local governments must increase investment into public water systems to meet stricter Federal water quality and drinking water safety standards—yet Federal appropriations for water infrastructure have declined between 2008 and 2012.[14] Often dominated by politics rather than engineering, decisions that set rates may simply reflect the least-cost path of patch and repair, ignoring resilience needs. This exacerbates longer-term problems and consequences, stretching the problems of a degrading infrastructure into future political cycles and generations of customers.

> "There is no more basic element sustaining human life than water. It's not too much to expect for all Americans that their water is going to be safe."
>
> *President Barack Obama, May 4, 2016, Flint, Michigan*

ATTRACTING AND MAINTAINING A HIGHLY SPECIALIZED WORKFORCE

A critical component of the Water Sector is its workforce—the men and women who operate and maintain water utilities every day. The number of employees and specialized nature of their work is

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[8] EPA, "Water Sense: Understanding Your Water Bill," 2016.
[9] Walton, "Price of Water 2016," 2016.
[10] Ibid.
[11] Ibid.
[12] Ibid.
[13] Snider, "Flint's other water crisis: Money," 2016.
[14] ASCE, "Drinking Water: Conditions and Capacity," 2013; and ASCE, "Wastewater: Investment and Funding," 2013.

dependent on the type, size, and complexity of a utility. For example, larger facilities may employ chemists, engineers, microbiologists, public relations staff, systems analysts, security personnel, and other specialists who are highly trained in their individual roles and as a team.[15]

Most entry-level career paths in the Water Sector require a high school diploma while advanced positions typically require additional post-secondary education or on the job training.[16] Utilities also rely on outside contractors for engineering services, laboratory analyses, chemical deliveries, security, and other positions.[17] Because of the importance of water to other sectors, investments within the sector can have significant economic impacts on a community. A study of 30 water utilities in 25 geographic areas found that on average, for every $1 million these 30 utilities spent, five direct and 11 indirect jobs were supported.[18]

But a 2008 survey found that workforce planning was consistently cited as one of the top issues facing utilities.[19] Despite this concern, workforce planning may not receive the attention that regulatory or infrastructure issues receive.[20] Workforce could become an even greater issue for water utilities over the next several years. The Water Sector is in the midst of a concentrated retirement bubble—similar to other critical lifeline sectors—that is exacerbated by the specialized skills needed for the work, the localized nature of the sector, and eligibility for retirement after 30 years.[21] Between 2010 and 2020, the Water Sector is expected to lose between 30 and 50 percent of employees to retirement.[22] Many of these employees have worked at the same utility for the majority of their careers, compounding the impact of these retirements due to the loss of institutional knowledge.[23]

Partnerships and collaboration between utilities, educational institutions, and other partners for resource sharing and technical support will be crucial in addressing workforce development, planning, and knowledge transfer. This is particularly true for smaller utilities with fewer resources.

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[15] EPA, *2015 SSP*, 2016.

[16] WRF and WERF, *National Economic and Labor Impacts of the Water Utility Sector*, 2014.

[17] EPA, *2015 SSP*, 2016.

[18] WRF and WERF, *National Economic and Labor Impacts of the Water Utility Sector*, 2014.

[19] WRF and AWWA, *Water Sector Workforce Sustainability Initiative*, 2010.

[20] Ibid.

[21] Ibid.

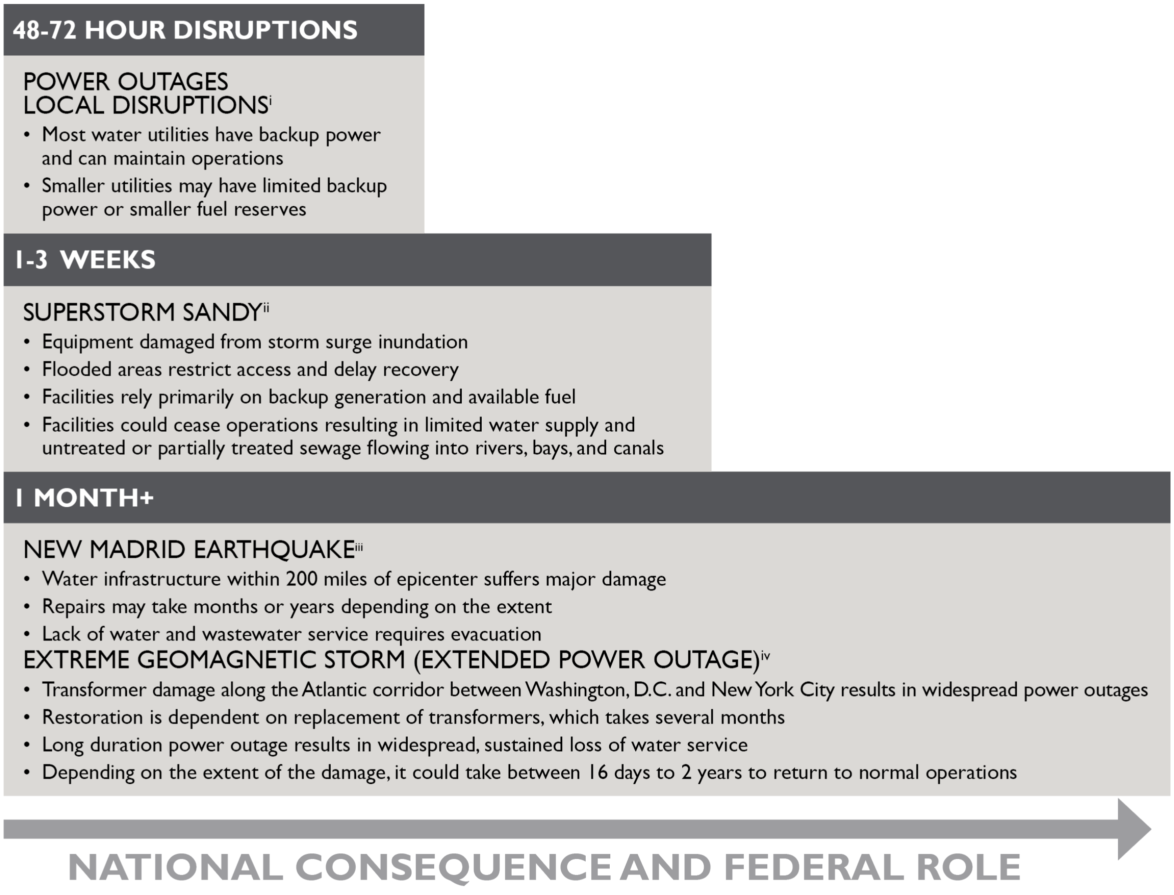
[22] Ibid.

[23] Ibid.

B. FEDERAL RESOURCES FOCUS ON RECOVERY AND WATER QUALITY

The Federal Government serves multiple roles in the sector, including regulator, enforcer, funder, and provider of critical aid and resources when service disruptions occur. This last role—providing critical aid and resources—is crucial during prolonged disruptions or shorter disruptions over a wide geographic area that can have national or regional consequences. Exhibit II-2 shows how the Federal role increases with the duration and scope of an event. Smaller utilities may be strained even during disruptions lasting from 48 to 72 hours, while larger utilities with deeper technical, personnel, and financial resources may need relatively little aid during shorter or intermediate disruptions, while. Virtually all systems will need aid for prolonged disruptions.

Exhibit II-2. Severity of Events and Increasing National Consequence and Federal Role



48-72 HOUR DISRUPTIONS

POWER OUTAGES
LOCAL DISRUPTIONS[i]

- Most water utilities have backup power and can maintain operations
- Smaller utilities may have limited backup power or smaller fuel reserves

1-3 WEEKS

SUPERSTORM SANDY[ii]

- Equipment damaged from storm surge inundation
- Flooded areas restrict access and delay recovery
- Facilities rely primarily on backup generation and available fuel
- Facilities could cease operations resulting in limited water supply and untreated or partially treated sewage flowing into rivers, bays, and canals

1 MONTH+

NEW MADRID EARTHQUAKE[iii]

- Water infrastructure within 200 miles of epicenter suffers major damage
- Repairs may take months or years depending on the extent
- Lack of water and wastewater service requires evacuation

EXTREME GEOMAGNETIC STORM (EXTENDED POWER OUTAGE)[iv]

- Transformer damage along the Atlantic corridor between Washington, D.C. and New York City results in widespread power outages
- Restoration is dependent on replacement of transformers, which takes several months
- Long duration power outage results in widespread, sustained loss of water service
- Depending on the extent of the damage, it could take between 16 days to 2 years to return to normal operations

NATIONAL CONSEQUENCE AND FEDERAL ROLE

[i] DHS OCIA, *Sector Resilience Report*, 2014.
[ii] FEMA, *Hurricane Sandy FEMA After-Action Report*, 2013.
[iii] Mid-American Earthquake Center, Virginia Tech, *New Madrid Seismic Zone Catastrophic Earthquake Response Planning Project*, 2009.
[iv] Lloyd's and Atmospheric and Environmental Research, Inc. (AER), *Solar Storm Risk to the North American Electric Grid*, 2013.

The Federal Government's role is most prominent in the regulation of water and wastewater quality by EPA. The Safe Drinking Water Act (SDWA) provides the basis for drinking water security by protecting water quality and sources of drinking water. It applies to systems designed for the public to consume water through pipes and other constructed conveyances. Under the SDWA, the EPA sets and oversees the implementation of standards for drinking water quality.

EPA delegates primary enforcement responsibility (termed primacy) to States if they meet certain requirements. The majority of States and territories have received primacy. For jurisdictions that do not have primacy, such as the District of Columbia and Wyoming, an EPA regional office administers the drinking water program.

STATE ROLE

In addition to administering Federal regulations State agencies:

- Implement State initiatives and priorities
- Maintain inventories of drinking water and wastewater facilities
- Regularly inspect drinking water and wastewater facilities
- Provide technical assistance and training
- Maintain laboratory and operator certification programs
- Monitor compliance by reviewing analytical results
- Review and approve plans and specifications for new and expanded drinking water and wastewater facilities

(*Source: EPA, 2015 SSP, 2016.*)

The Clean Water Act (CWA), also implemented by EPA, governs the quality of discharges to surface and groundwater. It establishes national technology-based standards for municipal waste treatment and numerous categories of industrial point-source discharges (e.g., discharges from fixed sources). Under the National Pollutant Discharge Elimination System (NPDES) program, the permitting authority (either a State agency or EPA) designates the use for a body of water and then adopts water quality criteria to protect those uses, which inform the permitting of discharges from wastewater treatment facilities.[24]

EPA is the Sector-Specific Agency (SSA), or Federal lead, for the Water Sector under the designations identified in PPD-21.[25] Most of the current and projected programs of the Water Security Division for fiscal year 2016 focus on actions designed to support the implementation of one or more of the Water Sector's priority activities as outlined in the *2015 Water and Wastewater Systems Sector-Specific Plan* (2015 SSP). This includes enhancing communication and coordination among utilities and government partners, and fostering engagements to strengthen public-private partnerships and improve response and recovery capabilities.

EPA regularly communicates and coordinates with the U.S. Department of Homeland Security (DHS) on Water Sector security and resilience, and works with DHS to implement presidential directives, executive orders, and statutes. Other Federal agencies that share aspects of the water security and resilience mission include the U.S. Army Corps of Engineers (USACE) for control of water resource infrastructure; the U.S. Department of the Interior (DOI) for dams, reservoirs, and water quality assessments; and the U.S. Department of Energy (DOE) for the interdependency between water and energy.[26]

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[24] EPA, *2015 SSP*, 2016.

[25] EPA, *2015 SSP*, 2016.

[26] Ibid.

Principal Federal funding available to States and municipalities is provided through two sources: EPA loans for water quality purposes and by the Federal Emergency Management Agency (FEMA) grants for emergency management. However, the pool of money available through FEMA is broader than just water and wastewater with FEMA grants going to a variety of qualified mitigation actions.

EPA's Clean Water State Revolving Fund (SRF) and Drinking Water SRF are partnerships between EPA and the States to provide low-interest loans for eligible water and wastewater projects. States operate their SRF programs and have the flexibility to target financial resources to specific community and environmental needs. As the money is paid back, the States are able to make new loans. The programs can provide different types of assistance under certain conditions, including refinancing, purchasing, or guaranteeing loan debt and purchasing bond insurance.[27] By comparison, the U.S. Department of Transportation (DOT) provides formula-driven grant dollars to States and transit agencies based on factors such as population, lane miles, and system condition. These transportation trust fund dollars provide certainty to States and local governments in planning their future investments. See Appendix F. Federal Policies, Agencies, and Activities for more information about the Federal role in funding, oversight, and resilience activities.

C. SECTOR PARTNERS OPERATE WITH A STRONG HISTORY OF COLLABORATION

Water utilities have a long, productive history of working together through associations and other collaborative mechanisms. This collaboration has produced a wealth of shared resources, including vital information, mutual-support relationships, planning processes, and analytical tools. The Federal Government built on this tradition of collaboration by using the partnership model, specified in HSPD-7, PPD-21, and NIPP 2013 to bring private and public sector participants into the planning and implementation of sector protection and resilience. EPA chairs the Water Government Coordinating Council (GCC), including Federal, State, and local entities, and the owners and operators of water utilities comprise the Water Sector Coordinating Council (Water SCC).

WATER SECTOR COORDINATING COUNCIL MEMBERSHIP

The Water Sector Coordinating Council membership is composed of water utility managers, two each appointed by the following representative associations: Association of Metropolitan Water Agencies (AMWA), American Water Works Association (AWWA), Water Research Foundation (WRF), National Association of Clean Water Agencies (NACWA), National Association of Water Companies (NAWC), National Rural Water Association (NRWA), Water Environment Federation (WEF), and Water Environment Research Foundation (WERF).

(*Source: Water SCC, "Charter of the Water Sector Coordinating Council," 2014.)*

The Water SCC member associations serve as the liaisons between the broader water services community and the government partners represented by the Water GCC.[28] The GCC—composed of Federal and State government representatives and national associations representing States—is

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[27] EPA, "How the Drinking Water State Revolving Fund Works," 2015; and EPA, "Learn about the Clean Water State Revolving Fund," 2016.

[28] Water SCC, "Charter of the Water Sector Coordinating Council," 2014.

chaired by EPA and co-chaired by the DHS Office of Infrastructure Protection. The GCC coordinates policy, strategy, and activities across government entities within the Water Sector.

Through public-private partnerships, the private sector works with government entities to help foster the innovative financing and technology needed to build infrastructure, provide service and maintenance for operations, and develop advanced technologies to improve security and resilience. Examples of private sector involvement in the Water Sector include:

- Vendors typically provide cyber assets, and some cyber operations positions may be staffed by contractors.
- American Water, the largest publicly traded water and wastewater utility company, launched a digital initiative with GE to harness advanced data and analytics to improve water infrastructure. [29] American Water is also collaborating with ComEd, an energy delivery company, on an Advanced Metering Infrastructure project to better manage water usage and water quality. [30]
- WaterStart is an organization located in Nevada that works with domestic companies, water agencies, policy makers, and international entities to test promising water technologies to help bring them to market faster. [31]

In addition, nongovernmental organizations (NGOs), such as the One Drop Foundation, serve as key partners who can help bring attention, funding, and expertise to public-private partnerships. NGOs work both domestically and internationally to raise awareness, work collaboratively with public and private entities, raise funds for water infrastructure safety and preparedness, and help foster new technologies that can improve water supply and sustainability.

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[29] American Water, “American Water COO Water Lynch Participates in White House Water Summit,” 2016.

[30] Ibid.

[31] WaterStart, “What WaterStart Does,” 2016; and Goldman, “Las Vegas is Betting It Can Become the Silicon Valley of Water,” 2016.

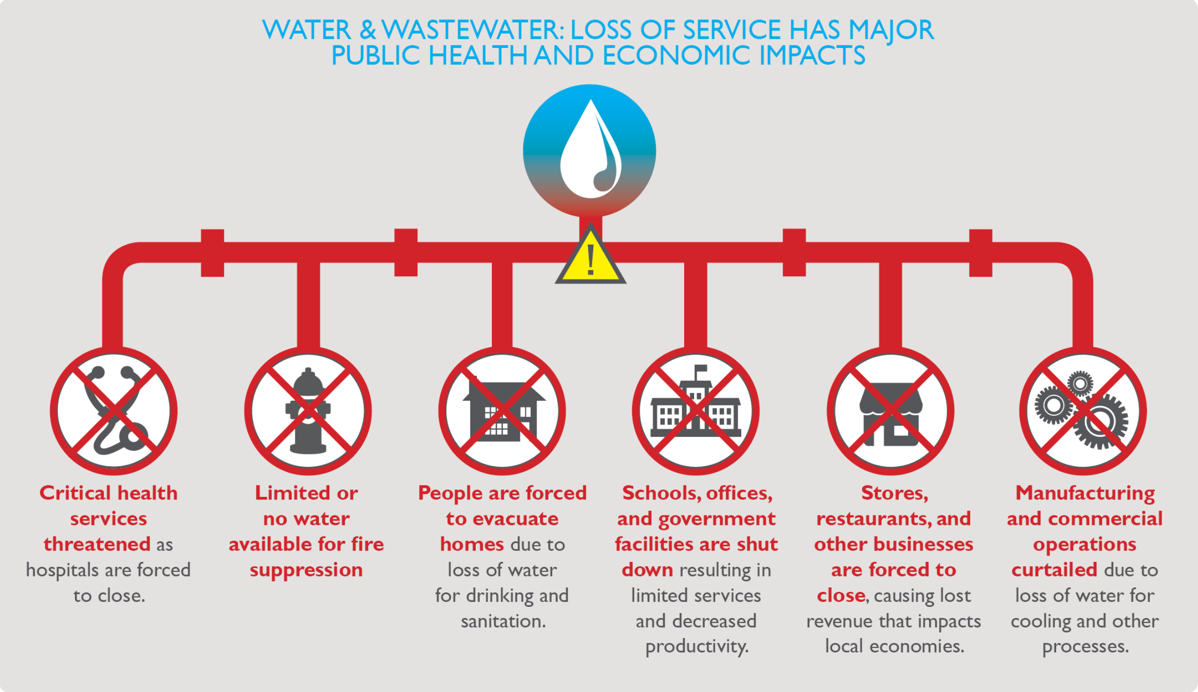
III. WATER SECTOR RISKS AND CRITICAL INTERDEPENDENCIES

Water services are essential to daily life, human health, and economic prosperity. Yet, these services are often misunderstood, undervalued, or taken for granted by both decision-makers and the public-at-large.

A. CONSEQUENCES OF WATER SERVICE DEGRADATION AND LOSS

When water and wastewater services are lost, even for short periods, the consequences can be widespread and dramatic. When these services are lost for an extended period of time, the results can be catastrophic. (See Exhibit III-1).

Exhibit III-1. Consequence of Water and Wastewater Service Disruptions



WATER & WASTEWATER: LOSS OF SERVICE HAS MAJOR PUBLIC HEALTH AND ECONOMIC IMPACTS

Critical health services threatened as hospitals are forced to close.

Limited or no water available for fire suppression

People are forced to evacuate homes due to loss of water for drinking and sanitation.

Schools, offices, and government facilities are shut down resulting in limited services and decreased productivity.

Stores, restaurants, and other businesses are forced to close, causing lost revenue that impacts local economies.

Manufacturing and commercial operations curtailed due to loss of water for cooling and other processes.

Secure and resilient water and wastewater infrastructure is essential to daily life, ensuring the economic vitality of the Nation and maintaining public confidence in utility services. Maintaining these services has many challenges, including:

- The capability to manage loss of water services varies widely according to utility size, resource base, and other factors.
- The economic costs of preparation and response may mean that there are insufficient funds to prepare for and address risks ahead of time and to the level at which the risk requires.

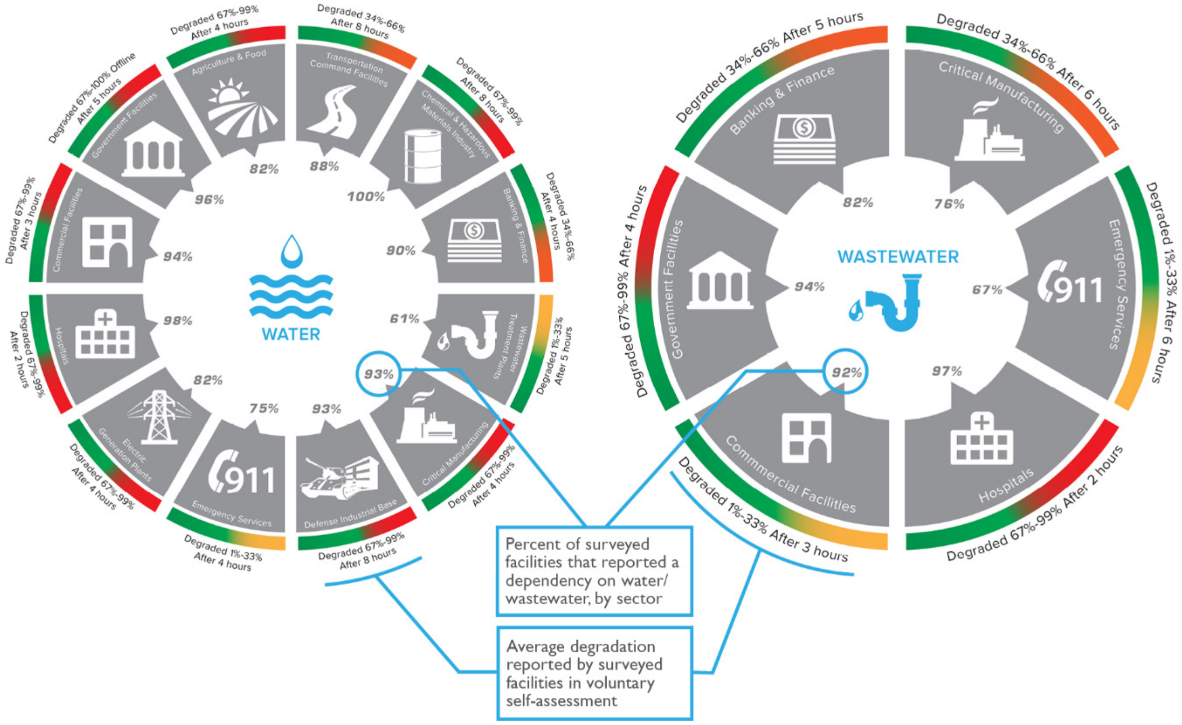
- An aging workforce that may result in loss of institutional knowledge and skills as employees retire.
- Reduced water consumption and conservation may result in less revenue available to maintain level of service and undertake infrastructure resilience projects.

While resilience—by nature—is a response to stressed conditions (natural or manmade disruptions to normal operating conditions), failures in nonstressed (normal) operating conditions may highlight underlying vulnerabilities that also affect resilience. The events such as those in Flint, Michigan show the underlying vulnerability of systems, and what can happen to a community when its water supply is disrupted. Resilience today in the Water Sector is very much a work in progress.
The following sections discuss sector risk and current practice, challenges facing the sector, and indicators of progress toward a more resilient future.

OTHER CRITICAL SECTOR SERVICES DEGRADE QUICKLY WITHOUT A FUNCTIONING WATER SECTOR

The Water Sector is considered one of the lifeline sectors because its functions are essential to core operations in nearly every other critical sector. When water services are lost for relatively short periods (less than eight hours), the functioning of multiple sectors is significantly degraded (see Exhibit III-2).

Exhibit III-2. Illustrative Impact of Water and Wastewater Disruption on Critical Sectors[32]



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[32] The information provided in the graphic is based on a limited sample of 2,661 voluntary facility assessments conducted between January 2011 and April 2014. The number of facilities represent a small fraction of the infrastructure across the United States, and respondents may not be geographically dispersed. The graphic

WATER OPERATIONS DEPEND HEAVILY ON OTHER LIFELINE SECTOR SERVICES

While the Water Sector is critical to all sectors, it is interdependent with several key sectors. Exhibit III-3 provides an overview of the impacts to water and wastewater services when electricity, communications, and transportation are disrupted.

Significant points of interdependencies include:[33]

- **Chemical Sector**: Chemicals are required to operate water and wastewater treatment facilities and water is often necessary in chemical manufacturing processes.
- **Energy Sector**: The Energy Sector relies on water services for different aspects of energy production and generation. The Water Sector relies on energy, specifically electricity, to operate its pumps, treatment facilities, delivery systems, and processing. Long-term power outages can overwhelm a water utility's backup energy supply or deplete fuel reserves. This scenario is worsened if the outage is systemic, in that multiple energy utilities in a region are shut down or multiple water utilities in a region have to compete for scarce backup resources. In addition, energy prioritization—the order in which disrupted sectors obtain energy services—may be an issue for water utilities as they work to restore services.
- **Communications and Information and Technology (IT) Sectors**: These sectors rely on water services for equipment cooling and facility operations, while the Water Sector relies on communications and IT for their operations and control systems, monitoring systems, internal communications, and communications with the public and emergency responders.
- **Transportation Sector**: Chemicals and other supplies are delivered by truck and rail. Water Sector personnel also rely on transportation to get to and from work.

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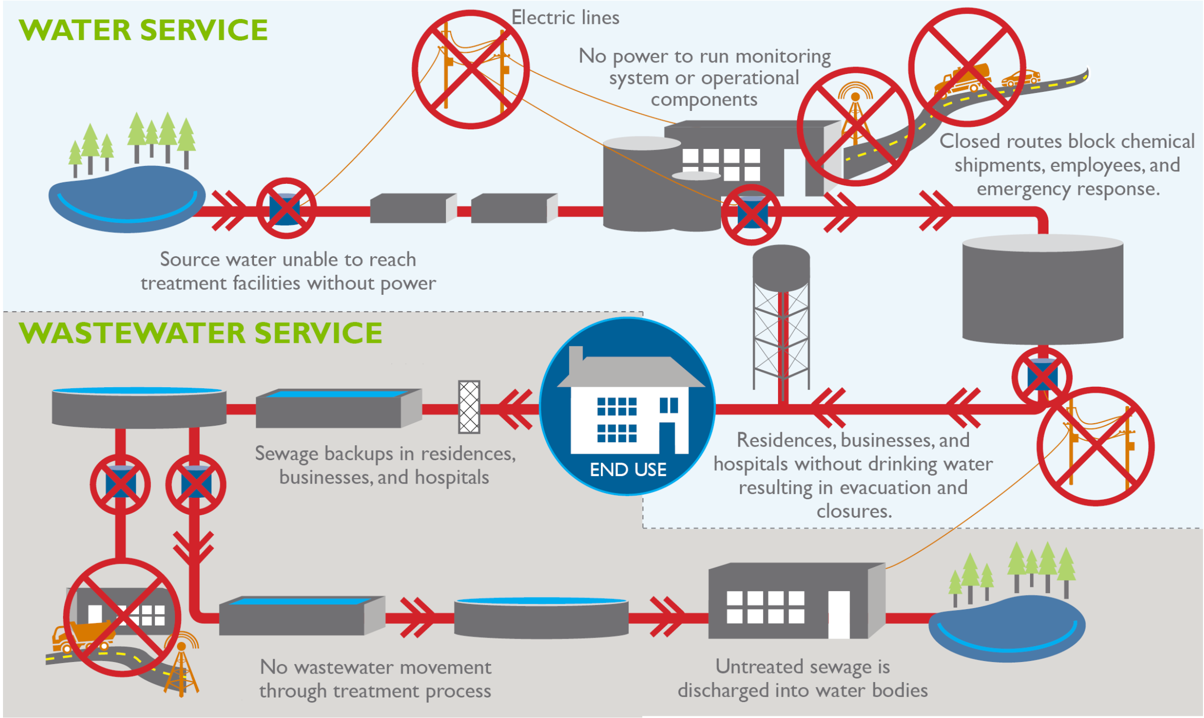
includes information on sectors where more than 60 percent of facilities within the group indicated a dependence on water or wastewater, and the percent degradation reported was the most frequent selection for the group—there may be other facilities that may be forced to evacuate after a certain amount of time within the sectors (DHS OCIA, *Sector Resilience Report*, 2014).

[33] DHS OCIA, *Sector Resilience Report*, 2014; and EPA, *2015 SSP*, 2016.

Exhibit III-3. Loss of Critical Infrastructure Services Effect on Water and Wastewater Services



Storing drinking water for short-term use to protect public health may seem almost routine—think of stocking up on water bottles and filling a bathtub before a major storm—yet it is impossible to store sufficient backup water or divert water resources to maintain water-intensive operations in places such as hospitals, office buildings, chemical plants, generators, and manufacturing facilities. Unlike electricity, water cannot easily be re-routed around disruptions, nor can facilities generate backup water onsite to maintain critical operations.

B. AGING INFRASTRUCTURE, CYBER DEPENDENCY, AND SEVERE WEATHER THREATS

Each water and wastewater owner and operator manages a unique set of assets and a distinct risk profile. Specific risks and risk-management priorities depend on utility size, location, assets and distinct risk profile. The following discusses three of the most significant, common risks faced by water and wastewater utilities.

DETERIORATING INFRASTRUCTURE IN A LIMITED-RESOURCE ENVIRONMENT

With the Nation's infrastructure suffering from chronic underinvestment, system failures and service shortfalls are becoming distressingly common. While this study focuses on the resilience of systems under stressed conditions, it does so with the understanding that improvements in resilience must go hand-in-hand with improvements to ensure consistent service under nonstressed conditions.

BY THE NUMBERS: AGING WATER INFRASTRUCTURE & INVESTMENT GAPS

- Inadequate capacity in wastewater systems creates as many as **75,000 sanitary sewer overflows per year**, discharging 3 billion –10 billion gallons of untreated wastewater and leading to as many as 5,500 different types of illnesses (EPA, *Impacts and Control of CSOs and SSOs*, 2004).
- Degrading assets contribute to an estimated **240,000 water main breaks per year** in the United States, a number that is likely to increase over the next 30 years (ASCE, "Drinking Water," *2013 Report Card*, 2013).
- Water infrastructure investment is not keeping up with the escalating need, creating an **investment gap that is expected to reach $105 billion by 2025** and continue growing over the coming decades (ASCE, *Failure to Act*, 2016).
- The EPA estimates that **$384 billion is needed to make necessary improvement**s for drinking water infrastructure between 2011 and 2030 (EPA, *Drinking Water Infrastructure Needs Survey and Assessment*, 2013).
- The EPA estimates that approximately **$271 billion is needed to maintain and improve** the Nation's wastewater infrastructure within the next five years (EPA, "EPA Survey Shows $271 Billion Needed for Nation's Wastewater Infrastructure," 2016).
- The American Water Works Association (AWWA) estimates it will cost **$1 trillion over the next 25 years** simply to maintain current levels of water service (AWWA, *Buried No Longer*, 2011).

The risks posed by systemic underinvestment in water infrastructure are being intensified by increasing vulnerability to extreme-weather events, cybersecurity challenges, and other threats. Current practice is often to patch and repair as incidents happen, at the expense of smart investment in resilient systems that has the potential to improve service at a cost below current practice.

Aging infrastructure and limited resources for adequate response planning and resilience investments are inextricably linked, creating a complex risk. Much of the water infrastructure has or is approaching the age at which it needs to be replaced. For both drinking and wastewater systems, the useful life of component parts ranges from 15 to 95 years depending on the component and its materials. For example, mechanical and electrical components in treatment plants and pumping stations have an average useful life of 15 to 25 years while the concrete structures of treatment plants and pumping stations average 60 to 70 years for drinking water and 50 years for wastewater.[34] Wastewater mains have an average useful life of 25 years while drinking water trunk mains have an average useful life of 65 to 95 years.[35]

> "The impacts from having aging infrastructure are substantial and without action they will become critical. Because most of this infrastructure is out of sight and because many fine professionals work every day to keep it operating under difficult conditions, the full extent of the challenge we face is generally not understood by government officials, businesses, and the public."
>
> *Dr. Gerald E. Galloway, PE, Martin Institute Professor of Engineering at the University of Maryland; July 25, 2013 statement to the U.S. Senate Committee on Energy and Natural Resources, Subcommittee on Water and Power*

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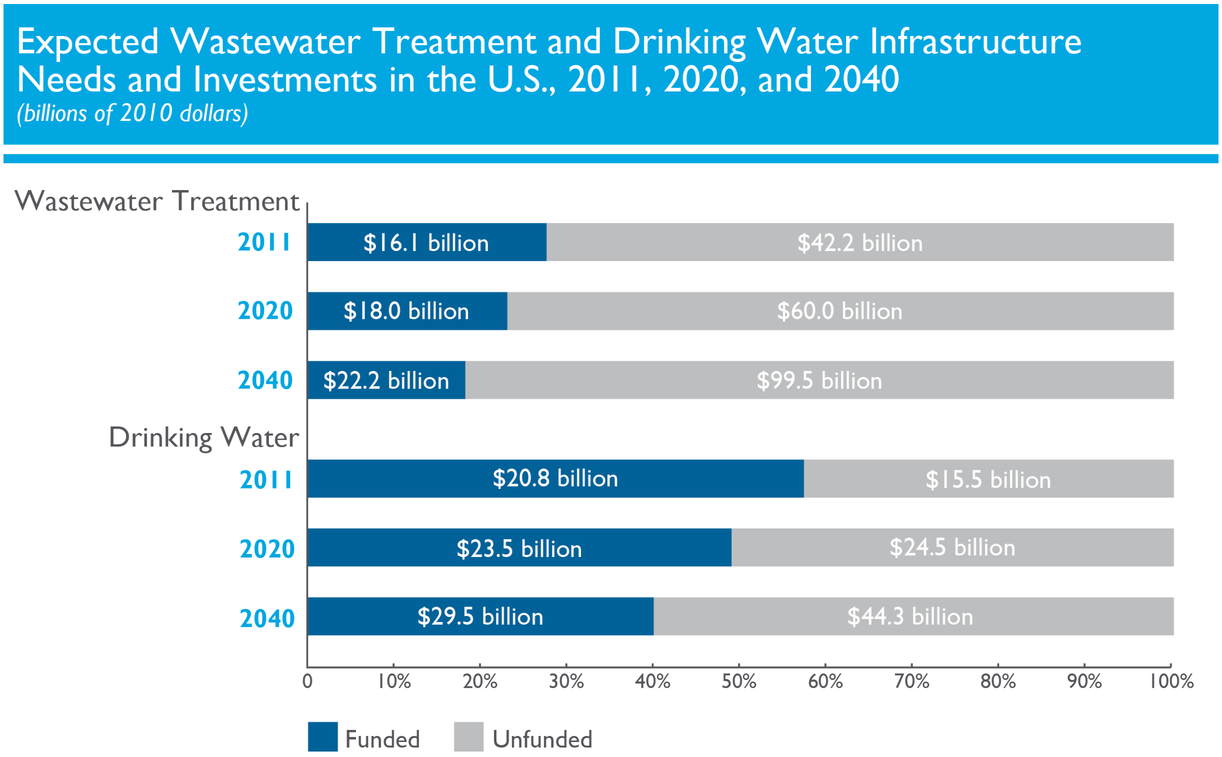
[34] ASCE, *Failure to Act*, 2011.

[35] Ibid.

Addressing this risk requires a massive investment in infrastructure. Estimates vary based on assumptions, time frames, and other factors; but it could cost several hundred billion dollars to as much as $1 trillion to address the Nation's infrastructure needs and maintain current levels of service.[36] Exhibit III-4 presents the American Society of Civil Engineers (ASCE) assessment of the sector's investments needs, specifically the gap between total need and the amount that is funded.

Exhibit III-4. Estimated Investment Gap for Water and Wastewater Infrastructure by ASCE[37]


Expected Wastewater Treatment and Drinking Water Infrastructure Needs and Investments in the U.S., 2011, 2020, and 2040
(billions of 2010 dollars)

SOPHISTICATED CYBER THREATS REQUIRE ADVANCED SOLUTIONS AND SPECIALIZED EXPERTISE

Water utilities increasingly use industrial control systems to continuously control treatment processes and delivery, remotely monitor operations, and control the pressure and flows in pipelines. These automated systems allow small teams of operators to efficiently and remotely manage complex physical processes using digital controls. Growing reliance on industrial control systems over the last decade has resulted in increased connectivity, a proliferation of cyber access points, escalating system complexity, and wider use of common operating systems and platforms—factors that increase cyber risk and require sophisticated cyber protections.[38]

Similar to companies in every sector, water utilities must protect their email, business systems, and billing systems from cyberattacks to protect sensitive business and customer data. Yet cybersecurity is even more imperative for the Water Sector's process control systems; a successful intrusion could

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[36] AWWA, *Buried No Longer*, 2011.

[37] Chart recreated from ASCE, *Failure to Act,* 2011.

[38] Water SCC Cyber Security Working Group, *Roadmap to Secure Control Systems in the Water Sector*, 2008.

allow malicious actors to manipulate or disrupt water treatment and services, damage equipment, and compromise the safety of the water supply.[39] Attacks involving process control and monitoring systems could risk customer health and erode public trust in the water system.

These threats are no longer hypothetical. Hackers recently hijacked a water treatment plant's industrial control system and modified the levels of chemicals being used to treat water. In a March 2016 report, Verizon Security Solutions reported that it was investigating a data breach for an undisclosed water treatment facility, when it discovered that hackers who breached the payment system were also able to manipulate the controllers that manage the amount of chemicals used to treat the water supply.[40] The hack disrupted water treatment but did not affect the safety of the water—though it provided insight into the type of damage a more experienced or targeted hack could inflict. System knowledge also makes insider threats particularly insidious. For example, in 2001, a disgruntled ex-employee of an Australia software vendor hacked into a wastewater treatment plant and released 264,000 gallons of raw sewage into local rivers and parks.[41]

Cyber threats are not one dimensional; vulnerabilities stem from personnel, processes, and technology. As cyber threats grow and evolve, utilities will require broad-based knowledge and tools, and most importantly, experienced personnel to understand cyber threats and apply new processes, technologies, and best practices to secure cyber systems.

THE MANY DIMENSIONS OF THE CYBER THREAT

- Industrial control systems monitor and control highly distributed physical processes, including remote control of often unmanned facilities. Utilities require the tools and expertise to rapidly detect and recognize cyberattacks.
- Cyber and physical security is intimately linked. A cyber intrusion could give a hacker the ability to manipulate physical processes (such as chemical treatment and water flows), while insufficient physical security (such as an unsecured control room door) could give an individual unauthorized access to critical cyber controls.
- Utilities primarily rely on hardware and software vendors to develop secure control systems and patch vulnerabilities. Utilities need a strong understanding of cybersecurity requirements to procure secure technologies.
- Spearfishing attacks that aim to obtain operator credentials are a key threat. With the right credentials, even an inexperienced hacker can cause disruption or damage. Disgruntled employees with control system access also pose a threat.
- Increasing reliance on automated systems and growing sophistication of cyber threats requires a large increase in resources for staff training, cybersecurity advances, and knowledge acquisition.
- Smaller utilities often lack the resources and specialized personnel needed for cybersecurity improvements. For example, larger facilities may have the resources to maintain a separate, more-secure system for operational systems. This is rare in smaller utilities.

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[39] Ibid; and DHS OCIA, *Sector Risk Snapshots*, 2014.

[40] Verizon Security Solutions, *Data Breach Digest: The Usual Suspects*, 2016.

[41] Godwin, "Water and Wastewater Cybersecurity," 2015.

NATURAL DISASTERS AND INCREASINGLY SEVERE WEATHER PATTERNS

Natural disaster can harm water quality, limit service availability, and damage infrastructure. Floods, hurricanes, earthquakes, and ice storms are of particular concern for water utilities, but the sector has centuries of experience managing such risks.[42]

The increased intensity and frequency of severe weather (e.g., major flooding) patterns linked to climate change threatens drinking water and wastewater infrastructure.[43] For example, most water facilities are located near bodies of water. Expected climate change impacts are sea level rise and higher storm surge, which can flood facilities, damaging equipment and halting operations. To prepare for this, facilities may need to move crucial equipment above expected flood levels. Increasing precipitation and drought can also degrade water quality, resulting in increased treatment needs to meet requirements.[44]

Black Sky Events

The Water Sector has a remarkable track record of maintaining water and wastewater services service during distressed conditions and minimizing the impact of disruptions that range from a few hours to a few weeks. The public is often unaware of the “near misses” that the sector has skillfully avoided. Disruptions are usually confined to local areas, but in rare cases—such as Superstorm Sandy—rise to a national-level event. But experts are predicting that far more serious incidents could take place in the near future. Often referred to as “black sky events,” these high-impact, uncertain probability events could cause a combination of severe physical damage to infrastructure and widespread, long-duration power outages lasting months or even years. Without power, water service cannot be provided.

> “If we look at the experience of the Water Sector during Superstorm Sandy, the sector by and large did a terrific job of sustaining services. But a number of them were on the knife’s edge of failure due to problems in the resupply of diesel fuel for stand-by generators, the burning out of generators and the scarcity of replacement spares, and other factors. I’m concerned that longer duration, wide area power outages in a black sky event would push us over that knife’s edge and lead to serious disruptions in water and wastewater service.”
>
> *Dr. Paul Stockton, Managing Director of Sonecon, LLC, and former Assistant Secretary of Defense for Homeland Defense*

Examples of potential black sky events, include:

- An earthquake in the New Madrid Fault Zone, which could cause extensive damage within 200 miles of the epicenter. A New Madrid earthquake was one of the five disruption scenarios the Study Group evaluated to assess Water Sector resilience during a high-impact event. (See Appendix C. Disruption Scenario Case Study for more details on the five disruption scenarios).

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[42] EPA, *2015 SSP*, 2016.

[43] EPA, “Climate Change: Basic Information,” 2016.

[44] NACWA and AMWA*, Confronting Climate Change.* 2009.

- High-magnitude earthquakes in sections of the San Andreas Fault, which experts indicate are overdue.[45] In 2008, the U.S. Geologic Survey examined the consequences of a major earthquake along this fault line in southern California. Despite the State's mitigation efforts, pipes that cross the fault line would be damaged or broken. In addition, due to the large area affected, there would not be enough replacement materials and pipes or people trained to install them quickly. It could take several weeks to up to six months to complete repairs and reestablish normal water and wastewater service. Recreating the water system may be necessary in the hardest hit areas, and for some pipelines, equipment and electronics, repairs could take up to five years to complete. The estimated cost to repair the water and sewer lines is $1 billion.[46]
- An extreme geomagnetic storm could also have widespread impacts that cross State lines and cause severe damage to transformers and other electrical equipment. A 2013 report by Lloyd's and Atmospheric and Environmental Research found that the greatest risk of this type of event is along the coast between Washington, D.C. and New York City, and that areas of the Gulf Coast and Midwest are also at high risk. The expected duration of the power outages could range from 16 days to up to two years depending on the availability of replacement electrical transformers.[47] The associated loss of water service can be expected to be of similar severity.

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[45] Lin, "San Andreas Fault,'" 2016; and Jones, et al., *The ShakeOut Scenario*, 2008.

[46] Jones, et al., *The ShakeOut Scenario,* 2008.

[47] Lloyd's and Atmospheric and Environmental Research, Inc., *Solar Storm Risk*, 2013.

WHEN INFRASTRUCTURES FAIL

Major infrastructure failures often expose the true value of the safe, reliable service we expect from our critical sectors. The examples below illustrate how serious infrastructure failures—in transit, electricity, and drinking water—can have severe near- and long-term consequences, regardless of the cause.

- **Minneapolis Bridge Collapse**: On August 1, 2007, the I-35W Bridge in Minneapolis, Minnesota suffered a catastrophic failure and collapsed into the Mississippi River, killing 13 people and injuring 145 people. The bridge carried more than 140,000 vehicles each day and provided access to downtown Minneapolis, the University of Minnesota, and businesses. The economic impact for drivers that used the bridge was $400,000 per day. For the State, the loss of the bridge resulted in economic impacts of about $17 million in 2007 and $43 million in 2008 (NTSB, *Collapse of I-35W Highway Bridge*, 2008; Minnesota DEED and Mn/DOT, *Economic Impacts of the I-35W Bridge Collapse*, n.d.; Jones, "Friday Marks 7 years since I-35W Bridge Collapse," 2014).
- **Superstorm Sandy**: Hurricane Sandy made landfall on Oct. 29, 2012 near Atlantic City, New Jersey as a post-tropical cyclone with heavy rains, 80-90 mph winds, and storm surges along the East Coast. One week later a Nor'easter swept into the affected region with strong winds, rain and snow, and coastal flooding, giving Sandy the "superstorm" moniker. In New Jersey, more than 200 million gallons of water from the tidal surge engulfed one of the largest wastewater treatment plants in the United States, operated by the Passaic Valley Sewerage Commission. The 152-acre plant stood in four feet of water (with 15—30 feet of flooding in underground systems), sustained damage to critical machinery and lost power for three days. Extensive dewatering of sewage sludge and critical repairs to bring the plant back to operation cost an estimated $200 million—about $50 million more than the commission's total annual operating budget (NIAC, *Regional Resilience*, 2013).
- **2003 Northeast Blackout**: On August 14, 2003, a confluence of events triggered a cascading electric transmission failure that caused a blackout across Ohio, Michigan, Pennsylvania, New York, Vermont, Massachusetts, Connecticut, New Jersey, and the Canadian province of Ontario. The blackout lasted up to four days in some locations, left 50 million people without power, contributed to at least 11 deaths, and cost $4 billion--$6 billion. The U.S.-Canada Power System Outage Task Force found that the blackout was caused by deficiencies in corporate policies, lack of adherence to industry policies, and inadequate management of reactive power and voltage (Minkel "The 2003 Northeast Blackout—Five Years Later," 2008; U.S.-Canada Power System Outage Task Force, *Final Report on the August 14, 2003 Blackout*, 2004).
- **Flint Water Contamination Crisis**: In April 2014, the water source serving the City of Flint, Michigan—with a population of 99,000 people—was switched from Lake Huron (treated by Detroit Water and Sewerage Department) to the Flint River (treated by the Flint Water Treatment Plant). The more corrosive Flint River water required corrosion-control treatment, but it was not put in place when the switch occurred. The untreated water corroded the lead feeder pipes that connect homes to the underground water mains, causing lead to leach into the drinking water. The Flint Water Advisory Task Force found that a mismanagement of the drinking water supply caused Flint water customers to be exposed to toxic levels of lead and other hazards. Appendix H. The Flint Water Crisis provides a detailed examination of this failure of water services (Flint Water Advisory Task Force*, Final Report, 2016;* Adams, "Closing the valve on history," 2014; Edwards, "Test Update: Flint River water 19X more corrosive," 2015).

IV. WATER INFRASTRUCTURE RESILIENCE TODAY

Chronic underinvestment, system failures, and service shortfalls are becoming increasingly common in the Nation's infrastructure. Though this study focuses primarily on the resilience of systems under highly stressed conditions, resilience improvements must go hand-in-hand with strategies and practices to ensure reliable operations under normal, nonstressed conditions. There is a broad body of knowledge available today—principally from water associations—on resilience strategy and practices for water utilities. Translating resilience knowledge into widespread practice, however, is often limited by resource constraints and funding challenges that require innovative strategies and collaborative approaches to address. This Chapter reviews the current state of practices, major challenges to raising resilience in the sector, and key indicators of progress.

A. CURRENT PRACTICE

Each water and wastewater owner and operator manages a unique set of assets and operates under a distinct risk profile. As such, each utility's risk-management priorities depend on many factors, including utility size, location, assets, distinct risks, and perhaps most importantly, the resources and capabilities the utility can access.[48] Some serve growing populations with increasing resources, while others serve shrinking populations with declining tax bases that must maintain systems, which are now oversized for the population they serve. While each utility is responsible for its own risk management, sector-wide collaboration and information sharing plays a major role in boosting the resilience of individual systems and the sector as a whole.

Key aspects of resilience practices in the sector are outlined below; Appendix G. Baseline Resilience in the Water Sector provides a more extensive review of the sector's components, risks, and practices.

HIGHLY DIVERSE RESOURCES AND CAPABILITIES

Water and wastewater utilities are quite diverse; some develop and implement leading-edge practices while others lack access to essential information, knowledge, expertise, tools, and lessons learned. Despite the value of these resources among water utilities, adoption of successful practices and resources has not been fully realized across the sector. The adequacy of human capital within the Water Sector is a growing concern, particularly with regard to knowledge retention and talent acquisition. Challenges that require new skill sets and training—such as cybersecurity—constrain the ability of utilities to adapt to a changing environment. The loss of institutional knowledge due to retirements compounds this shortfall.

The relatively few very large systems in the Water Sector that serve the majority of the Nation's population —about 20 percent of water and wastewater systems serve more than 90 percent of the population—tend to have comparatively strong resilience measures in place. Smaller systems do not

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[48] Water SCC, "Charter of the Water Sector Coordinating Council," 2014; and CIPAC Water Sector Strategic Priorities Working Group, *Roadmap to a Secure and Resilient Water Sector*, 2013.

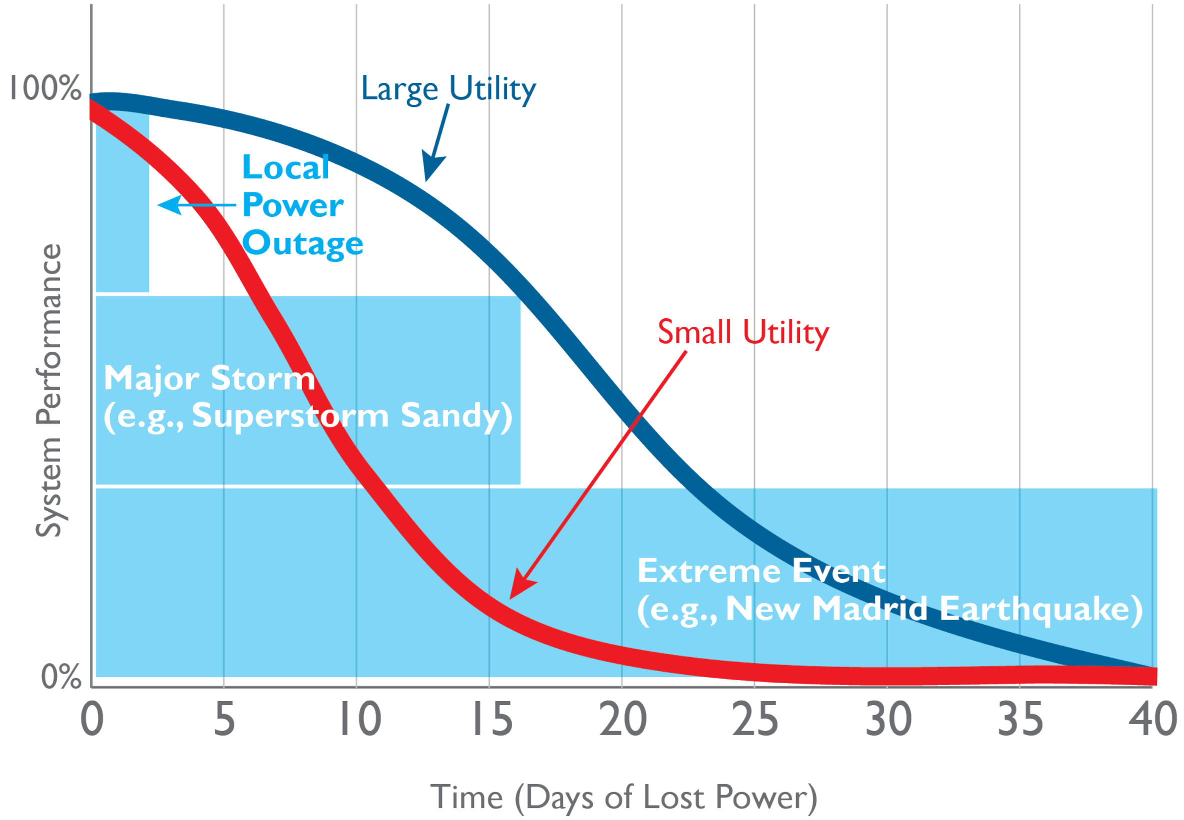
enjoy the same level of resources, and must rely on the transfer of knowledge and tools from other experts. Associations representing components of the Water Sector, aided by DHS and EPA, have been very active in developing and disseminating models, tools, and best practices, which are transferable to smaller systems. The *2015 Water SSP* includes many examples of this resilience-building approach.[49]

UTILITY RESPONSE CONSTRAINED BY SIZE AND RESOURCES

The Water Sector is adept at maintaining water services during short-term disruptions, such as a power outage lasting less than 24 hours. Beyond that time frame, the ability to maintain services depends largely on the size of the system, its location, and access to resources. For example, large utilities in a metropolitan region may have more robust backup and contingency resources, and depending on their location may have more options that allow them to "fail gracefully," such as access to mobile generators, access to nearby water utilities in the region that can provide aid, or relationships with other critical infrastructure partners that can share resources.

Exhibit IV-1 is a conceptual graph that shows how degradation of services can differ between large and small utilities. Larger utilities often are more equipped to handle power outages or other disruptions to critical infrastructure for several days or longer. But when disruptions stretch out into weeks or months, all systems—regardless of size—will need help maintaining services.

Exhibit IV-1. Conceptual Degradation Curve between Large and Small Utilities during Disruptions



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[49] EPA, *2015 SSP,* 2016. Appendix 6, Table A6-1, pp. 47-49.

FEDERAL INVOLVEMENT

The Water Sector is facing a dynamic and complex risk environment in which the full impacts of water disruptions and potential cascading impacts are not fully understood among critical infrastructure operators, local and State leaders, and water service customers. As such, the history of major disruptions show that water and wastewater services are receiving inadequate attention in disaster planning, prevention, and response among public officials and interdependent sectors. The lack of widespread, cross-jurisdictional collaboration can lead to stovepiped decision-making that is counterproductive to effective emergency response.

As noted in Chapter II. Water Sector Operational Snapshot, the Federal Government's role in the Water Sector is primarily focused on water quality (EPA) and emergency response and recovery (FEMA). Resilience has not been substantially integrated into the actions of Federal agencies and resilient outcomes are not typically part of Federal programs and resources. In contrast to the Energy and Transportation Sector, the Water Sector does not have a cabinet-level department and there is no dedicated Emergency Support Function (ESF) for water.

Current authority for water is distributed across four ESFs and multiple Federal agencies, leading to uncertainty, leadership challenges, information-sharing complications, and an overtaxing of Water Sector response resources—all of which can impede water service recovery during disasters. In contrast, the Energy Sector has a dedicated ESF. In our 2009 report, *Framework for Dealing with Disasters and Related Interdependencies*, the Council recommended that the Water Sector should be elevated to an ESF within the National Response Framework (NRF) during the next revision cycle.[50] Despite the fact that the NRF was revised and released in 2013; the Water Sector remains disbursed across four different ESFs.[51]

EMERGENCY SUPPORT FUNCTION (ESF) AND THE WATER SECTOR

What is an ESF? ESFs provide the structure for coordinating interagency support in response to an incident. They are mechanisms for grouping common disaster response functions, with each ESF composed of multiple agencies performing similar functions as a single, cohesive unit. There are 15 different ESFs designed to improve emergency management and response.[52]

What is the relationship between ESF and the Water Sector? Responsibilities for emergency water service support is disbursed across four different ESFs: ESF 3 (Public Works and Engineering), ESF 4 (Firefighting), ESF 6 (Mass Care, Emergency Assistance, Housing, and Human Services), and ESF 8 (Public Health and Medical Services). Essentially, water and wastewater services are a subordinate function under four different ESFs, with each ESF having a different ESF Coordinator/Primary Agency responsible for that function. Under this design, water agencies do not have sufficient visibility with function leadership or the resources to support four different ESFs during an emergency.[53]

Water Sector	Energy Sector
• **ESF structure disbursed** across 4 different ESFs	• **Dedicated ESF structure**, ESF #12

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[50] NIAC, *Framework for Dealing with Disasters and Related Interdependencies*, 2009.

[51] FEMA, *National Response Framework*, 2013.

[52] FEMA, *Emergency Support Function Annexes*, 2008.

[53] NIAC, *Framework for Dealing with Disasters and Related Interdependencies*, 2009.

COLLABORATION IN PLANNING

The Critical Infrastructure Partnership Advisory Council (CIPAC) Water Sector Strategic Priorities Working Group developed the *2013 Roadmap to a Secure & Resilient Water Sector* (2013 Roadmap) to prioritize activities to strengthen sector security and resilience. The 2013 Roadmap identified three top priorities for the Water Sector over the next five years: 1) advance the development of sector-specific cybersecurity resources; 2) raise awareness of the Water Sector as a lifeline sector and recognize the priority status of its needs and capabilities, and 3) support the development and deployment of tools, training, and other assistance to enhance preparedness and resilience.[54]

These priorities are currently being used by public-private partners in the Water Sector to focus on activities in a two- to five-year timeframe that can strengthen the sector's ability to plan for effective response and recovery, maintain resilience during a calamitous event, and garner support for both disaster and risk-mitigation cost recovery.

INFORMATION SHARING TO SUPPORT RESILIENCE

Information sharing plays an essential role in the security and resilience of the Water Sector. There are several key information-sharing methods extensively used in the sector. Associations play a fundamentally critical role in knowledge development and transfer, as well as in developing practices to share multiple types of resources during disasters. One of the most well-known and utilized mechanisms is the Water/Wastewater Agency Response Network (WARN), which is active in all 10 FEMA regions and Canada. In addition to providing mutual aid and assistance, WARN provides valuable after-action reports, such as the WARN *Superstorm Sandy After-Action Report*.

The Water Information Sharing and Analysis Center (WaterISAC) serves as an information-sharing arm of the sector. Members include hundreds of utilities serving more than 200 million people in the United States, as well as Federal, State, and local agencies and consulting firms.[55]

WARN: WATER UTILITIES HELPING WATER UTILITIES

The Water Sector is designated a lifeline critical infrastructure sector, meaning that other sectors depend on it to recover after a major disruption. Bringing disrupted water utilities back online to mitigate further disruption to other sectors and the community is a priority mission. To assist in this mission, AWWA led the creation of the Water and Wastewater Agency Response Network (WARN).

WARN is a network of utilities helping other utilities to respond and recovery from disruptions. Participating utilities can provide and receive emergency assistance (personnel, equipment, materials, and other critical services), as necessary, from other water or wastewater utilities. Mutual aid networks like WARN enable water utilities to:

- Secure sector-specific resources to quickly respond/recover from a disaster; and
- Build relationships with similar or nearby utilities that can be leveraged during preparedness, response, or recovery.

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[54] CIPAC Water Sector Strategic Priorities Working Group, *Roadmap to a Secure and Resilient Water Sector*, 2013.

[55] National Council of ISACs, "Join Your Sector's Information Sharing and Analysis Center," 2015

B. CHALLENGES

Developing and sustaining effective risk-management practices comes with a broad range of challenges. While the challenges may vary according to a utility's size, resource base, and experience in risk management, the following challenges reflect common and critical challenges for water and wastewater utilities:

- **A Difficult Starting Point**. The Nation's water infrastructure is aging and needs reinvestment. Although there are certainly exceptions, too many systems are old, fragile, and have served well beyond their planned life spans. Restoring the long-term viability of these systems will be difficult—just to meet the demands of nonstressed conditions.
- **Support for Water as a Public Good**. Water services exist in a quasi-public-service world. While often considered a public good, they are nonetheless generally operated on a basis that does not account for the full life-cycle costs of systems. Inequities among wealthy and poor communities can exacerbate the affordability of clean water and create social justice concerns. A public good requires public investment.
- **Backing Solutions with Decisions**. An extensive array of knowledge, tools, and potential solutions has been developed by Water Sector professionals—in individual utilities and in professional associations. However, widespread improvement in resilience can only be achieved by adoption and funding of these potential improvements by decision-makers.
- **Enabling New Approaches**. Most State and municipal decision-makers are constrained by the long-held expectations by customers for water as a low-cost, affordable service that does not account for true life-cycle costs. This is particularly challenging in low-income areas with a shrinking tax base and limited economic opportunities. Political reluctance to opt for new technology, funding, and investment approaches –which may substantially differ from traditional ones and may constrain progress. With new challenges, the need for and value of new approaches must be understood.
- **Partnership and Champions.** The Federal Government involvement with services that are primarily delivered at the local level is understandably constrained. However, the government can assist by providing invigorated leadership with guidance, resources, incentives, and innovative approaches that leverage infrastructure investments into jobs. The challenge is simply too large for States and municipalities to go it alone.

C. INDICATORS OF PROGRESS

A number of concerted efforts by Water Sector partners have made progress in achieving the shared vision of a secure and resilient drinking water and wastewater infrastructure. This infrastructure provides clean and safe water as an integral part of daily life and ensures the economic vitality of and public confidence in the Nation's drinking water and wastewater service. Enhanced collaboration has yielded advances in areas such as the improved sharing of resources; the expanded use of new tools, knowledge, and training; and improved characterization of emerging threats, such as cyber intrusions and extreme-weather events.

Several examples of these collaborative successes are presented in Exhibit IV-2 and highlight both the critical role played by associations and the collaborative nature of successful endeavors. Appendix I. Collaborative Tools and Practices presents additional examples.

Exhibit IV-2. Examples of Collaborative Efforts for Improving Water Sector Resilience

RISK AND RESILIENCE MANAGEMENT OF WATER AND WASTEWATER SYSTEMS

AWWA developed standard J100-10 (R13), the first voluntary consensus standard encompassing an all-hazards risk and resilience management process for use specifically by water and wastewater utilities. It is a foundational, consensus-based standard that encompasses an all-hazards risk and resilience management process for use specifically by water and wastewater utilities.[56]

CIPAC WATER SECTOR CYBERSECURITY STRATEGY WORKGROUP: FINAL REPORT & RECOMMENDATIONS

The report recommends approaches to outreach and training to promote the use of the *National Institute of Standards and Technology* (*NIST) Framework for Improving Critical Infrastructure Cybersecurity;* identifies gaps in available guidance, tools, and resources for addressing this framework in the sector; and identifies measures of success that can be used by Federal agencies to indicate the extent of use of the framework in the Water Sector.[57]

ROADMAP TO A SECURE & RESILIENT WATER SECTOR

Developed by the CIPAC Water Sector Strategic Priorities Working Group, the roadmap establishes a strategic framework that articulates the priorities of industry and government in the Water Sector to manage and reduce risk. It also produces an actionable path forward for the Water Sector GCC, SCC, and government and private sector security partners in the sector to improve the sector's security and resilience within the next five years.[58]

CYBERSECURITY GUIDANCE & TOOL

Based on recommendations in the *2008 Roadmap to Secure Control Systems in the Water Sector*, AWWA's Water Utility Council developed a cybersecurity resource designed to provide actionable information for utility owner/operators based on their use of process control systems. The Use-Case Tool provides the foundation of a voluntary, sector-specific approach for adopting the NIST Cybersecurity Framework, created in response to Executive Order 13636 – Improving Critical Infrastructure Cybersecurity.[59]

EPA WATER INFRASTRUCTURE AND RESILIENCY FINANCE CENTER

In January 2015, EPA launched the Water Infrastructure and Resiliency Finance Center, which supports the government-wide Build America Investment Initiative. The center provides communities, municipal utilities, and private entities with information and technical assistance on how to effectively use existing Federal funding programs, access leading-edge financing

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[56] AWWA, *AWWA J100-10 (R13) Risk and Resilience Management of Water and Wastewater Systems*, 2010.

[57] CIPAC Water Sector Cybersecurity Strategy Workgroup, *Final Report and Recommendations*, 2015; and NIST, *Framework for Improving Critical Infrastructure Cybersecurity*, 2014.

[58] CIPAC Water Sector Strategic Priorities Working Group, *Roadmap to a Secure and Resilient Water Sector*, 2013.

[59] AWWA, "Cybersecurity Guidance & Tool;" and AWWA, *Process Control System Security Guidance for the Water Sector*, 2014.

solutions, and develop innovative procurement and partnership strategies. Although relatively new, the center has already undertaken several initiatives including establishing a network of university-based Environmental Finance Centers that correspond to the 10 EPA Regions; hosting Regional Finance Forums to bring together municipal officials and interested stakeholders to facilitate peer-to-peer interactions, share best practices, and build relationships; and providing technical assistance and tools through its Community Assistance for Resiliency and Excellence (WaterCARE) program. The center, which is advised by EPA's Environmental Financial Advisory Board, also works closely with other Federal partners.[60]

TRANSFORMING COMMUNITIES THROUGH SUSTAINABLE INFRASTRUCTURE INVESTMENTS

Leading organizations are rethinking how investment in resilient infrastructure can be leveraged to create new opportunities to reinvigorate communities, increase inclusion, and stimulate local business investment. The San Francisco Public Utilities Commission (SFPUC) has created a Community Benefits Program that engages neighborhoods that are directly affected by the operation of its water, wastewater, and power enterprises. The program includes education, workforce development, economic development, land use, neighborhood revitalization, funding for the arts, localized professional services contracts, and philanthropic partnerships. SFPUC seeks to balance economic, environmental, and social equity goals to expand economic inclusion, create job opportunities, revitalize low-income neighborhoods and support climate change priorities.[61]

In the Transportation Sector, Secretary of Transportation Anthony Foxx recently issued a letter that encourages grantees and stakeholders to take advantage of opportunities to leverage $305 billion in Fixing America's Surface Transportation (FAST) Act funding to create new jobs, pointing out that every $1 billion invested in Federal highway and transit infrastructure would support 13,000 jobs. A new pilot program, for example, enables recipients of Federal highway and transit funds to use innovative contracting requirements designed to create jobs that may have traditionally been disallowed due to competition concerns. Another approach, the U.S. Employment Plan developed by the Jobs to Move America Coalition, contains a contractual provision that provides incentives for companies to create American jobs, locate facilities in the United States, and generate opportunities for unemployed workers through recruiting and training efforts.[62]

In essence, there is a great deal of information about the *mechanics* to solve the problem—what to do, how to do it, and who to work with—this is only the start of a solution. The *political challenge*, which spans the spectrum from developing public understanding to the willingness of elected officials to opt for investment, is daunting. The mechanics of a solution may well be easier than obtaining political will.

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[60] EPA, "About the Water Infrastructure and Resiliency Finance Center," 2016.

[61] SFPUC, "Community Benefits Program," 2013.

[62] Office of the Secretary of Transportation, "Letter to Transportation Stakeholders," 2016.

V. FINDINGS AND RECOMMENDATIONS

The Water Sector is a lifeline sector that is critical to the core operations of other sectors and essential to human health and daily life. The Water Sector faces a unique set of challenges due to services being historically reliable and low-cost, and out of sight of the public and decision-makers.

A. FINDINGS

Through interviews with Federal agency representatives and subject matter experts, extensive research, and the work of the Study Group, the Working Group identified six areas of findings that encompass the challenges, needs, and strategies for improving security and resilience within the Water Sector:

1. Poor Understanding of the Criticality of the Water Sector
2. Inadequate Valuation of Water Services
3. Wide Disparity of Capabilities and Resources
4. Significant Underinvestment in Water Sector Resilience
5. Fragmented and Weak Federal Support for Water Resilience
6. Regional Collaboration Not Broadly Applied

The findings highlight the criticality of water, the need to address emerging risks, and the significant challenge of funding needed improvements to water and wastewater infrastructure.

Finding 1: Water is not given appropriately high priority as a critical lifeline sector by public officials and dependent sectors during disaster planning, prevention, and response.

The Water Sector is facing a changing and complex risk environment, and critical infrastructure operations, State and local leaders, and customers often do not understand the full impacts of water service disruptions, including the potential cascading impacts of extended disruptions. As a result, the Water Sector may not receive the high priority it deserves to perform emergency restoration. For example, water utility employees often lack priority access to damaged assets during a disaster due to a misunderstanding of the steps needed to fully repair water systems and the time sensitivity of operational recovery in the sector.

1.1. Under the National Response Framework, water responsibilities are distributed across four Emergency Support Functions (ESFs) and multiple Federal agencies. This can result in water being excluded from unified command or interagency coordination, and can create confusion during response and recovery efforts that can impede water service recovery during disaster.

1.2. Water and wastewater utilities rely on electricity for operations, fuel for backup power and transportation, and chemicals for water treatment. While these dependencies are known to operators and emergency personnel, it is more difficult to track the changing risks within the interdependent sectors that supply critical products and services. These dependencies and the associated risks are often not sufficiently addressed in practices, such as business continuity or response planning along supply chains or across dependent sectors.

Finding 2: Water services are often undervalued and taken for granted because they are typically highly reliable, inexpensive, and hidden from view.

This undervaluing makes it difficult to gain public support and necessary funding for infrastructure improvements, upgrades, repairs, and maintenance that would increase resilience and maintain the sector's excellent track record.

2.1 A significant portion of the infrastructure includes underground pipes and other assets that are invisible to the public eye. This location can mask the need for significant repairs, replacements, and upgrades as the infrastructure ages. Public perception of water infrastructure condition may not match the backlog of needed maintenance on many systems.

2.2 There are very few high-profile examples of major water infrastructure failures. As a result, weak public understanding and recognition of the critical nature of water services makes it difficult for public officials and decision-makers to justify the time and money required to make repairs following an incident, as well as fund key infrastructure improvements.

2.3 It is difficult for public officials to gain support to increase rates or allocate public funds for short- and long-term water infrastructure projects, particularly if disadvantaged or low-income populations would be harmed by rising water prices.

2.4 Investments in resilience can produce order-of-magnitude savings compared to expenditures for emergency response and repair.

Finding 3: Technical capabilities and resources vary widely among water utilities. Smaller utilities in particular often lack the qualified staff, tools, technical expertise, and reliable information needed to manage new risks.

An evolving risk environment requires utilities to prepare for a wide range of potential risks amidst day-to-day operations without loss of service levels. Such planning and preparation requires significant resources, including the technical and financial capability to manage long-term, risk-management decisions and "make the case" to decision-makers to address high-impact, low-frequency risks that must compete with other operational priorities.

3.1 As water utilities—particularly those that are under-resourced—balance day-to-day operations with long-term, risk-management decisions, they may lack the capabilities to adapt to a range of uncertain threats, such as extreme-weather events and rising sea levels. Water utility planners lack reliable projections, guidelines, or design standards from Federal agencies that would enable them to design, build, and maintain resilient infrastructure.

3.2 The increasing prevalence of cyber intrusions challenge business-as-usual practices for nearly all utilities. Strong cybersecurity awareness and practices among utility personnel is often limited. The number of available Water Sector cyber experts is insufficient for current needs, and utilities are constrained in their ability to offer competitive hiring packages to attract top cybersecurity experts.

3.3 It is difficult to maintain, recruit, and train qualified personnel due to specialized job requirements and competition for skilled workers, leading to a loss of institutional knowledge and skills. Many utilities are unable to invest in enough engineering resources to assess existing and future infrastructure needs.

3.4 The technology, knowledge, and tools to promote resilience exist, but awareness of their availability and adoption does not appear to be spread widely throughout the sector, and knowledge transfer lags.

3.5 Water and wastewater utilities are diverse in the advancement of their operations—some are developing and implementing leading-edge practices, while others lack the information, expertise, and tools to do so.

Finding 4: There is significant, chronic underinvestment in water infrastructure and resilience due in part to widespread public ownership and a reluctance to raise rates.

The estimated investment gap ranges from $400 billion to almost $1 trillion to maintain the current level of water service. The majority of Water Sector assets are publicly owned, making it difficult to gain approval for large infrastructure investments to improve resilience from the elected boards/commissions that set rates and approve capital projects. Without public support, it is difficult to create the political will necessary to fund forward-looking investments, especially if they increase the burden on low-income populations.

4.1 Public resources are often available for immediate short-term needs, such as emergency response; but historic patterns of inadequate investment have delayed needed maintenance and inhibited long-term improvement projects. This has created frequently distressed conditions that threaten reliable operations outside of emergency events.

4.2 Publicly owned utilities often use bonds to fund construction and rely on rate increases to recoup costs. The requirements for additional Federal or State funding to support an infrastructure project, such as State Revolving Funds, can make it difficult to access or use these sources.

4.3 The challenge of maintaining affordability for all customers, including low-income or at-risk customers, can make it difficult for some water and wastewater systems to implement full cost-of-service pricing.

4.4 Some publicly owned utilities do not adequately invest in pre-disaster mitigations because they believe that the Federal Government will provide significant resources to repair their system in the wake of a major disaster.

Finding 5: Resilience has not been substantially integrated into the actions of Federal agencies, and resilient outcomes are not part of Federal guidance and resources.

The Federal agencies and departments that oversee the Water Sector, such as EPA and State primacy agencies, are primarily focused on public health and environmental protection measures, and resilience programs are often voluntary.

5.1 Some Federal regulations inhibit utilities from taking steps to improve resilience or build in redundancy, such as building and operating cost-effective power generation or allowing for different water quality standards to be met during an emergency.

Finding 6: Limited regional coordination across jurisdictions and water systems leads to inefficient, siloed decision-making that can hamper resilience.

Although there are notable exceptions, water utilities within a region tend to plan and operate independently, leading to a lack of visibility and understanding of infrastructure system dependencies within metropolitan areas and regions. Multiple local and/or State jurisdictions tend to complicate cross-jurisdictional coordination and may cause utilities to react to an event independently without consideration for a regional, collaborative solution that would yield quicker and more cost-effective results.

6.1 The lack of a broadly accepted framework for regional goals, resource-sharing criteria, and performance metrics hinders the development of a shared approach to disruption. The framework should apply to all phases of resilience, not just response.

6.2 Water disruptions primarily affect local communities, but can have a significant impact on local and regional lifeline sectors. Insufficient attention is given to the risk and impact of a large-scale national disruption.

6.3 The sector has made in-roads in this area through its Water/Wastewater Agency Response Network (WARN). The interstate, volunteer-based network provides mutual aid between member utilities following a disaster to aid in expedited restoration of services.

B. RECOMMENDATIONS

The Water Sector has made progress in the area of resilience by actively planning and collaborating on key efforts, such as the *2013 Roadmap to a Secure and Resilient and Water Sector* and the *CIPAC Water Sector Cybersecurity Strategy Workgroup: Final Report and Recommendations*. But as the findings suggest, much more needs to be done. Marshalling political will and public support is a protracted process that requires communication, collaboration, and unfailing dedication: champions are needed at all levels of government.

During each of our last two studies, the Council witnessed disasters that provided examples of how infrastructure can fail under stress. We witnessed the destruction brought by Superstorm Sandy and the 2012 derecho during our *Regional Resilience* study, and the effects of West Coast port shutdowns and winter storms that crippled the Boston transit system and caused a dangerous freight derailment in West Virginia during our *Transportation Resilience* study. The Flint water crisis that unfolded during our current study provided us with insights of how mismanagement, poor governance, and infrastructure shortcomings can converge to wreak havoc on the daily lives of citizens of a small city. While our study is not focused on the Flint situation, we believe that our recommendations closely align with some of the underlying failings that led to the problems in Flint.

The Council recommends the following steps be taken to improve resilience in the Water Sector. For each recommendation, we have identified specific actions that the Federal Government should take to ensure the success of these recommendations. Many of these recommendations have been presented in previous studies by the Council or other organizations. Appendix E. Compendium of Prior Recommendations provides a list of these recommendations most relevant to this study.

Recommendation 1: Analyze and map the complex risks of major water disruptions and develop mitigations.

The Federal Government should assist owners and operators in the Water Sector to uncover emerging cross-sector risks and develop mitigations for disruptions that could cascade into other sectors and regions, particularly if they have the potential for national consequences. To accomplish this, the Federal Government should commit funding and expert resources to help identify, analyze, and map hidden risks that result from complex sector interdependencies, regional interconnections, and increased convergence of physical-cyber systems.

Specific Actions

1.1 The DHS National Protection and Programs Directorate (NPPD)—in coordination with EPA; DOE; DOT; U.S. Department of Health and Human Services (HHS); State, Local, Tribal, and Territorial Government Coordinating Council (SLTTGCC); and other Federal and State partners—should conduct joint tabletop exercises, across jurisdictions and interdependent sectors, to test the resilience of the water infrastructure during major incidents, such as cyberattacks and large-scale power outages. The joint exercise should be conducted within 12 months of the release of this report.

1.2 The Federal Government should identify existing user-friendly models that would help emergency managers and planners better understand systems and interdependencies at the metropolitan and regional level. The evaluation should identify best practices and data needed to improve existing models. The Federal agencies best positioned to improve and distribute models should work with the water associations on outreach and distribution of the models and best practices so they can be applied more broadly across the sector.

1.3 Within one year, the Federal Government, in partnership with the Water Sector, should identify analytic tools, guidelines, and check lists for assessing cross-sector and cyber vulnerabilities to be part of a series of pilot projects at selected sites across the water infrastructure. The pilots should leverage existing tools and guidance, and the results of the pilots should be used to encourage the application of successful tools and best practices more broadly across the sector by providing decision-makers with the evidence and data they need to justify investments.

1.4 The Federal Government, working with the Water Sector, should identify analytic tools (including those for assessment of cross-sector vulnerabilities and dependencies); guidance for mitigation, and associated best practices (including those from other sectors) to provide water utilities with measureable, actionable information they need to prepare for emerging threats and risks, particularly as they make decisions related to planning and capital investments (e.g., hardening assets, protecting or building facilities).

Recommendation 2. Fortify Water Sector response and recovery capabilities.

The Water Sector has historically maintained continuity of service during events and provided rapid response and recovery despite obstacles. However, because of the criticality of water and wastewater services, the Federal Government should take immediate actions to formalize and improve the response and recovery capabilities at every level of the Water Sector. To accomplish this, the Federal Government should increase planning for extreme events, consolidate Federal response responsibilities, and increase funding for successful sector mutual aid efforts.

Specific Actions

2.1 The National Security Council (NSC) should direct the Water Sector and Government Coordinating Councils to create a government-industry playbook for managing extreme events. The playbook, which could be modeled after the Electricity Sector Coordinating Council Playbook, should clearly define the roles and responsibilities of agencies and utilities to help sustain operations during a severe event and help prioritize activities, such as providing fuel for emergency generators and re-supply of crucial chemicals.

2.2 The Secretary of Homeland Security should direct the administrator of FEMA to consolidate Federal emergency response roles and responsibilities for water into a single ESF within the Annex to the National Response Framework. This would improve coordination and reduce confusion, improve information sharing and communication, and alleviate over-taxing of resources within the Water Sector.

2.3 EPA should increase funding to expand the successful mutual aid program, WARN, to facilitate regional collaboration of events that extend across jurisdictions and reinforce the program as a successful model for addressing the full spectrum of resilience and physical and cyber asset challenges.

Recommendation 3. Increase Federal funding, investment, and incentives to improve water infrastructure resilience.

The Federal Government should establish new funding mechanisms, structures, and incentives to increase investment in resilience at the regional and local levels to counter historic underinvestment in infrastructure, and to remove obstacles that public agencies face in increasing rates, particularly when they impact low-income communities.

Specific Actions:

3.1 EPA, under existing or newly established authorities, should work with HHS to create a Federal financial assistance program (similar to the Low Income Home Energy Assistance Program) to reduce the financial burden on low-income communities from water rate increases and allow communities to make necessary infrastructure investments and set rates that reflect the true cost of providing services. To launch the financial assistance program, EPA should work with the major water associations to implement a pilot with five water utilities within 12 months of this report's release.

3.2 Create a disaster deductible for allocating Stafford Act funding to incentivize communities to make investments to increase resilience. In recent years, the Federal Government has stepped in on numerous occasions following an event to provide post-disaster relief. This has created a moral hazard—communities are not investing in measures that could mitigate the impacts of a low-frequency, high-consequence event because they expect the post-disaster funds will be available, if needed. The effects of disasters often cross jurisdictions and impact entire regions; because of this, the deductible should have a regional focus.

- The NSC, DHS, and FEMA should develop resilience criteria that takes into account the multiple factors that can affect investment by water utilities and recognizes utilities that provide mutual aid and support.
- Mitigation and resilience actions would be credited toward a region's deductible. If they do not take certain steps, in the event of a disaster, there would be a certain amount of covered assistance that they would be responsible for paying.

> "For publicly-owned infrastructure there is actually a disincentive for investing in measures that mitigate risk of disruption whether it be from naturally occurring or manmade events, because local and State officials can be almost certain that when these low-probability, high consequence events happen, the Federal Government will come in afterward with significant resources to make them whole."
>
> *Dr. Stephen Flynn, Professor and Co-Director of the George J. Kostas Research Institute for Homeland Security at Northeastern University*

3.3 Identify and promote innovative financing options that fast track and streamline investments in water infrastructure and resilience, including public-private partnerships and century bonds; new or expanded use of the State Revolving Funds, as recommended by the Environmental Financial Advisory Board; or new ways to leverage other Federal grant programs, such as those available through the U.S. Department of Housing and Urban

Development, the U.S. Department of Agriculture, DOE, and FEMA. EPA's Water Infrastructure and Resiliency Finance Center appears well-positioned to lead this effort and can also conduct the necessary outreach, share best practices, provide technical assistance, and serve as a clearinghouse for effective mechanisms.

3.4 DHS, Science and Technology Directorate should reduce the risk of implementing innovative technology and funding mechanisms by developing cost-share pilot projects with water utilities to speed adoption of better and more cost-effective approaches to service delivery. Successful demonstrations should include an evaluation of whether the mechanism is applicable to other sectors.

3.5 Federal critical infrastructure investment should be repositioned to catalyze economic development; encourage smart, sustainable, and resilient systems; and create job opportunities and inclusion at the local level that will build public awareness and support for infrastructure investment. To achieve this, the President, through the Office of Management and Budget (OMB) and in coordination with the NSC, should direct the heads of all Federal departments and agencies responsible for critical infrastructure investment, as identified in PPD-21, to:

- Identify and report annually to OMB, all current and planned department/agency investments in critical infrastructure for which they have oversight;
- Design innovative programs and approaches that create job opportunities and local community benefits using Federal infrastructure investments; and
- Establish multiyear goals and performance milestones for critical infrastructure investments and include them in department/agency strategic plans.

Recommendation 4. Increase technical and financial resources and expertise available to the Water Sector.

The Federal Government should work with larger and well-resourced utilities to help improve the technical and financial capabilities of smaller or less-resourced utilities by creating programs that link regional technical resources to local water utilities and leveraging the established programs, expertise, and capabilities of universities. The Federal Government should also assist national and regional water associations to expand their outreach efforts that increase utility access to valuable tools and models. These efforts should emphasize improving the cybersecurity capabilities of water utilities that have limited cyber capacity.

Specific Actions

4.1 Create a network of land grant universities to build localized technical capabilities, services, and expertise for water utilities that can be leveraged with private funding, and help train the next-generation workforce. The initial program should start with 10 geographically dispersed universities that meet certain criteria, such as access to State funding, existing subject matter expertise, applicability to selected research topics, and their location.

4.2 The Secretary of Homeland Security should direct funding to water associations to increase outreach efforts of financial tools and life-cycle assessment models that help utilities justify necessary infrastructure investments and support improved asset management practices.

4.3 NSC and DHS should expand cyber resources, expertise, and workforce training for the Water Sector. This should include sharing best security practices and applications through outreach and leveraging existing programs such as the Protective Security Advisor's cybersecurity initiative.

Recommendation 5: Strengthen Federal leadership, coordination, and support for Water Sector resilience.

The President should strengthen Federal leadership on water infrastructure issues by coordinating across Federal agencies, raising awareness about the importance of water, leveraging investment to create job opportunities and inclusion for local communities, and identifying and removing legal, regulatory, and policy barriers that impede investment and implementation of resilient measures.

Specific Actions

5.1 Establish a temporary high-level Federal coordinating body led by DHS—with senior-level representatives from major agencies that have a role in water—to proactively lead collaboration across Federal, State, and local governments and the Water Sector, with particular emphasis on extreme and national-level events. To avoid creating another level of bureaucracy, the coordinating body should be limited to two years.

5.2 The focus on water at the Federal level has traditionally been on clean water (EPA), control of water resource infrastructure (USACE), and emergency response (FEMA), with little emphasis on proactive resilience and security. One of the first tasks for the Federal coordinating body should be to identify barriers to resilience and rapid recovery in existing Federal oversight, laws, and regulations through analysis.

> “Right now, the way [environmental laws and regulations] are being applied, is like taking a 1965 Ford Mustang manual and trying to fix a Prius.”
>
> *Patricia Mulroy, senior fellow in the Metropolitan Policy Program at Brookings*

- The review should result in recommendations for statutory reforms that could promote resilient activities, encourage innovation, and provide flexibility in regulatory compliance during emergency situations.
- The review should also ensure that rules do not overlap or overrule each other.

5.3 The Federal coordinating body, working with national water associations and the Water Sector SCC and GCC, should initiate a national public outreach campaign to increase awareness about the importance of water services.

5.4 Within one year of issuance of this report, the NSC, in coordination with the Council of Economic Advisors, should convene a national public-private philanthropic leadership forum with representatives from business, government, community advocates, education, labor, and philanthropic organizations to determine the best approaches for leveraging Federal infrastructure investments to increase economic opportunities and build public support for Water Sector investment.

C. NEXT STEPS

Our message is clear: we can no longer ignore the deterioration of the Nation's water infrastructure in the face of emerging and uncertain risks. Water utilities have done a remarkable job of keeping the water flowing in the face of disasters and budget challenges. But growing interdependencies among lifeline sectors, and the vital role that water plays in nearly all human endeavor, demands more proactive steps.

Building and sustaining a resilient water infrastructure must be a top national priority. It will require stronger Federal leadership, more funding, and collaboration, commitment, and perseverance among all Water Sector partners. Investment in infrastructures must also be tied to investment in our people, our communities, and our economy. Cities and communities across the country face chronic unemployment and under employment, inequality, and affordability challenges that require urgent national action. Special attention must be given to our most vulnerable populations in high needs communities. The weak levees in New Orleans and the corroding lead pipes in Flint drive home important lessons about the need for public/community engagement, greater accountability/ transparency, and expanded partnerships in building and operating critical infrastructures.

Fault lines in the Nation's water infrastructure have been slow to emerge and virtually invisible to most of us. Reversing this trend will not be easy. The risks are complex and the challenges in investment, workforce development, and managing extreme threats will strain even the most capable utilities, and overwhelm smaller ones. We must not simply rebuild old and failing systems; we must build-in resilient characteristics by leveraging the capabilities of all partners.

To succeed in this endeavor, we must generate strong public interest, support, and the political will to reinvigorate crumbling infrastructure. New investments in smart, sustainable, resilient infrastructure must be used as a catalyst for job creation, economic competitiveness, and an equitable and shared prosperity. New investments in communities will translate into greater support for the infrastructures that serve them. Simply put, when infrastructures serve people, people will support infrastructure.

Strengthening the security and resilience of our critical infrastructure exceeds the capabilities of any one company, sector, or government agency. Water associations, NGOs, academia, and the private sector, particularly CEOs, must be engaged and committed to progress. Much of the responsibility rests with the owners and operators who design, build, operate, maintain, and repair the infrastructure, but Federal and State governments are critical partners in this endeavor. The government must make it easier for the owners and operators to invest in infrastructure improvements; they must identify and remove regulatory barriers that inhibit resilient behavior; they must help to identify and mitigate cross-sector risks that hide between the seams of interdependent sectors and regions; they must develop measurable standards and best practices to guide water agencies in their resilience efforts; they must leverage the science and engineering resources of our national laboratories and universities to develop innovative technologies and bring them to market; and they must strengthen leadership and coordination among agencies across all levels of government.

We believe this study, along with our previous ones, provides a practical template for action that can help ensure the long-term security and economic prosperity of our Nation’s critical infrastructure.

APPENDIX A.
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APPENDIX B.
COMPENDIUM OF INFORMATION FROM SUBJECT MATTER EXPERTS

This appendix synthesizes information from Working Group interviews and Study Group panel discussions and interviews with Federal agency representatives and subject matter experts (SMEs) in water and wastewater systems and critical infrastructure. It is organized into six sections:

- Water Sector Risks and Barriers to Resilience
- Cross-Sector Dependencies and Interdependencies
- Risk-Management Policies and Practices
- Infrastructure Investments and Funding
- Making the Business Case
- Leadership and Coordination

I. WATER SECTOR RISKS AND BARRIERS TO RESILIENCE

In the Water Sector, resilience focuses on minimizing water and wastewater service outages and recovering services as soon as possible following a disruption. To do this, utilities need to have the capacity to maintain operations despite challenges to the system, such as stressors, incidents, or disruptions. However, there is no consistent definition of resilience used throughout the sector. Note that while the engagements with SMEs focused on resilience, the security of systems—reducing the risk to critical infrastructure by physical means or cyber defense measures—is embedded in many aspects of resilience. Some highlights on Water Sector resilience:

- Utilities tend to focus on response after a major incident (e.g., severe drought) and not on resilience before an incident occurs.
- Shifting to a next generation resilience strategy will change how utilities manage risks.
- All-hazards preparedness perspective is key to resilience.
- Utilities need to plan for emerging threats. Such threats for the Water Sector include increasingly severe weather events, capacity issues stemming from changes in customer demographics and movement patterns (e.g., increased movement toward urban environments and coastlines), and cybersecurity.
- Utilities should examine infrastructure criticality, potential failure consequences, single points of failure that could cause significant problems, and ways to mitigate against each.
- Resilience is entirely voluntary for utilities, and must be balanced against other priorities, such as regulatory compliance, available funding, demographic shifts in customer base, and aging infrastructure.

There are five key barriers to resilience:

- Governance structure is not organized to advance resilience. It's organized around narrow political jurisdictions (e.g., local, county, State, Federal. However, infrastructure is increasingly regional, metro-regional, and interdependent.
- Limited training and education are focused on resilience. This makes it a challenging to have a workforce that can understand the complexities of resilience.
- Sectors have limited understanding of infrastructure systems, their vulnerabilities, interdependencies, and the hazards that will disrupt them.
- Infrastructure systems are generally not designed for resilience. They are designed for efficiency, safety, and security. This does not account for the fact that infrastructure will likely fail at some point and need to recover.
- There is a lack of economic incentives for sectors to invest in resilience, and sometimes there are disincentives for investing in resilience. This is particularly pronounced in the Water Sector.

The U.S. Environmental Protection Agency (EPA) has identified four critical components or core elements of resilience:

- Risk assessments to outline risks and what assets are at risk
- Emergency response planning
- Training and exercises
- Recovery

Within each of these, EPA set basic and advanced benchmarks, but they are optional to implement. Other components to resilience include:

- Having an emergency resource plan, including backup power and supplemental employees to operate facilities in an emergency.
- Establishing multiday water storage capabilities
- Finding mutual aid and assistance
- Revising the National Incident Management System (NIMS) to prioritize Water Sector
- Examining what finances a facility has available for recovery

Long-term threats to water infrastructure include infrequent/uncertain hazards and extreme weather events, limited funding and flexibility, and aging infrastructure.

- Hazards are well-established risks, but are infrequent and uncertain. This uncertainty generates inaction.
- Organizations need to establish what level of risk they are comfortable with and create response plans. While it may be impossible to prevent all impacts of an event, planning

shortens recovery time. Utilities have to build risks into planning, particularly with securing major equipment.

- Utilities and local governments are planning for resilience at a local level. However, threats such as extreme weather cross jurisdictional boundaries. The Water Sector needs to plan for infrequent hazards and justify expenditures that mitigate against these threats.
- Limited funding for infrastructure investments threatens resilience. The current price of water is not sustainable for full recovery of the cost of service.
- Aging infrastructure including the physical degradation of infrastructure is a major issue, particularly for wastewater utilities. Aging infrastructure can lead to public health problems.

Black sky events are natural and manmade forces that are high-impact but have an uncertain probability. These could cause a power outage more extensive and more severe than those that occurred during Superstorm Sandy.

- Black sky events have uncertain probability, but are not low-frequency. Risks are growing, especially in terms of manmade hazards.
- Black sky events cause wide area power outages that may extend for months, with the twin effects of long duration of power loss and physical damage to Water Sector infrastructure.
- Manmade hazards, cyber, kinetic, and electromagnetic interference attacks pose a substantial threat to the electric and natural gas industries, with cascading effects on the Water Sector.
- The United States is overdue for a catastrophic earthquake in the New Madrid Seismic Zone on scale with the 1812 earthquake. This would cause a massive electric and natural gas infrastructure failure.

Utilities have built some resilience for black sky events, but additional preparedness is needed.

- Utility chief executive officers (CEOs) will decide what constitutes prudent investments against black sky hazards. Focusing on black sky preparedness is important, but incremental preparedness for less intense events is also useful. Practical, step-by-step improvements could improve overall preparedness. Water executives could focus on incremental improvements for power outages.
- Sector-Specific Agencies (SSAs) for the Energy and Water Sectors have a vested interest in advancing resilience and addressing dependencies in the event of large-scale power outages. The *Resilience for Black Sky Days* report (conducted on behalf of the National Association of Regulatory Utility Commissioners) contains catastrophic scenarios for regulated utilities. The report examines the cost associated with not preparing for these low-probability, high-consequence events.
- It is important to examine resilience data, understand where we are today, and identify preparedness gaps.
- There is a lack of cross-system visibility for how black sky factors could disrupt functions.

Power failure is the largest risk dependency to the Water Sector and can generate regional and national impacts.

- There is a lack understanding about how a long-term power outage would disrupt municipal functions. If electricity is down for an extended period of time, utilities would not process wastewater effectively, if at all, crippling the city and leading to evacuations.
- Advanced systems—such as wastewater treatment systems that are highly mechanized and reliant on energy—are more vulnerable to disruption.
- For large plants, available generators may not be large enough to address power requirements.

Cybersecurity vulnerabilities of most concern include spearfishing; insider threat; the cyber-physical nexus; and impacts of an attack on operations, automated systems, supervisory control and data acquisition (SCADA) systems, and public confidence.

- Cybersecurity is not a one-dimensional problem; there are vulnerabilities in personnel, processes, and technologies.
- Control rooms can be vulnerable to spearfishing, inadvertent attacks, or undetected or unauthorized system access.
- Distributed systems make understanding cyber vulnerabilities difficult. The operator may not see the cyberattack (as they would a physical attack) because of distributed systems or because the attacker wants to remain undetected long enough to incur significant damage.
- IT security consequences, risks, and vulnerabilities are different on the operations side than in billing or program management systems. Security measures should be different depending on the environment.
- A cybersecurity failure in the Water Sector could have cascading effects across multiple sectors because of interdependencies.
    - For example, data centers depend on huge amounts of water to cool systems. If their water source is compromised, data centers cannot function without adequate alternative water sources. This would affect the operations of many interdependent sectors.

The Water Sector's cybersecurity challenge is complex and cybersecurity capabilities vary depending on resource availability and utility size.

- A variety of stakeholders in the Water Sector are connected to cybersecurity—vendors, engineers, owners/operators—and risk can generate from anywhere in this chain. Exchanging information is critical.
    - Cybersecurity principles are often not embedded throughout an entire organization.
    - Vendors may not have the cybersecurity tools a utility needs. However, vendors can adapt their practices to industry norms.

    - Comprehensive cybersecurity training and resources is necessary to ensure that personnel, across the sector, are up-to-date on cybersecurity solutions and practices.
    - There is an opportunity for adopting/adapting cybersecurity practices from the private sector. Expanding public-private sharing of information regarding cyber threats and incidents would be helpful.
- Utilities need more guidance on how to conduct cybersecurity risk assessments and prioritize assets. Although excellent guidance is available through associations, its application remains comparatively limited.
- Vendor cyber vulnerabilities, such as limited cybersecurity in products sold to water utilities, can create Water Sector cyber insecurity.
- SCADA systems are not standardized between facilities and do not have consistent interoperability with other water-automation programs. This leads to varying levels of cybersecurity risk.
- Smaller systems often lack resources and specialized personnel for large-scale cybersecurity improvements. Some large facilities have the resources to separate their Internet connectivity and infrastructure between operations. Smaller systems generally lack this capacity, resulting in more risk exposure.

Maintaining and enhancing a viable workforce is a core challenge for the Water Sector.

- Experienced personnel are a crucial part of the safe and reliable operation of water utilities. As risk evolves and new risks emerge, new or improved skill sets are required, and sometimes training commensurate with these risk areas is costly.
- Retirements and attractive pay outside of the Water Sector can result in a loss of institutional knowledge.
    - About 30 percent of the Water Sector workforce is eligible for retirement. The sector is actively working to respond, including examining how it can compete with private sector employment.
    - Obtaining and retaining cyber expertise is a particular challenge.
- Training, development, and recruitment are opportunities where the Federal Government can help. Industry can partner with the Federal Government on retraining the industry.

Water utilities must prepare for a variety of weather events and develop tools for comprehensive extreme weather planning.

- Severe storms, flooding, drought, changing weather patterns (e.g., El Niño, more frequent severe storms), and earthquakes are the natural events of most concern to utilities. Such events are difficult to plan for and can lead to loss of pumping capacity, limited access to critical resources (e.g., chemicals), and power outages. The following provides context for these extreme weather events.

  - 2016 El Niño is resulting in sea levels 6 to 10 inches higher than normal. “King tides” are becoming more threatening to coastal combined systems.
  - Severe, prolonged drought is particularly challenging because it may not follow predictable weather patterns.
  - During severe heat and wind events, the risk for water disruptions increases. For instance, water supply goes down because of water used to fight fires.
  - Major natural disasters, such as blizzards or hurricanes, are a major concern because they also affect the workforce required to operate the systems.
- Efforts to address extreme weather events include:
  - Working with regional partners to diversify the water supply to limit the effects of severe drought.
  - Studying extreme weather events and determining how they might impact infrastructure and what projects are needed (e.g., stormwater capture).
  - Understanding risks and vulnerabilities. Oftentimes, third-party organizations (e.g., nonprofit, private) can find vulnerabilities that were not anticipated by the owners and operators.
  - Investing in preparedness, such as ensuring equipment is available for long-term use. Systems with generators require adequate fuel to run the generators or backup power.
- Climate change will affect water infrastructure in different ways depending on the region’s vulnerabilities. The combination of aging infrastructure, population growth, and potential storm surge magnifies the effects of sea level rise for East Coast utilities. Consequences may include flooded sewer lines and salt water intrusion. In the Western United States, utilities experience water scarcity issues.

II. CROSS-SECTOR DEPENDENCIES AND INTERDEPENDENCIES

There are critical interdependencies between the Water Sector and other lifeline sectors. These are often not fully understood until after an incident occurs. In addition, sectors may lack visibility into the vulnerabilities of other sectors. This may be compounded by a reluctance to share information on vulnerabilities, both inside sectors and among interdependent sectors.

Dependencies and interdependencies exist along the Water Sector supply chain. The Water Sector has dependencies on sectors such as the Energy, Chemical, and Transportation. It has interdependencies with most sectors (e.g., Healthcare and Public Health are dependent on water).

- Water and wastewater utilities rely heavily on access to chemicals, transportation networks, and energy supplies.

- Personnel that know the system and that are trained in recovery processes are critical to resilience. Both within the Water Sector and along the supply chain, they are critical to maintaining operations. Personnel are needed to implement procedures.
- Challenges for addressing dependencies include:
    - Cascading failure analysis helps to identify and evaluate dependencies. However, sectors do not commonly share vulnerabilities.
    - Water distribution and collection systems may be inadequately addressed during analysis since they are located outside the central utility.
    - Technological and regulatory barriers can prevent utilities from securing onsite energy supplies.
    - The Water Sector needs to coordinate with the Energy Sector to restore power after a long-term loss of power. Priority customers rely on both water and energy, so the sectors should coordinate restoration based on the criticality of customers.

Action is needed to better understand cascading impacts (including regionally) and vulnerabilities throughout the sector. There is a need to break down silos and focus resources to address governance barriers.

- The vulnerabilities of larger supply chain systems, such as those outside of the Water Sector, are a major concern to local water utilities. There is a need for better dialogue on these vulnerabilities.
    - The Water Sector prides itself on silent service (i.e., reliable, consistent service). As a result, facilities may not fully understand or be reluctant to share their vulnerabilities.
    - Utilities are impeded by the limited sharing of vulnerabilities along the supply chain and are unable to conduct adequate cascading failure analysis and supply chain vulnerability identification.
- The Water Sector needs to examine Energy Sector dependencies. Water utilities could operate “off the grid” (e.g., use co-generation and onsite generation to ensure continuity of operations).
    - However, the utility will be treated as an energy generator and not as a water facility (and will become subject to energy regulations). This adds significant costs, which must be justified to customers and stakeholders.
- The Federal Government can support coordination between dependent sectors.

Although every water system has a unique set of assets/processes and operations are individualized, there is an increasing emphasis on creating system interconnections, where possible to allow greater flexibility. This enhances resilience, particularly for severe, long-term events such as droughts.

- System interconnectedness has driven utilities to consider a regional utility system. A hub would provide wholesale service to smaller utilities while all utilities are networked.

However, there is a concern that such a network would transmit cascading failures during disruptions.

- Organizations are focused on understanding dependencies among water systems and addressing cross-jurisdictional challenges. More attention is being directed to coordinated, long-term management of water resources.

III. RISK-MANAGEMENT POLICIES AND PRACTICES

The Water Sector maintains a key focus on effective all-hazards risk-management policies and practices. However, additional work is needed to ensure policies and practices are responsive to the risk environment and promote resilience. Adopting a comprehensive resilience framework that is forward thinking, focused on aging infrastructure and asset management, coordinated and inclusive of cybersecurity would advance resilience. In addition, those outside the Water Sector should recognize the sector as a lifeline sector during emergency response.

Utilities are moving toward an all-hazards emergency management approach, implementing a variety of risk-management solutions to combat a range of risks. However, investments in improved Water Sector response and recovery are needed.

- Examples of preparedness include training, planning for incidences beyond what is traditionally expected, using new technology and tools (e.g., flood inundation maps), and conducting large-scale drills on Unified Command.
- Depending on the utility size, infrastructure, and provided service, utilities may have difficulty in locating resources to facilitate a rapid recovery.
  - Many communities will be asking for the same equipment and supplies at once.
  - Navigating “red tape” and the logistics of getting equipment are challenges. Guidance, planning, and region-specific depots would provide much needed assistance.
  - Investing in backup energy equipment is costly, and it is difficult to provide an effective return on investment. Getting the ratepayer to understand investment needs is challenging, as ratepayers may have never experienced a utility losing all sources of power at once.
  - Replenishment of fuel stocks is a problem, especially during major events. If there was a widespread incident, fuel would be hard to get everywhere.
  - Backup needs could be registered with the 249th Engineering Battalion (Army) with dimensions, sizing, and fitting measurements to help utilities obtain replacements quickly.
  - Utilities could connect with other utilities that have similar equipment.
- The Water Sector would benefit from its own Emergency Support Function (ESF). Emergency management agencies train and include other government agencies, but they do not perform enough outreach to utilities. Incorporating the private sector is critical to response efforts.

    - The Emergency Management Assistance Compact (EMAC) structure can be leveraged to secure water-specific resources. This mutual aid structure can be tested through a coordinated exercise.

- The Water Sector should improve partnership and information-sharing capacity internally, and with other sectors and government agencies. It can do so by:
    - Developing utility partnerships to work through emergency planning challenges, providing training from more experienced utilities, and regularly conducting cross-jurisdictional exercises.
    - Participating in information-sharing networks (e.g., Water/Wastewater Agency Response Network (WARN), Information Sharing and Analysis Center (ISAC)) to ensure that a broader population is aware of threats and resources. These networks aggregate information from many sources.
    - Strengthening partnerships with local/State emergency management and law enforcement agencies. Emergency managers can train utilities in emergency management. Exercises and discussion forums will provide an opportunity to uncover gaps and understand roles/responsibilities.
- Many utilities have an emergency response plan for the organization, but not a response plan for a large-scale, regional incident. Hosting exercises—whether regional or all-hazards—ensures that organizations understand their responsibilities and provides an opportunity to test emergency response plans.

Improving risk-management solutions and considering effective response/recovery solutions enable utilities to navigate major disasters and prolonged disruptions and to mitigate cascading consequences.

- Many communities will be asking for the same equipment and supplies at once.
- Business continuity planning is critical; it may be necessary to release water at a lower quality rather than to have sewage leaks. Flexibility for quick solutions is needed.
- There needs to be better scenario planning rather than just growth-based planning.
- Response personnel should understand the Water Sector has unique characteristics, such as cascading effects on schools and hospitals. A Water Sector event can quickly escalate into a major event and potentially into a political one.
- At Battery Park City during Hurricane Sandy, various buildings needed onsite treatment. The area’s distributed infrastructure (e.g., water treatment, systems) included 80 natural water facilities affected by the event. Facilities were up and running 24 hours after Sandy because they were not in flood-prone areas and energy back-up was obtained within a day. This enabled utilities to maintain services throughout the disaster.

The Water Sector needs to adopt an inclusive resilience framework that is forward thinking and that enables faster recovery after major disasters. After each disaster, rebuilding infrastructure up to higher standards means utilities will come back online quicker.

- The U.S. Water Alliance is focused on “one-water framework” for water resource management (e.g., drinking water, storm water, and wastewater) as a way to improve community outcomes.
- Based on past extreme weather events, some utilities have developed more robust resilience plans, such as detailed plans that addresses severe and long-term drought patterns.
- Workforce management and access is an issue that needs to be addressed. Skilled workers—already in short supply—must be able to reach facilities and have adequate resources to operate safely for extended periods.
- The sector needs a common set of performance metrics for resilience and green infrastructure.
- A comprehensive regional risk-management plan that should incorporate all sectors in the region.
- Revising the EPA Needs Survey for wastewater and water utilities should be examined. Surveys are based on specific statutory criteria. The Needs Survey should capture evolving needs related to preparedness and resilience.

Due to aging water infrastructure, utilities should implement an asset management programs.

- Asset management enables utilities to be efficient and better anticipate when equipment replacement will be needed. Effective asset management programs can provide more reliable and resilience service with comparatively small investment.
- Utilities should include these measures as part of an asset management program:
    - Inventory, track, and assess key system components with respect to age, application, and condition.
    - Ensure they have two sources of water supply to maintain drinking water availability, water pressure, and fire capability.
    - Examine storm water capture systems and how to use alternative sources of water.
    - Identify key accounts for prioritized restoration, depending on water service criticality.
    - Consider prioritizing service to areas that were already stressed before the shock/incident (especially for disadvantaged populations).
- Utilities are making investments in storm water management—being able to use water within their systems and not just pumping water out. Water can be stored and used for emergencies.

Cybersecurity practices at utilities have increased to focus on planning, understanding the physical-cyber nexus, coordinating across the supply chain, balancing budget priorities, and integrating components.

- Cybersecurity requires well-thought out plans, but not all utilities have included cyber in their risk-management plans.
- Utilities must understand both cyber and physical risks. Combining cyber and physical security processes and assets could simplify security infrastructure management, making it easier to detect and prevent security incidents and improving response and recovery efforts.
- Designers, vendors, and owners/operators must collaborate to find solutions for the sector. Vendors should understand new devices (including new technologies) and the requirements for integration into new systems. However, it can be costly to pay for multiple vendors to be onsite and remain updated.
- While utilities are used to investing in physical infrastructure with long life cycles, the life cycle of IT is short, and often misunderstood by utility management. For example, risk assessments are used to prioritize investments, which requires policy decisions related to specific aspects of SCADA and cyber system engineering. Decision-makers may not have the necessary expertise or understand the difference between IT and physical security.
- Sometimes heterogeneity and noncentralization of technology is an asset. In an attack, the operator may not have access to the entire system because the utility is segmented.
- EPA and the American Water Works Association (AWWA) have issued beneficial cybersecurity guidance to help improve water utility cybersecurity practices.

Although cybersecurity practices have improved, additional investment in cybersecurity is necessary.

- Investing in cybersecurity information sharing is critical to preventing, responding to, and recovering from a cybersecurity incident.
    - The WaterISAC is used to collect threat information, conduct analysis, and share information with partners. However, some information requires further research and vetting by the utility.
- A cybersecurity mutual aid network (e.g., WARN network) or knowledge sharing would help address cybersecurity challenges.
    - There is no functional equivalent for cyberattack mutual aid in the Water Sector. Personnel specially trained for cybersecurity, but deployable to partner utilities, may be worth developing.
- The sector needs leadership, unified security protocols, and common cybersecurity specification requirements for products/processes used in the Water Sector.
    - Leadership buy-in would empower cybersecurity programs. The Water Sector has a top-down security culture and cybersecurity programs should take this into account.

- Building cyber resilience into all aspects of water utility business and improving security measures (e.g., vendor-managed security processes) along the supply chain would help to address cybersecurity challenges.

Water is often not recognized as a lifeline sector during emergency response. Water infrastructure and the critical nature of its services should be a priority both before and after an incident.

- The Water Sector was successful in sustaining service during the Sandy outage, but many utilities were on the brink of failure due to lack of backup power, limited fuel for generators, or generators burning out from running too long.
    - Water was not given priority when fuel for generators or equipment was delivered.
    - Employees were unable to access facilities to help restore services, and in some cases had to find ways around police barricades.
- Although some Emergency Operation Centers (EOCs) have increased representation from the Water Sector during emergencies, this needs to be applied more consistently to ensure water is incorporated into response efforts.
- The Water Sector needs to identify and set realistic goals for a long-duration power outage to maintain services and to reduce the need for mass evacuations. Playbooks need to be created to achieve those goals, and targeted investments are needed to carry out the playbooks. The playbooks should outline what the utilities can do to help themselves and what partners can do to maintain service.
    - Water utilities can use advanced planning to provide service continuity for the highest priorities in their communities (e.g., lowering water pressures, limiting the service area).
    - Water Sector partners can prioritize distributing diesel fuel to water utility backup generators, providing extra parts, and resupplying chemicals during an extended power outages.
    - Military agencies (including the U.S. Army Corps of Engineers (USACE) and the Defense Logistics Agency) are integral to these efforts.

IV. INFRASTRUCTURE INVESTMENTS AND FUNDING

Infrastructure investment and funding levels may not be sufficient to address the Water Sector's resilience needs. Water systems planning should consider future system needs, and investment decisions should consider risk assessment results. Next generation resilience financing is driven by funding availability, affordable and responsible rate structures, and informed decision-making. However, resilience investment challenges exist and must be addressed in order to achieve next generation Water Sector resilience.

Water systems should be planned to ensure performance of systems against current and emerging threats. This entails building a robust set of planning and decision-making tools to help resilience.

- Water utilities will see increased costs in regions with high population increases. However, per capita water use is decreasing and revenues are flat. Infrastructure investments mean significant rate increases, because sales are flat. This issue only gets worse as infrastructure ages.
- Utilities are unsure what level of response to prepare for and how much to invest for each risk. Utilities focus on allocating resources to assets directly impacted by an event but not on preparing the whole system for future events.
    - There are limited resources (e.g., time, information, funding) devoted to resilience—most of the focus is simply on responding to the disruption and not on mitigating or preventing it.
- Capital improvements can be used to address aging infrastructure and to mitigate vulnerabilities.
- Utilities should leverage Federal resources, capabilities (e.g., the U.S. Department of Homeland Security (DHS), U.S. Department of Energy (DOE)), exercises, and resilience assessments against the utility's highest infrastructure priorities.
- Effective planning models from outside the sector can be leveraged for infrastructure investment.
    - The private bond market has model for natural disaster and risk assessment.
    - If you look at the insurance industry, two weeks of disruption is a key number. If you're out more than two weeks, small businesses have difficulty returning to normal operations. Defining this temporal endpoint would be helpful. There is also a distinction between manmade (terrorist) and natural hazard events, in terms of investment.

Investment decisions should be based on risk assessment results. A stronger link between asset management planning and day-to-day operations is needed.

- A risk assessment-informed investment approach would take the unique hazards of every region's water preparedness needs (e.g., flood, hurricane, earthquakes) into account.
- More perspectives are needed for future investment decisions
    - Managers should collect information from utility workers.
    - The customer should be at the center of the business model.
- Priority should be given to infrastructure projects that incorporate resilience.
- Utility managers should plan for population growth.

Improving information sharing would provide a better understanding of the risk environment for utilities, government agencies, and the public.

- There is a need for more information sharing from the Federal Government to quantify the probability of certain risks, including potential terrorist attacks.
- One barrier to information sharing and assessments is that utilities consider risk information to be proprietary.
- Partnerships sponsored by the Federal Government would enable utilities to share resources for mitigation and resilience.
- The information-sharing environment remains challenged by limited information and that utilities may not fully understand how to act on that information.
    - The industry does not self-report, so they don’t have aggregated data to share. There is a lack of reporting outside of regulatory requirements.
    - Consequence analysis information is limited.
    - More data on trends related to evolving threats (e.g., cybersecurity) are needed.

Factors that drive next generation resilience financing include financing portfolio variability, affordable and responsible rate structures, and informed decision-making.

- The portfolio for financing options differs depending on the community—e.g., metropolitan communities have more options available than small communities. Options also access depend on staff expertise and utility risk tolerance.
    - For large, credit-worthy, prosperous communities options include: cash funding of capital, public issuance of bonded debt (fixed vs. variable rate). Other funding source include State Revolving Fund loans and private capital (less common in the United States than the rest of world).
    - Smaller systems have less financial flexibility, which can put them at risk since they are less able to make adjustments to respond to emerging risks. They often focus on resolving day-to-day issues.
    - Utility needs, assets, and communities served vary across the sector. Utilities can select the “right” financing mechanism based on their environment.
    - Associations (e.g., National Association of Clean Water Agencies (NACWA)) have taken a key role in socializing public-private or private-exclusive funding options.
- Pricing and funding levels are largely variable throughout the sector. Examining how to raise rates in an affordable and responsible way and improving the cost-of-service dialogue are needed to improve resilience investments. This includes:
    - Securing community buy-in for investments is crucial and difficult.
    - Political pressure keeps rates and charges to customers low, and impedes the case for resilience investment.

    - Alternatives should be examined for how costs should be allocated. Some resilience costs can be allocated based on a normal water utility model, but some of the costs can be allocated in a new way (e.g., based on taxable property value).
    - In the future, utilities may move from a variable to a fixed model. The revenue streams will be more stable, but the variable model will put pressure on low water users (which are also low income users).
    - Utilities can price service for minimum health and sanitation needs and then use nonrate revenues to provide support for nonessential needs.
- Sharing best practices and success stories across the Water Sector would improve knowledge regarding resilience infrastructure investments.
    - In San Francisco, there was a $4.8 billion investment in seismic reliability. There was limited pushback because people understood the need for investing in this reliability.
    - The Smart Grid energy project is an example of successfully investing in resilience and raising rates.
    - Flint, Michigan, is an example of what not to do—the decision to switch water sources was an economic decision that was not cost-effective because it did not account for risks and potential disruptive events.

Resilience investment challenges include addressing increased rate and resilience investment justification challenges, institutional barriers, and available insurance solutions.

- Some utilities may divert significant portions of water-service feeds to other purposes (e.g., use as general funds.)
- Servicing low-income or disadvantaged communities is a challenge. Utilities need to move forward without further disadvantaging people.
    - More robust affordability models and support programs are critical.
    - Utilities are not willing to raise the rates to make capital improvements.
- Rates and charges to customers need to keep pace with investment, especially absent of any significant Federal and State government investment in local infrastructure.
    - Justifying resilience investments is difficult because customers do not see anything new—it is insurance for a future event. The utility is not getting new customers or providing a higher level of immediate service. Utilities may not think the investment is worthwhile.
    - If you make investments and reflect that cost in the rates, the cost of service becomes a challenge.
    - Utilities that successfully implemented rate increases under the full-cost pricing model phased rate increases over several years and conducted significant public outreach to explain the increase, what the money was needed for, and the plans for making the investment in the systems.

- The Water Sector has many financing options. The private sector has flexibility and interest in investment but there is no open dialogue to discuss options.
- Regulatory restrictions and targets may limit smart investments. Many utilities who invested in supply reliability are still being held to water supply reductions/conservation cuts—the sector is painted with a broad brush.
    - By using rigid pricing models, States may hinder the ability of utilities to invest in resilience.
- More work needs to be done to examine how best to allocate large infrastructure investment expenses efficiently. Long-term capital planning could be incorporated into budget processes.
- Utilities are interested in resilience-oriented insurance but innovative insurance solutions are limited.
    - The current way of thinking is an obstacle—State/local governments know they have the safety net of the Federal Emergency Management Agency (FEMA). Utilities need to move from being reactive to proactively building resilience.
    - Catastrophe bonds are worth exploring, as they make response and recovery resources available immediately. They also provide certainty that funds will arrive, allowing the bond holder to set up contracts/assistance ahead of time to speed recovery.

Existing funding levels and mechanisms do not sufficiently address Water Sector resilience.

- There is a large deficit between the projected funding need for water infrastructure repairs, and the funding that is expected to be available.
    - The Federal Government used to be the main supplementary source of funding to local water authorities but recently State governments have taken on more of the burden. Tax and rate increases are often the result of this change. These revenue streams can be negatively perceived by the public if they are not properly framed.
- The State Revolving Funds (SRF) do not include resilience investments. Adaptation will cost billions of dollars, and there is not current path forward to pay for it. While some of it will be funded by rate payers, this is not sustainable over time.
    - Aging infrastructure intensifies investment needs, resulting in a larger funding gap than if resilience investments were instituted earlier.
    - More public outreach should communicate the need for resilient infrastructure.
    - More money is spent on mitigation than on adaptation. The Federal Government can support the shift away from event-driven financing.
- Resilience funding is a challenge, due to uncertainty in calculations and lack of understanding. For instance, many utilities do not know how to operationalize climate change analysis data to make the necessary investments.

- Existing mechanisms (e.g., FEMA Hazard Mitigation Funds) are not viable options to fund the necessary capital projects related to resilience.
    - Competing interests on who gets money and priorities are challenges.
    - Incentives to look at resilience and implement backup systems could be valuable.
    - Examine Federal highway funds allocation related to drinking/driving. This could be an example of matching investments to ensure appropriate resilience is considered.
    - The Federal Government can work to implement community behavior incentives, promote community engagement, and address resilience governance issues.

Additional Federal funding and mechanisms, and innovative funding solutions are needed for infrastructure investment.

- The Federal Government can create a pool of money for utilities to tap into for resilience investments.
- The Federal Government can leverage the Low Income Home Energy Assistance Program (LIHEAP) model for the Water Sector. This would enable infrastructure investments to move forward without further disadvantaging customers.
- SRFs are particularly helpful for smaller issuers that have difficulty with market access. However, the funding comes with many Federal requirements, which can make the program difficult or costly to use.
- The Federal Government should update Federal funding conditions to require risk mitigation, recovery, and adaptation. Whenever there are incentives, the Federal Government should examine how to leverage that to get desired behaviors.
- The Federal Government should create a tiered structure for the Stafford Act to address the issue of relying on Federal after-the-fact aid instead of investing in resilience.
    - Tier I: Keeps current level of funding, but is conditioned on certain criteria.
    - Tier II: Reduced funding, if criteria is not met.
- Create incentives for States to take action on infrastructure resilience.
- FEMA issued an Advance Notice of Proposed Rulemaking to receive comments on the agency establishing a Disaster Declaration for its Public Assistance Program. If communities take certain actions focused on mitigation and resilience, those efforts would be credited toward their deductible. If they do not take certain steps, in the event of a disaster there would be a certain amount of covered assistance that they would be responsible for paying.
- In addition to improved Federal funding mechanisms, public-private partnerships can encourage creative arrangements that benefit both the public and private sector and are a way to leverage existing resources.

Mitigation and recovery are key components to resilience. FEMA Mitigation Programs and the Public Assistance Program under the Stafford Act can help resilience investments.

- Pre-Disaster Mitigation Grant Program: The grant program assists communities with small-scale pre-disaster mitigation projects.
- The Hazard Mitigation Grant Program (HMGP) funds projects to reduce or eliminate long-term risks, consistent with State or local mitigation plans, following a Presidential major disaster declaration.
- Public Assistance Program allows for repair and replacement of damaged public infrastructure (e.g., if a wastewater treatment facility or pumping station was damaged). During rebuilding, if those facilities decide to implement cost-effective mitigation measures, they could be covered up to 75 percent.

V. MAKING THE BUSINESS CASE

Resilience practices take time and capital investments to institute. Utilities need dedicated funding based on justification resilience investments. This requires that the customers and political decision-makers are is aware of the value of water, resilience, and the financial and planning tools necessary to forecast and plan for myriad hazards.

The Water Sector may need to consider a new business model to encourage next generation resilience.

- Water infrastructure is invisible to customers. As a result, water functions are taken for granted until systems fail. The public is also not aware of what is required to maintain infrastructure, making it more difficult to explain the value of additional funding.
- Utilities need consistent messaging at the State and local level to ensure customers are aware of the value of water. Extensive community outreach and public education are needed to increase awareness and educate customers about their role in demand management and conservation.
- The relatively low cost of water in the United States makes it difficult to secure the necessary funding for large-scale water infrastructure projects. There is a disconnect between current rates and the true cost of maintaining water service. Structuring the value of these projects to nonmarket benefits makes the argument stronger.
- Private sector funding can be a potential solution. For example, in Corpus Christi a company determined that the local water supply was not resilient enough, so they are building their own desalination plant.
- Special consideration for low-income communities is needed. They are often affected first and the most by extreme weather. Legislation can direct requirements for resources to low-income communities.
- The sector must adopt resilient-design principles and convince decision-makers to fund future investments that lead to resilience.

    - The old systems approach, based on historical data, is the cost of protection versus the cost of failure. This should change.
    - If we do not value or are not willing to pay for flexibility in capital investments, then it will be hard to know the required design criteria for facilities.
    - The sector should examine flexible infrastructure solutions (i.e., infrastructure that serves more than one purpose) and avoid generalizing risk—an individual utility-level approach is needed, structured around a sector resilience framework.
- Create a market around resilience, build tools, and emphasize a cross-sector approach
- Regardless of the business model (e.g., public versus private, single municipal owner versus multiple), utilities need customer support for rates, flexibility to respond, and fast and nimble solutions to disruptions. Examples include Lower Manhattan discussing the value proposition of major investments and the loss to commerce relative to hardening infrastructure and the U.S. Global Change Program.
- The Water Sector should build on green infrastructure practices to add resilience. It takes time for the government and customers to change their perceptions, and include security and resilience in infrastructure are new practices.
    - Green infrastructure is a relatively new concept to utility customers. The community needs to understand the *value* of sustainability, beyond additional costs. Additional grey infrastructure is more expensive.
    - Examples of green infrastructure investment include managing stormwater at the source, using solar panels, or implementing a green jobs program to help economically stressed areas.
    - The Green Infrastructure Calculating Tool shows how many gallons green infrastructure can capture and conveys it in an easily understandable way. Spatial information/data is always effective (e.g., showing things on a map is helpful).
    - Major cities are adopting green infrastructure. The NYC Green Infrastructure Plan is a tool used to manage storm water. In San Francisco, a regional nonprofit planning group (as a neutral broker) convened stakeholders and city departments to talk about green infrastructure being a collective opportunity for the city.
    - The U.S. Water Alliance is making the economic value argument about green infrastructure. The sector needs to talk about the benefits of integrated storm water management and to build collective ownership.

Tools, modeling, and research enable risk-based, financial, and planning decisions.

- Risk investments need to be well-informed to justify costs.
    - Utilities recognize they have to make smarter decisions and not just spend money on today’s needs. Zero risk is unachievable and getting close to it is expensive.
    - Critical infrastructure interdependency tools (e.g., short-term, event-based modeling or examining water demands) are needed to enable decision-making.

    - A consistent, locally and sector informed definition of risk is needed, along with standards and guidelines.
    - Models to estimate economic impact may be a good Federal investment.
    - The Federal Government can provide risk assessment and consequence expertise.
    - Modeling tools in the insurance industry could be leveraged for use in the Water Sector.
    - Science and engineering needs to be incorporated into water resilience planning and infrastructure improvements. One way to accomplish this is to integrate resilience into standards.
    - The Water Sector needs to have a more holistic approach for designs systems to better withstand challenges, recover, and adapt. Part of this is investing in sustainability.
    - Metropolitan-regional mapping should be conducted to understand infrastructure system dependencies that can also aid faster recovery in the event of failures.
- The frequency and intensity of extreme weather events require a new way of thinking. More "outside the box" scenario planning is needed. As the risk landscape changes, utilities have to plan for unusual/unpredictable events (e.g., a major cyber incident).
    - Extreme weather planning needs supportive funding structures, as current rate structures only cover regular operations and basic projects. Utilities have to justify investments.
    - Utilities have to balance risk acceptance. After an unusual event, utilities may be asked to install resilient solutions (e.g., generators) that can be costly and come with no guarantee that they will be used in the future.
    - Tools are good for short-term modeling, but are not as accurate in the long term, which is different from real-time feedback provided in the power industry.
    - There are effective models that forecast the direction, timing, and strength of storms. The National Hurricane Center forecast capability has improved noticeably over the last 20 to 25 years. They depend on satellite data, and aging satellite infrastructure is a concern.
    - The Water Sector must enable short-term and long-term planning. Short term planning includes how quickly snow melts and how to manage it. Long-term planning includes examining climate variables relating to runoff, which is more problematic.
    - In the long term, there is a need for good forecast capability (for supply of water) and scenario-based forecasting.
    - While there is scientific evidence regarding high-impact events (e.g., earthquakes, floods, and other natural disasters), an underlying impediment to implementing long-term solutions is local community opposition to permanent infrastructure built

    in their area. We need decision-makers to present science in the clearest way possible.

    - Federal agencies, including EPA and USACE, have internal models and publicly available tools and models that can conduct forecasting both in the short term and long term. Modeling evaluates hydrology, the effects of demographic shifts, and cascading impacts on infrastructure to assist in accurately capturing future scenarios to aid in planning and preparation.
    - Disaster resilience uses different time scales. Some hazards (e.g., climate change, mega droughts) unfold over longer time frames and it is difficult to predict outcomes in order to fully justify investments.
    - Improved modeling and new technologies that combine sensor and historical data will enhance utility preparedness.
    - Government agencies often work together to ensure their climate change modeling and information is consistent. USACE works with other Federal agencies, such as the National Oceanic and Atmospheric Association (NOAA), and universities, to ensure that assumptions and modeling is consistent when they apply it to tools and resources. One example of this is their sea level change calculator, which is available to the public, and focused on USACE projects.
    - Modeling software and Water Sector-specific training support is needed.

- Financial/Decision-making tools:
    - Resilient infrastructure requires major costs, which can impede resilience. One way to address this is to consider the current financial environment and calculate costs over planning windows that make sense to decision-makers.
    - Many hazards occur infrequently, but could cripple regions. Because of this, you have to convince people must be convinced the hazard is important. Hazard analysts need to make results comparable to the traditional planning windows used to make financial decisions.
    - The Water Sector should support research and technological development by disseminating success stories and best practices and collaborating with the research community (e.g., how to annualize costs for water infrastructure).
- More informed resilience activities, such as scenario planning tools, response exercises, employee training on automated technological solutions, and tools that account for the "human side of resilience," need to be deployed throughout the Water Sector.
    - Dealing with complex systems requires experience. Models do not always include the complexity/characteristics to capture the true nature of a system.
    - During major disasters (e.g., an earthquake or pandemic), the effects of the event on the workforce will be a major challenge to overcome.
    - About 25 to 30 percent of the workforce is approaching retirement. Utilities are conducting market-based benefits analysis on how to compete with the private

sector. This will allow the utilities to competitively re-staff 50 percent of the workforce in the next five years. The industry is also evolving into more specialized work and needs knowledgeable staff.

- Research needs to:
    - Focus on energy efficiency and smaller-scale effective treatment operations.
    - Fund technologies that will limit future damage.
    - Encourage cross-discipline collaboration for better models.
    - Address snow-pack melting; cities are dependent on water imported from miles away.
    - Address seawater intrusion on local water supplies.
    - Examine the transportation-water connection.
- Utilities often struggle with making the business case for cybersecurity investments.
    - As cyber threats increase in frequency and intensity, customers will want to know what cybersecurity measures or programs have been implemented. However, the regular rate-paying customer is oblivious to potential disruptions from cybersecurity, as a consequence of the Water Sector's success in providing "invisible service."
    - Management may think cybersecurity solutions are too expensive.
    - Sector-specific cybersecurity tools that are sensitive to implementation cost issues are needed.

The Federal Government can support resilience in the Water Sector by focusing on affordability and providing funding, conducting risk analysis, sharing best practices, and helping utilities "make the case" for resilience.

- The Federal Government can provide support through analytic work and risk analysis. Utilities do not have the capacity to downscale global climate models; national labs can help provide the tools to guide utility decision-making.
- Utilities had to implement security upgrades after the September 11th attacks, and the public understood the need for this. If the Federal Government mandates a greater level of resilience and includes a resilience model for what infrastructure should look like, then utilities and the public will be better able to understand the need for changes and the costs associated with them.
- The Federal Government can support a group of professional associations or research foundations to examine these tools. National Institute of Standards and Technologies (NIST) committees can also help facilitate this kind of tool.

- The Federal Government can help promote resilience solutions as best practices:
    - The Center for Neighborhood Technology works with local finance organizations to address water incidents by convening communities and financing infrastructure adaptation.
    - Los Angeles and Philadelphia embrace decentralized activities and collaboration.
    - Texas has diversified its water supplies to mitigate a system shut down because they were dependent on one supply.
    - San Francisco leverages its technology boom to secure resilient solutions and private sector investments.
- EPA's Water Security Division conducts outreach and provides technical assistance to water utilities. The division provides electronic software tools, including an in-process tool called the "Route to Resilience" to help facilities develop risk assessments by answering a series of questions (similar to online tax software). The division facilitates connections with water/wastewater facilities across the United States and conducts tabletop exercises and risk assessments. The training also helps foster relationships between agencies in the Federal Government. The division provides direct technical assistance, including helping with risk assessments.
- EPA's State Revolving Funds are a potential vector for funding to help communities achieve resilience.
- Following Hurricane Katrina, the USACE was part of a large-scale hydraulic modeling effort with the U.S. Department of Defense (DOD), universities, NOAA, and representatives from across the Nation and globe. The effort involved modeling physical features of the area, developing thousands of potential scenarios for the next probable maximum flood, and developing design criteria for New Orleans and Southeast Louisiana.
    - Following Superstorm Sandy, the effort was expanded and real-time flood inundation information is available to States to assist in decision-making. Other tools include coastal modeling and sea level rise calculators that can be applied in community planning and development decisions.
- The North Atlantic Coast Comprehensive Study's tools are publicly available and are being used to help communities across the Nation define their risks.
- WaterSMART (Sustain and Manage American Resources for Tomorrow) is a Bureau of Reclamation program that looks at the Nation's changing landscape and assists in determining whether modifications are needed to maintain a sustainable water supply. Factors such as climate change and population shifts yield recommendations such as conservation and water source shifts.
    - The Bureau also examines the risk of long-term dam failure. As the condition of the dam itself changes, the risk assessment is continually reviewed to identify necessary repairs.

- The Regional Resiliency Assessment Program (RRAP) is a cooperative assessment of specific critical infrastructure within a designated geographic area and a regional analysis of the surrounding infrastructure. To improve the efforts in the RRAP, metro area dependencies should be examined and an implementation plan should be proposed.

VI. LEADERSHIP AND COORDINATION

There is a need for resilience at the regional level and for resilience across all sectors—not just the Water Sector—due to dependencies. Planning for and responding to all types of catastrophic events requires developing partnerships and acting regionally; major disasters should be seen from a regional perspective, not from local needs or the service area. However, a shift to a regional approach requires a new paradigm for how the systems are operated (i.e., not just on individual utility assets, but on operating systems based on regional needs). Coordination is needed between governments and utilities in the region, and should include hosting joint exercises and preparedness meetings.

Collaboration between levels of government and the Water Sector has focused efforts and resources on defining a collective vision for resilience and identifying roles and responsibilities. Proven results have included creating local resilience strategies and ensuring water systems perform during situations more severe than planned.

- The greatest resilience progress is realized when jurisdictions/regions have mechanisms for collaboration. They convene multiple actors and take a regional approach.
    - In New York City, the “Big U” plan started out with fortifying lower Manhattan from storm surge. It evolved into a green infrastructure project, called Dry Line, designed to build resilient infrastructure that can generate private sector funding/investment.
    - In one State, when a small facility is unable to meet water quality standards, Health and Human Services is brought in to give guidance to drinking water constituents. In some cases, the utility is forced to merge with a larger utility in order to help finance projects.
    - Southern Nevada collectively defined the disaster response vision for the region.
    - Other examples include California and West Coast (seismic activity), South Carolina (floods), Contra Costa Regional Capacity Study (water transfer), Bay Area Regional Reliability (BaRR) project, and Lake Oswego (joint funding and planning water supply for the region).
    - Concepts of enterprise zones have been set up in the past and some are now considering resilience zones.
    - Mississippi River: planning, construction, and collaboration built into the system meant that the river performed successfully for situations that were much more severe than planned.
- Political will is required to collaborate with other regions, especially on the benefits to the State and region of resilience investments.

    - Los Angeles Mayor Garcetti issued a water order to organize the region around "one water."
    - New York City Mayor Bloomberg included a "One NYC" resilience chapter in "Plan NYC" to help manage dependencies, especially based on lessons learned from Superstorm Sandy.
- Managing dependencies and interdependencies between sectors must be a priority for sectors, government agencies, and regional organizations. There is major interest in strengthening the connection between water, energy, and climate issues. Coordination exists but needs to be improved.
    - Inefficiencies are created by not looking at lifeline sectors (Transportation, Energy, Communications, and Water Sectors) as interdependent systems.
    - In California, State, regional, local partners examined Water Sector supply chain dependencies and interdependencies (e.g., identified vulnerabilities and what/who should build the redundancy into the system). The State is also building shared capabilities across local utilities to create local resilience, meaning the utilities are not just dependent on the State.
    - Utilities are examining next generation resilience practices from outside the sector.
    - The Water Sector needs to examine how to prioritize the allocation of scarce resources needed to sustain service during major events. There will be political perspectives on which systems will need to be prioritized first.
    - The scarce supply of fuel will be a major challenge. Multisector disruptions will draw heavily on the Energy Sector.
    - There is a growing amount of data from NOAA on climate change, and the ability to predict climate change effects is improving. However, there are data gaps for groundwater. Water management is very local and data may be difficult to obtain.
    - Governments expressed the need for integrated water management approaches to better prepare for resilient systems, particularly for extreme weather events.
    - Creating regional organizations that are united by factors such as customer base and water source can spread out costs on improvement/risk-management and storage projects, help avoid utility hikes (especially for small companies), and result in a more regional approach to water.

Although change is occurring at the local level, the overall vision for resilience must come from the Federal level. Action is needed in laws, regulations, authorities, and standards; policy and funding; risk and vulnerability assessments; cybersecurity practices; response and recovery practices; and coordination across sectors and regions.

- The Federal Government can support resilience by communicating the need for resilient infrastructure. This includes leading a "clean water revolution" (supporting investments, funding, and research).

- Federal laws and regulations should be evaluated to determine what currently applies, what should be modified, where overlaps exist, and how they should be modified to allow for new technologies and new ways to improve Water Sector security and resilience.
    - Laws and regulations such as the Clean Water Act, Safe Drinking Water Act, and Endangered Species Act were effective when they were first enacted more than 40 years ago. Today, however, they are making it difficult for agencies to adapt to the changes that are needed because of climate change.
    - Flexibility in water quality would allow stressed systems to recover faster. Short-term discharge of impaired water and delivery of less-than-drinking-water quality water for other uses than human consumption could facilitate a staged recovery. However, a realistic assessment on what is practical in extreme weather emergencies is needed.
    - Regulatory approval processes to build infrastructure can be lengthy and expensive. One solution could be a multiagency project team with representatives across Federal departments to facilitate collaborative problem solving.
    - Regulations on co-generation should enable water utilities to set up energy resilience programs without barriers. This issue is not specific to the Water Sector; other facilities (e.g., hospitals, police stations, community centers, evacuation centers) could benefit from regulatory.
    - If a high-level position is established at the White House to coordinate water issues, the position requires statutory authority over budget, training, and agency activities to be effective.
- Resilience varies between utilities. Federal resilience polices should be written to allow flexibility to capture these variances and to address unique needs. Guidance, tools, and information do not always reach the local level.
    - For example, water utilities are often located in flood plains and are built to sustain once-in-100-year floods. Superstorm Sandy nearly topped a wall built to withstand a 500-year flood. Standards need to be adjusted.
    - A Federal guidance document (e.g., an EPA best practices compilation) should allow organizations to identify ways to address resilience at the local level.
    - Federal agency (e.g., FEMA, U.S. Department of Housing and Urban Development (HUD), EPA, and USACE) standards need to be reconciled.
- Federal financial assistance should require recipients to meet conditions that encourage innovation and resilience (e.g., incentives using scoring criteria and measures).
    - The concepts of preparedness and flexibility need to be introduced into State, regional, and local systems. Otherwise, investments may be hard to defend.
    - EPA has clarified eligibility for certain funding streams, such as the State Revolving Funds, to include resilience projects.

  - Federal funding driving resilience is only one issues as smaller/rural utilities do not use Federal funding streams. Procurement policies (at all levels of government) need to be updated to allow for easier transition to newer/resilient practices and vendors.

- Programs should aid low-income customers:
  - Utilities should be transparent about how service fees are used, including what rate increases will finance and the schedule of improvements.
  - A program like the Low Income Home Energy Assistance Program (LIHEAP) could be implemented in the water industry.
  - Current program examples include waiving a portion of service fees, providing discounts, and accepting voluntary donations to reduce the cost of water for low-income individuals:
    - The U.S. Department of Health and Humans Services (HHS) Office of Community Services (OCS) programs provide capital assistance for utilities with low-income customers.
    - The American Water Company of Pennsylvania and the Baltimore, Maryland Department of Public Works both have low-income assistance programs.
    - Detroit, Michigan has a grassroots program that collects donations that help people who have problems paying their water bills.
    - Information on smart meters, retro fitting old devices, and other conservation efforts should be provided.
- The Water Sectors should address issues that impact multiple sectors or a region, such as risks and cascading failures.
  - After the September 11th attacks, to address concerns about the security of water/wastewater facilities, EPA issued a series of requirements for facilities to conduct vulnerability assessments. This is an example of Federal activity affecting the local level, which resulted in regular assessments.
  - The Dams Sector identified a need for a common baseline to compare different risk environments. As a result, the *Federal Guideline for Dam Safety Risk Management* was created to set industry standards.
  - The Hydrologic Engineering Center (HEC) software programs can inform local municipalities and impart confidence about water surface elevation. That is useful for local emergency plans, enabling them to forecast events.
- Cybersecurity is a multidimensional challenge that cannot be resolved by one utility. The Federal Government can promote effective cybersecurity best practices and ways to mitigate risk throughout the sector, while supporting a coordinated sector approach to cybersecurity. All sectors need to modernize systems and increase cybersecurity.

    - Federal cybersecurity capabilities are helpful and additional resources (e.g., tools, guidance) are needed. Examples include DHS risk assessments, Control Objectives for Information and Related Technology (COBIT), IT Infrastructure Library (ITIL) security management, the DHS Daily Open Source Infrastructure Report, and DOD programs/capabilities.
    - The Federal Government can develop and socialize solutions to reduce system penetration from external sources. This may entail establishing a front-line of defense against immediate threats (e.g., situational awareness of network vulnerabilities, threats, and events), increasing countering capabilities and supply chain security for key information technologies, expanding cyber education, coordinating research and development, and defining and developing strategies to deter malicious cyber activity.
    - A vulnerability assessment for smaller companies can help to determine their current level of cybersecurity risk.
    - Vendors address security differently and a consolidation of vendor cybersecurity practices would be helpful, particularly in addressing international vendors—what is acceptable in Germany may not be acceptable in the United States.
- The Water Sector should support cross-agency and cross-sector collaboration. Resilient water systems are a shared endeavor.
    - It is a challenge to unify Federal, State, and local government efforts.
    - Changing the approach to look at the whole system could make emergency response and recovery funding easier to obtain.
    - The FEMA administrator is a centralized role that could take on more pre-event planning. During Hurricane Sandy, the FEMA Administrator kept governors updated on restoration, planning, and operations efforts. This practice should continue to ensure coordination of all key players.
    - National, State, and regional plans needs to outline pre-event collaboration with water and wastewater utility owners.
    - Federal agencies (e.g., EPA, Bureau of Land Management (BLM)), the Water Sector Coordinating Council (SCC) and Government Coordinating Council (GCC), and trade associations could jointly lead collaboration and disseminate resilience guidelines and best practices. EPA is disseminating guidance on what constitutes a robust resilience plan.
    - There is a need for regional joint capacity planning with the Water and Energy Sectors to manage the assumption that each other's supply will always be there.
    - The U.S. Department of Transportation (DOT) and EPA could jointly provide regional planning.

    - Federal and State governments can partner with local utilities. Communities are willing to do more, but they need guidance and information (e.g., hearing about best practices, including from the private sector).

- The Defense Industrial Base Sector can support efforts to mitigate effects to public health and safety.
    - Federal, State, and local emergency managers should lead response efforts and facilitate dialogue with any military response.
    - The National Guard can mitigate the effects of a Black Sky Event by providing drinking water and addressing other immediate public health needs. When there is a wide-spread attack on infrastructure a State's governor can call on the Quartermaster Corps within the National Guard to supplement replacement facility parts.
    - Military installations regularly rely on close collaboration with the utilities, and mutual understanding is critical. The National Guard has systems that can convert raw water to water and transportation support capabilities, and can conduct debris removal work. There are opportunities for DOD to support industry.
    - There is ambiguity on what authority has decision-making power on water rights. Individual States believe they have final say in water rights. But the Federal Government believes it has Federal Reserve water rights. Constitutional tension could affect water supply in a crisis.
    - Water and water infrastructure is extremely complex because most owners are local municipalities. As a result, there is not a direct Federal role.
    - The USACE's involvement is often in response to disasters. USACE focuses on a systems approach with Federal and civilian infrastructure working in tandem. Following Superstorm Sandy, the Federal Government was operating under the National Response Framework. As the lead for ESF#3, the Corps was working closely with EPA to help a wastewater treatment facility return to operations.
- FEMA plays a key role in response and recovery:
    - FEMA is chair of a group established under Presidential Policy Directive 8 (PPD-8). This Mitigation Framework Leadership Group is an interagency group that also has State and local representatives. It is tasked with using the Federal Government's resilience and mitigation approach. The group works to establish standards, including executive orders related to Flood Standards (EO 13690), Seismic Standards, and Wild Urban Interface related to fire.
    - Projects built with the help of Federal investments must be built to withstand future events. FEMA can ensure the projects meet standards.
    - FEMA should make sure there is flexibility in the recovery process so that communities can rebuild in a manner that promotes resilience.

APPENDIX C.

DISRUPTION SCENARIO CASE STUDY

In order to help inform the National Infrastructure Advisory Council's (NIAC) Working Group recommendations to the full Council, the Study Group was tasked with assessing resilience during a high-impact scenario to identify challenges and opportunities. To that end, the Study Group designed a case study workshop that assessed water system resilience under five different disruption scenarios encompassing various regions and levels of disaster scale (local, State, and regional) and both manmade and natural hazards. The five disruption scenarios were selected due to their applicability to the Study Group's task and information learned during the Study Group's discussions, as well as being consistent with risk areas identified in the *2015 Water and Wastewater Systems Sector-Specific Plan* (2015 SSP).

Workshop participants included Study Group members and additional subject matter experts with experience in sector and cyber-physical dependencies, cybersecurity, natural disaster response and planning, and information sharing. To enable a robust discussion, participants were provided with comprehensive background information on the disruption scenarios and common resilience themes across the scenarios. The disruption scenarios covered the following risk areas: natural disasters, cybersecurity, and energy disruptions. The following five disruption scenarios were discussed during the workshop:

- **Natural Disasters**
    - Midwest Floods of 2008
    - Superstorm Sandy
    - New Madrid Earthquake

- **Cybersecurity**
    - Cyber-based Attack

- **Energy Disruptions**
    - Northeast Blackout of 2003

Section I of this appendix summarizes the results of the workshop. Section II provides the analysis of the five disruption scenarios in greater detail, including an examination of disruption impacts, dependencies, gaps and challenges, and opportunities.

I. WORKSHOP RESULTS

The workshop focused on identifying common resilience themes and uncovering gaps, challenges, and opportunities. This section highlights information learned from the workshop discussion, providing insights and perspectives on Water Sector resilience issues. It is organized by five major themes of Water Sector resilience:

- Priority as a Critical Sector and Valuation of Water Services

- Greater Investment in Resilience

- Changing Risk Environment

- Regional Disaster Preparedness
- Federal Support for Resilience

PRIORITY AS A CRITICAL SECTOR AND VALUATION OF WATER SERVICES

- Water utilities should be a “tier 1” priority for power restoration after a disruption.
- After a large-scale disaster, supply chain challenges proliferate and there is no formal prioritization of resources (generators, pumps, fuel) to support the Water Sector. The situation is further complicated by disrupted sectors connected to the Water Sector supply chain; for instance, transportation (e.g., transporting equipment for recovery) and chemical (e.g., chemical procurement challenges).
    - Resource prioritization is a direct output of the partnership model. Some utilities work with the State emergency management office, Federal Emergency Management Agency (FEMA), U.S. Army power teams, and adjacent utilities to receive prioritized resources.
    - Local/State emergency managers should champion both prioritization and holding cross-sector workshops and exercises.
- Robust communication (i.e., with the public, media, local government, local utilities) is important to not only convey information during times of emergency but also the overall value of water services.

GREATER INVESTMENT IN RESILIENCE

- More advanced water utilities should develop emergency resource request templates for and build information-sharing relationships with smaller, local utilities.
- Personnel represent a critical point in response/recovery and greater personnel investment is needed. Employee assistance programs (e.g., interest free home preparedness loans, food/gas/toll support) enable personnel to report to work during times of disruption.
- Greater investment in the sectors with a nexus to water infrastructure is needed (e.g., investing in the power grid, or facilitating public health sector exercises on water outages).
- Within the past 15 years, there has been a major push for earthquake preparedness causing earthquake preparedness gaps to close. Earthquake science has also improved and there is a better understanding of the risk. This success can be applied to other risk areas.
- Typically, utilities plan for a three to seven day power outage. There is a need for utilities to plan for short-, medium-, and long-term power outages.
- Utilities can invest in infrastructure resilience using the worst historical case; however, the risk environment changes and as such, utilities should consider investing/building-in resilience beyond the worst case.

CHANGING RISK ENVIRONMENT

- One water utility designed two-way lines of communication between the utility and State/local emergency management agencies. It is intended to expedite resources and de-conflict emergency response activities.
- Utilities need an appropriate framework to help them examine short- and long-term risks.
- Improved risk communication (e.g., flood risk) is needed.
- Water facility access issues significantly complicate recovery operations. These include access control and credentialing for water utility personnel, security infrastructure losing power, and transportation issues.
- The following represents information related to water cybersecurity issues:
    - The Water Sector can leverage cybersecurity lessons learned from the Energy Sector, for example their cyber-physical exercises.
    - Cybersecurity awareness throughout the utility (e.g., for all engineers, operators, and decision-makers) is limited.
    - Utilities do not have clear governance related to the management of cyber systems and incident preparedness and response roles/responsibilities.
    - Control system engineers see cybersecurity as “redundant” (i.e., ensuring continuity) and not “resilience” (i.e., preventing cyber incidents).
    - There are many systems and cyber processes and people supporting them; and as such, there are many points of vulnerability to control.
        - The U.S. Department of Homeland Security (DHS) can assist water utilities with identifying vulnerabilities.
    - Depending on information access levels (e.g., clearances), utilities may be information-rich (bordering on inundation) or information-poor. However, all utilities struggle with operationalizing cyber threat information and generating concrete threat-response actions.
        - Some utilities are also reluctant to share vulnerability and incident-learned information or join information-sharing networks.
        - There is a limited group of personnel intersecting the understanding of water utilities and cybersecurity. If there is a major, coordinated cyberattack on utilities there may not be enough available personnel to respond.
        - Utilities are unable to offer competitive packages to attract top cybersecurity experts.
    - Water utilities would greatly benefit from conducting cyberattack disruption exercises, during which they have to run their utilities manually.
    - Technology changes rapidly, resulting in frequent updates and increased opportunities for building-in resilience into cyber systems or falling farther behind.

REGIONAL DISASTER PREPAREDNESS

- Regional natural disasters (e.g., major floods) are infrequent and utilities are not able to assure power supply (e.g., fuel storage limitations and electricity is perishable).
    - Preparations are difficult.
    - Everyone needs the same resources, at the same time.
- Utilities should conduct the following regional event preparedness actions:
    - Establishing relationships with adjacent utilities for resources (e.g., personnel, equipment) during an emergency.
    - Pre-identifying resource needs, such as resources for minimum operations, and developing contracts to secure those needed resources.
    - Issuing purchase orders in advance to pre-approved vendors, enabling the vendor to move quickly.
    - Meeting with stakeholders (e.g., customers, local government, communities, emergency services) to communicate water utility recovery objectives and system outages, in the event of a major disruption.
- Additional exercises are needed within the Water Sector and in coordination with other sectors, in particular those that the Water Sector depends on (Chemical, Energy, Communication, and Transportation Sectors). This enables utilities to understand roles/responsibilities and identify ‘choke points’ in the system and system risk.
    - Exercises can be convened through the following: Local interdependent utilities convening themselves, local city/county emergency management, State lifeline infrastructure resilience councils, or FEMA.

FEDERAL SUPPORT FOR RESILIENCE

- The Water Sector’s ability to construct dedicated power-generation sources is also constrained by investment challenges. Utilities are supporting generation equipment for something infrequent, which competes against dollars for aging infrastructure and more immediate needs.
- Regulatory flexibility is critical to navigating disruptions. During emergencies, water utilities need to maximize their operations to minimize down-stream disruption impacts (e.g., public health impacts).
    - There is a need to continue the dialogue regarding regulations that prohibit ‘smart’ emergency responses.
- A lot of cybersecurity information is shared with the sector, but utilities need more actionable information and guidance on what to do with this information.

II. DISRUPTION SCENARIO ANALYSIS

In support of the Study Group's tasking to consider Water Sector resilience related to a high-impact scenario, an assessment was conducted on available high-impact scenarios. Scenarios were selected based on their strong applicability to the Study Group's charge, as well as relevancy to key Water Sector resilience issues uncovered during Study Group panel discussions. This section summarizes the disruption scenarios which were examined, highlights common resilience themes across all five scenarios, and provides a synopsis of the core disruption aspects for each scenario.

DISRUPTION SCENARIO SUMMARY

Natural Disasters

Midwest Floods of 2008 (Actual Scenario)[63]

Hazard Type: Natural Disaster, Flooding

Key Characteristics: Heavy rainfall generates flooding exceeding historic flood levels in Idaho and southern Wisconsin, with some areas falling outside of the 100-year floodplain. Four wastewater facilities in Southern Wisconsin were examined.

Superstorm Sandy (Actual Scenario)[64]

Hazard Type: Natural Disaster, Hurricane/Superstorm

Key Characteristics: In October 2012, Superstorm Sandy made landfall in New Jersey. The storm surge rapidly inundated infrastructure, particularly wastewater sites. Relevant information from three New Jersey wastewater facilities, District of Columbia Water and Sewer Authority (DC Water, combined drinking water and wastewater treatment facility), New York City Drinking Water, and other water utilities participating in water response networks were examined.

New Madrid Earthquake (Fictional Scenario)[65]

Hazard Type: Natural Disaster, Earthquake

Key Characteristics: A major earthquake (7.7 magnitude) strikes the Central U.S. region—a region with un-reinforced infrastructure and a concentration of lifeline infrastructure. In areas within approximately 200 miles from the epicenter, drinking water and wastewater infrastructure is destroyed and service is unavailable to the vast majority of hospitals, government buildings, and communities, as well as for fire suppression.

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[63] FEMA, *Midwest Floods of 2008 in Iowa and Wisconsin*, 2009.

[64] FEMA, *Hurricane Sandy in New York and New Jersey*, 2013; *City of New York, A Stronger More Resilient New York*, 2013; and AWWA, *WARN: Superstorm Sandy After-Action Report*, 2013.

[65] Mid-America Earthquake Center, *Earthquake Hazard and Impact in the New Madrid Region*; and Mid-America Earthquake Center, *Impact of New Madrid Seismic Zone Earthquakes on the Central USA*, 2009.

Cybersecurity

Cyber Storm IV: Evergreen (Fictional Scenario)[66]

Hazard Type: Manmade, Cyberattack

Key Characteristics: A cyberattack targeting infrastructure at the local level was exercised across 16 States; focusing on State-level response and examining escalation from internal discovery to national information-sharing and remediation considerations.

Energy Disruption

Northeast Blackout of 2003 (Actual Scenario)[67]

Hazard Type: Manmade, Energy Disruption

Key Characteristics: A cascading outage of electric transmission and generation facilities produced a blackout of most of New York, as well as States in the Northeast and Midwest and Canada. A water supply district in Cleveland, Ohio—providing drinking water to 1.5 million people—was examined.

COMMON RESILIENCE THEMES

The following are key themes that crosscut the five scenarios.

- The **energy-water nexus** and its potentially adverse impacts on water utilities during a disruption is the most common theme across both manmade and natural disasters.
- **Elevating the priority status of the Water Sector** is a common after-action need, particularly as it relates to the energy-water nexus.
- **Energy, Transportation, and Communications** Sectors are ones that water utilities depend on for disruption response and recovery. The public health sector experiences the greatest downstream impacts from water disruptions.
- Major disruptions were beyond the capacity of the water utility to exclusively resolve and as such, water utilities relied on external resources and coordination with other water utilities, sectors, and emergency management. Across all disruptions, it was evident that additional pre-event **relationship-building, exercising, and understanding roles/responsibilities** would have improved disruption management.
- **Timely, accurate information sharing** to the public, media, and emergency management liaisons is critical to ensure public health and safety, mitigate panic, and facilitate response. Risk communication is essential.
- Utilities will experience major impacts if their infrastructure is not **built to withstand impacts** from a low-probability, high-impact event (e.g., major flooding).
- **Water facility access issues** significantly complicated recovery operations. These include access control and credentialing for water utility personnel; security infrastructure losing power; and transportation issues.

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[66] DHS NCCIC, *Informing Cyber Storm V: Lessons Learned from Cyber Storm IV*, 2015.

[67] Center for Infrastructure Protection and Homeland Security, GMU, *Blackout*, 2013.

- **Personnel represent a potential point of failure** in response and recovery, as they can also be significantly impacted by major disruptions and unable to reach the facility. Once at a facility, they must be assured of personal safety along with food and drinking water.

OVERVIEW OF DISRUPTION ASPECTS

This section examines the five scenarios with response to four topics:

- **Scenario Impacts** – Key scenario information, inclusive of economic and physical infrastructure effects.
- **Dependencies** – Points of failure in processes, communication, or infrastructure leading to disruption in the Water Sector
- **Gaps and Challenge**s – Complications and obstacles experienced or uncovered during or after the Water Sector disruption
- **Opportunities** – Lessons learned information or expert-suggested actions, which could improve Water Sector security and resilience

Scenario Impacts

2008 Midwest Floods – Region: SE Wisconsin

- Iowa and Wisconsin reported billions in economic and agricultural losses
- One wastewater facility sustained $2 million in damages
- Flooding occurred above record stage and outside 1-percent-annual-floodplain-chance
- Plant inundation (from surface flows and river flooding) generated a complete plant shutdown
- It took two days to remove floodwaters from wastewater facilities; they were able to operate on permanent power two weeks later
- Personnel abandoned sites for safety; some facility access roads were impassable
- Emergency generators could not run due to water inflows, shut off fuel supplies, and transport issues

2012 Superstorm Sandy – Region: Northeast (NY, NJ, DC)

- Over 8.5 million people with no power; estimated $71 billion in damages; at least 162 dead
- Transportation corridors, roads, tunnels flooded—causing fuel shortages
- Power restored within hours to days but damaged power systems caused recovery delays; e.g., in Howard County, MD, loss of power resulted in release of 25 million gallons of raw sewage
- 10 of 14 New York City wastewater plants released partially treated/untreated sewage into local waterways; 42 of 96 pumping stations damaged
- Storm surge rapidly inundated wastewater sites, preventing planned actions (e.g., de-energizing plants)
- Equipment and systems damaged by floodwater, delaying recovery

New Madrid Earthquake – Region: Central U.S. (Fictional Scenario)

- 2.6 million households without electricity and 1.1 million households without water
- Within 200 miles of epicenter, drinking water and wastewater service unavailable to the vast majority of hospitals, government buildings, and communities
- 86,000 casualties and 3,500 fatalities
- 425,000 breaks to utility pipelines; nearly 715,000 damaged buildings; over 3,500 damaged bridges
- $300 billion in direct economic loss
- More than 730,000 people permanently displaced
- Limited medical, firefighting, and law enforcement services

Cybersecurity Incident (Fictional Scenario)

- *Not Available – impact information not disclosed in public report*

2003 Energy Blackout – Region: Cleveland, OH

- Large portions of Ohio, Michigan, Pennsylvania, Massachusetts, New York, Connecticut, New Jersey, and Ottawa, Canada were without power
- 50 million people affected
- Economic impact is estimated to be $4 billion to $6 billion for affected regions
- In the greater Cleveland area, it took 30 hours to restore power; and in NYC, it also took 30 hours
- Approximately 80 percent of the Cleveland water distribution system experienced partial outages
- Boil advisories are issued, impacting a majority of service customers

Dependencies

2008 Midwest Floods – Region: SE Wisconsin

- Transportation
- Energy
- Public Health (downstream disruption)
- Emergency Services to navigate access challenges
- Communications to disseminate information

2012 Superstorm Sandy – Region: Northeast (NY, NJ, DC)

- Energy-particularly electricity and fuel supply
- Transportation corridors
- Communications

New Madrid Earthquake – Region: Central U.S. (Fictional Scenario)

- Nearly all critical infrastructure, particularly: Energy, Transportation, Communications, Public Health (downstream), and Information Technology

- Personnel are unable to reach the facility, taking care of their own families

Cybersecurity Incident (Fictional Scenario)

- Internal/external system (e.g., cyber, physical) dependencies
- Communications

2003 Energy Blackout – Region: Cleveland, OH

- Energy-water utilities were disrupted due to a massive cascade of external failures
- Information Technology
- Communications
- Personnel

Gaps and Challenges

2008 Midwest Floods – Region: SE Wisconsin

- Wastewater facilities are located in low-lying areas prone to flooding
- Flooding recurrence levels are difficult to predict
- Transportation challenges in accessing flooded water facilities
- Fuel challenges—local fuel stations were out of service
- Power generation challenges—original and back-up generators were flooded, inoperable; offsite power utilities were disrupted
- Backup equipment had been installed below base flood elevation

2012 Superstorm Sandy – Region: Northeast (NY, NJ, DC)

- Wastewater facilities are located in flood zones, near major bodies of water
- Unprecedented storm surge and debris was beyond the capacity of the sewer/wastewater system to perform
- Essential and backup equipment had been installed below base flood elevation
- Permanent generators (in-place) were uncommon
- Lack of support for power and fuel requests
- Loss of electricity meant water supplies could not move through high-rises
- Radio/communication lines were temporarily lost
- Key transportation corridors, access roads were flooded
- Access control issues limited utility personnel's damage assessment and repairs

New Madrid Earthquake – Region: Central U.S. (Fictional Scenario)

- Entire water infrastructure within 200 miles of epicenter suffers major damage
- Water storage tanks collapsed and limit planned water supplies
- Wastewater overflows into buildings and spills into nearby water bodies
- Impassable roads and highways block access to many facilities
- Communications are all but eliminated

- Local equipment to repair infrastructure are damaged
- Chemical storage tanks and piping have ruptured, creating hazardous materials spills
- Large numbers of water and wastewater personnel are not at work because they are dealing with family issues and the loss of homes and schools

Cybersecurity Incident (Fictional Scenario)

- Major system dependencies exist, and taking systems down or bringing them up requires major coordination and collaboration
- There was uncertainty regarding when to communicate, what to communicate, and with whom
- Legal and authority questions challenge public and private interactions
- Escalating cyber emergencies
- Resource allocation procedures absent or inadequate
- Federal emergency response authorities unclear during a major cyber event
- Gaps in communication, responses plans, and resources were identified

2003 Energy Blackout – Region: Cleveland, OH

- Dependence on national power grid is a major vulnerability and there is a lack of understanding of the grid's complexities and connections
- Offsite networks and IT systems had to be powered down due to danger of overheating
- Back-up generators were limited and what exactly was connected to them was unknown
- Logistical issues (establishing a chain of command in decision-making, overworked personnel, deploying staff to field offices, availability of knowledgeable staff onsite) had to be quickly overcome
- Security gates lost power

Opportunities

2008 Midwest Floods – Region: SE Wisconsin

- Locate critical facilities outside 2-percent-annual-chance flood hazard area; if not possible, protect equipment to that level
- Use flood damage-resistant material and construction practices to reduce losses and facilitate cleanup
- Reduce direct inflows to prevent overwhelming operational equipment
- Coordinate with major users to reduce demand on facility
- Issue information bulletins to encourage the reduction of water use and sewage flows
- Develop emergency operations plans and checklists (e.g., contact information) for all facilities
- Plan to stage emergency equipment (e.g., pumps, generators, fuel) outside of mapped flood hazard area
- Place stronger emphasis on flood risk communication

2012 Superstorm Sandy – Region: Northeast (NY, NJ, DC)

- Improve Energy Sector communications; coordinate with utilities to improve reliability
- Make Water Sector power restoration a priority for all power providers
- Establish Water Sector support and define roles/responsibilities for Emergency Operations Centers (EOCs)
- Form pre-defined response teams for various events; determine roles
- Protect key infrastructure to a higher risk, lower probability flood event (e.g., 500-yr flood)
- Develop a flood protection strategy for all facilities (central, offsite)
- Conduct pump-station power loss exercises
- Develop a plan to secure critical equipment (trucks) and fuel after storm
- Invest in staff support (food, gas/toll support, temporary shelter)
- Work with local/State/regional planners and responders
- Federal response partners to ensure water utility personnel have site access
- Increase participation in Water/Wastewater Agency Response Network (WARN) and Emergency Management Assistance Compact (EMAC)
- Develop a more systematic process to gain utility operation status
- Address communication system interoperability issues; ensure internal/ external communications

New Madrid Earthquake – Region: Central U.S. (Fictional Scenario)

- Implement and support a continuous planning and exercise event cycle for major regional events
- Continue the interregional and Federal planning effort
- Focus on senior leadership involvement in catastrophic planning
- Develop a comprehensive lifelines recovery strategy
- Continue disaster air operations planning
- Examine emerging technologies to enhance recognition, warning, and post-event information sharing

Cybersecurity Incident (Fictional Scenario)

- Define dependencies in advance, identify critical systems, and develop communication/ coordination planning
- Clearly define roles/responsibilities and an incident command structure
- Ensure cyber plans include: response and recovery processes/procedures, contingency plans, coordination guidance, prioritization of mission critical systems, and information-sharing protocols
- Increase familiarity and exposure to cybersecurity issues (e.g., threats)
- Promote ongoing training to keep staff knowledge levels current
- Identify and understand available resources prior to an incident

2003 Energy Blackout – Region: Cleveland, OH

- Share information on national power grid dependencies
- Identify options for dedicated service, priority service, and other agreements with power suppliers
- Define decision-making process and roles/ responsibilities
- Establish an EOC for each offsite facility
- Develop protocols and ready-made templates for internal, external and public/media communications
- Ensure sufficient equipment for handling logistics and communications
- Have an EPA or State representative onsite to provide the 'other side' of disruption impacts
- Develop protocols and ready-made templates for internal, external and public/media communications
- Establish a public call center and regular communication with media
- Address security concerns (e.g., backup power for security gates) and establish procedures to avoid dissemination of critical facility information

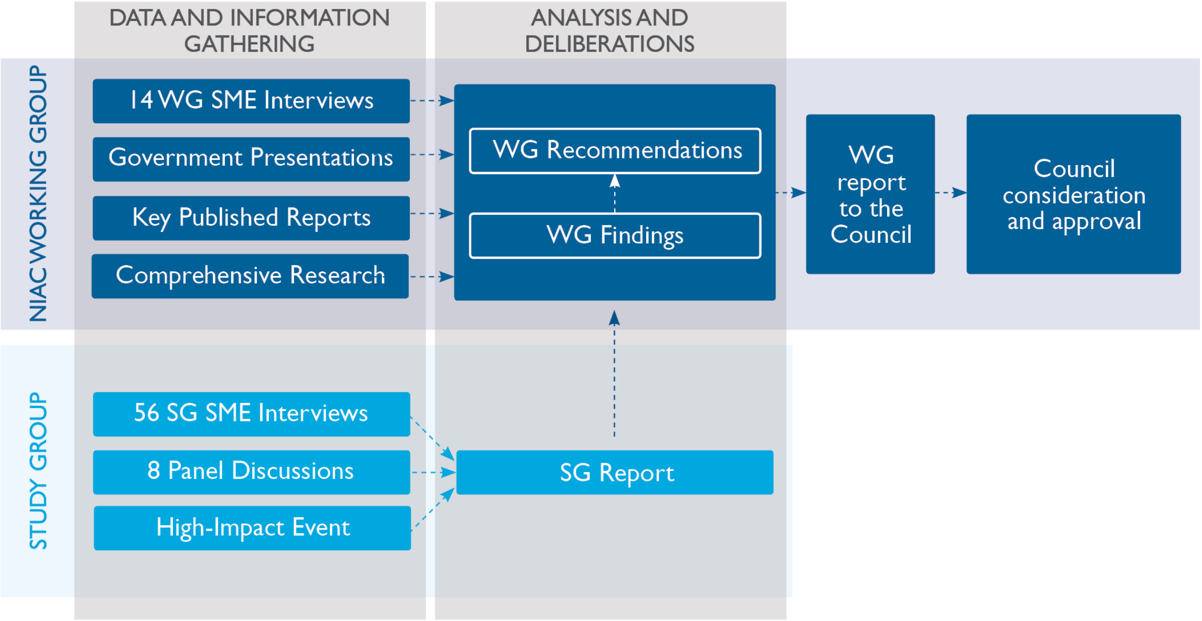
APPENDIX D.
STUDY GROUP FINDINGS AND CONCLUSIONS

The Working Group formed a non-NIAC-member Study Group to examine specific technical, financial, and operational issues. Specifically, the Study Group was tasked to:

- Identify baseline resilience of the sector
- Identify the risk profile of the sector including current, emerging, and long-term risks and the strategies and practices the sector is implementing to mitigate them
- Identify unique factors within the sector that influence risk mitigation, including investments and operational decisions
- Identify gaps in resources and practices, and opportunities to remedy them
- Summarize research and interviews into key findings and conclusions
- Prepare a summary report of Study Group findings and conclusions to the Working Group

Exhibit D-1 shows the formal entry point for the Study Group report that was invaluable during the analysis and deliberations phase. This Study Group input, in addition to the Working Group's expertise and experience, interviews with subject matter experts, extensive literature reviews, and comprehensive research resulted in a well-documented report.

Exhibit D-1. Overview of Working Group and Study Group Efforts



The Study Group has developed six main findings:

- Water is not given appropriately high priority as a critical sector.
- Water services are undervalued.
- Greater investment is needed to improve Water Sector resilience.

- A dynamic risk environment requires sustained research and analysis to support risk management.
- Regional collaboration is highly valuable but effectiveness requires expanded support.
- Federal program support for resilience is fragmented and weak.

These findings and their related conclusions are presented below.

Study Group Finding 1: Water is not give appropriately high priority as a critical sector.

The Water Sector's role as a lifeline sector is not sufficiently recognized—and acted upon—by the majority of stakeholders at the local, State, and national levels. This is a fundamental failing, as multiple sectors are critically dependent on water, and water is arguably the single most important resource for community health and well-being. Enhanced coordination across sectors on planning and prioritization of resources needed during restoration is needed to support the sector as a national priority.

Specific challenges include:

- Continuity of water services requires a full spectrum of resilient activity rather than simply focusing on response. This is not yet fully understood by the public or decision-makers.
- Planning for larger-scale (multicommunity, multijurisdiction) supplies of emergency drinking water is inadequate; the capability of individual States to effectively deliver needed water is limited.
- Cascading effects of disruptions among critical sectors are not fully understood or valued, particularly during major disasters when all critical services are being stressed.
- Service restoration requires improvement in coordination and communication between the Energy and Water Sectors.
- Current authority for water is distributed across four Emergency Support Functions (ESFs) under the National Response Framework and multiple Federal agencies, leading to uncertainty, leadership challenges, information-sharing complications, and an overtaxing of Water Sector response resources—all of which can impede water service recovery during disasters.

Study Group Conclusions: Opportunities to Increase the Priority of Water

A. Treat water and wastewater services as a first-tier national priority across the full spectrum of for preparedness—prevention, protection, response, mitigation, and recovery—as defined in Presidential Policy Directive 8 (PPD-8).

B. Examine the Federal/State capability in providing emergency water supplies under emergency conditions, particularly given recent events in Michigan, Ohio, and West Virginia.

C. Build a shared understanding among critical interdependent sectors of assumptions, plans, capabilities, and prioritization of resources.

D. Facilitate coordination between water utilities, fuel and chemical providers, and law enforcement and emergency managers to increase awareness of and improve service restoration processes.

E. Strengthen Federal coordination during emergencies and improve sector response, by streamlining and coordinating Water Sector emergency support functions (e.g., consolidating Federal assistance for the Water Sector under a single ESF).

Study Group Finding 2: Water services are undervalued

Water Sector services are often undervalued, if not simply taken for granted. Understanding, recognition, and support for the value of resilient water services is lacking by both the public-at-large and decision-makers. Proactive investments in resilience can produce order-of-magnitude savings compared to expenditures for emergency response and repair. However, this requires decision-makers who are willing to champion and fund resilience priorities, combined with underlying public support.

Specific challenges include:

- The lack of appreciation is an underlying contributor to lack of support for infrastructure investment.
- Decision-makers at every level need to support system upgrades that build resilient capacity and encourage system redundancy.
- Public outreach and education is critical to build the case for investment. Improved understanding by the public—and elected leaders—is fundamental to taking effective and sustained action for resilience.
- The challenge of raising rates to meet actual short- and long-term needs—including resilience—is enormous.

Study Group Conclusions: Opportunities to Appropriately Value of Water

A. Conduct a full life-cycle cost/benefit analysis to demonstrate the overall value of infrastructure investment—in health, convenience, economic prosperity, and overall quality of life—and the payoffs associated with investment now to avoid more costly impacts later.

B. Provide water utility decision-makers with specific and validated information to value water appropriately, about the positive cost/benefit characteristics of resilience investments, and to support and defend investments in system resilience.

Study Group Finding 3: Greater investment is needed to improve Water Sector resilience.

Enhancing resilience requires strategic investments in infrastructure, technology, and expertise, yet many water and wastewater systems are constrained making such investments, particularly in smaller utilities. While resources are often available for short-term operational needs, such as emergency response, investment in preventative measures has often been inadequate to ensure reliable service delivery under distressed conditions. Constraints include a lack of focus on full life-cycle costs for building resilient infrastructure, a deepening shortage of experienced personnel, a lack of awareness or availability of tools and information, and a concern by political leaders about the impact of rate increases on low-income populations. Enhancing the ability of the Water Sector to make improved strategic investments can build resilience while complementing short-term operations.

Specific challenges include:

- While capital is available to most systems, incorporating a full accounting of risk is difficult because rate-setting is often a political process.
- Water and wastewater utilities are highly diverse; some develop and implement leading-edge practices while others lack information, knowledge, expertise, tools, and lessons learned. Despite the criticality of sharing these resources, adoption of successful practices and resources has not been fully realized.
- Information and tools to understand risks and conduct risk assessments are available and valuable, but are currently underutilized throughout the sector due to lack of awareness.
- The adequacy of human assets within the Water Sector are a growing concern, particularly with regard to knowledge retention and talent acquisition. Challenges that require new skill sets and the costs of training constrain the ability to adapt to a changing environment. The loss of institutional knowledge due to retirements compounds this shortfall.
- The affordability challenge makes it difficult for some communities to have full-cost-of-service pricing.

Study Group Conclusions: Opportunities to Increase Investment in Water Resilience

A. Incorporate risk into financial decisions and capital investments in building and sustaining resilient systems as cost-effective solutions that balance short- and long-term needs with normal and distressed operations.

B. Facilitate partnerships between water utilities, associations, and the private sector to educate and promote resource sharing and knowledge transfer (e.g., best practices and resilience case studies).

C. Encourage mentorships between leading edge utilities and less-mature utilities—such as between large and small utilities—and facilitated by associations.

D. Invest in the implementation (e.g., streamlining and increasing awareness) of currently available tools, especially standardized risk-analysis tools that inform capital project design and investment decisions, and ensure Federal agencies collaborate on tools to avoid duplication.

E. Invest in job and training programs and technical assistance—in partnership with higher-education providers, nongovernmental organizations, and veteran’s services—on the use of information and tools.

F. Authorize and fund a financial assistance program, similar to the Low Income Home Energy Assistance Program (LIHEAP), to address the affordability challenge for disadvantaged populations.

G. Utilize asset management tools and green infrastructure approaches to increase investments in critical assets.

Study Group Finding 4: A dynamic risk environment requires sustained research and analysis to support risk management.

Water Sector partners recognize that planning for historic patterns of disruption do not fully account for changing and emerging risks. This situation is not exclusive to the Water Sector, as new and/or expanding threats (e.g., cyberattacks, aging and moving populations, and increasingly severe weather events) are becoming more prominent for all critical infrastructure. A dynamic risk environment requires continued research and analysis to improve confidence in long-term risk-management decisions, even while utilities struggle to meet the current demands of day-to-day operations. The cybersecurity challenge in particular will test the capabilities of risk-management processes, with the acquisition and retention of human-capital assets of particular concern.

Specific challenges include:

- Despite the increasing unpredictability of extreme-weather events, systems may lack the advanced capabilities to adapt to a range of potential threats (e.g., rising sea levels, expanding populations in coastal areas, and more severe storms).
- Sector dependencies, while generally well-understood, may not be adequately addressed in practice. Planning may not address either the extent of the need for supplies or their actual availability. For example, the duration of events may be underestimated, and the existing supply chain planning for electricity, critical chemicals, and fuels may in fact be inadequate. In addition to underestimating need, shortfalls may reflect transportation difficulties as well as difficulties at the point of production or origin. Disasters are not single-sector events, and joint lifeline-sector planning is essential.
- While a broad range of information, tools, analysis, and research are available to utilities, broad use across the sector to manage risk lags due to the lack of investment in consolidation and awareness of these resources.
- The increasing prevalence of cyber intrusions challenges business-as-usual practices. Cybersecurity awareness throughout utility personnel (e.g., for engineers, operators, and decision-makers) is often limited. In addition, the number of available Water Sector cyber experts is insufficient for current needs; utilities are constrained in offering competitive packages to attract top cybersecurity experts.

Study Group Conclusions: Opportunities to Increase Research and Analysis for Risk Management

A. Assist water utilities in adapting to potential threats by research and providing actionable information (e.g., better understanding of emerging cyber threats and how to respond), access to analytic tools (e.g., for assessment of cross-sector vulnerabilities and dependencies), and best practices and guidance.

B. Develop and update regularly a compendium of lessons learned, best practices, expert knowledge, and tools to support effective preparation and response for all threat types. Consolidate and broadly market these resources into a one-stop-shop for easy access by utilities.

C. Connect applied research to utilities, particularly in the areas of new technologies to support resilience and applying methods and technologies successful in other sectors to the Water Sector.

D. Develop and offer to water utilities exercises on cyber disruption and manual operation to determine cyber system management governance and incident roles/responsibilities.

Study Group Finding 5: Regional collaboration is highly valuable but effectiveness requires expanded support.

Regional-level planning and response is a highly effective approach for enabling resilience through joint action. While there are some notable exceptions, systems within a region containing multiple local and/or State jurisdictions tend to plan and operate independently. Improved understanding of, and support for, effective joint action is needed among local, State, and national leadership. Collaborative planning, relationship building, resource sharing, and knowledge transfer can aid individual utilities while simultaneously contributing to shared resilience improvements and an integrated approach to preparedness.

Specific challenges include:

- The lack of a broadly accepted framework for regional goals, resource-sharing criteria, and performance metrics hinders the development of a shared approach to disruption; such a framework is needed for all phases of resilience, not simply response.
- Although the consequences of a disruption of water and wastewater services are primarily local and regional, insufficient attention is given to the risk and impact of a large-scale, national disruption.

Study Group Conclusions: Opportunities to Improve Regional Collaboration

A. Develop and offer joint exercises—across jurisdictions and interdependent sectors, including chemical, energy, and transportation—to test and strengthen a regional resilience framework.

B. Reinforce successful mutual aid and assistance models—such as the WARN—as mechanisms to address the full spectrum of resilience and physical and cyber asset challenges.

C. Support knowledge transfer and resource sharing for the management of emerging threats and cyber vulnerabilities, such as through the WaterISAC.

D. Analyze the risk, impacts, and required actions associated with 1) a large-scale water or wastewater service disruption that requires the evacuation and relocation of large populations or 2) a widespread, coordinated cyberattack on utilities that stresses the capacity of cyber experts to respond.

Study Group Finding 6: Federal program support for resilience is fragmented and weak.

While resilience is well established in Federal policy (e.g., PPD-8), it has not been substantially integrated into the actions of Federal agencies. Resilient outcomes are not part-and-parcel of Federal guidance and resources. Reviewing statutes and regulations to support resilience, incentivizing resilience, and leading coordination are measures the Federal Government can take to actively implement resilience practices in accordance with Federal policy.

Specific challenges include:

- Federal authorities, regulations, reporting requirements, and funding mechanisms currently do not promote a unified response to the resilience needs of the sector.
- The sector's flexibility to operate during emergencies (e.g., water quality, power-generation sources) is constrained by regulatory requirements.

Study Group Conclusions: Opportunities to Strengthen Federal Support for Water Resilience

A. Focus resources, eliminate redundancy, and rationalize appropriate guidance, funding, and regulatory processes by examining the current structure of Federal authorities.

B. Review current statutory and regulatory structures with the intent to promote, rather than impede, resilient activity, and encourage innovation and flexibility in regulatory compliance. For example, coordinate and streamline the permitting of resilience projects (such as advocated in Title XLI of the Fixing America's Surface Transportation (FAST) Act) to enable more timely and effective planning and investment decisions.

C. Provide utilities with the regulatory flexibility needed during emergencies to discharge water of a less-than-permit specification quality, or to generate power without having to operate as both a regulated water and power utility.

D. Coordinate an approach across Federal agencies for nonregulatory programs that support resilience—such as grant funding requirements, streamlined project guidance, and education and knowledge transfer.

E. Increase authorizations and appropriations for resilience activities through existing Federal programs such as the Clean Water State Revolving Fund (SRF), Drinking Water SRF, Water Infrastructure Finance and Innovation Act (WIFIA), and Water Resources Reform and Development Act (WRRDA).

F. Continue tax-exempt status for municipal funding.

G. Incentivize or reward resilience in local and State planning and investment decisions—based on State and local input—to provide a common foundation for resilience at local, State, and regional levels.

H. Support pilot and demonstration projects that test innovative technology and provide funding mechanisms that reduce the risk to local, State, and regional decision-makers in adopting promising, yet unproven, innovations that could offer newer, better, and more cost-effective approaches to service delivery.

I. Proactively lead collaboration among local, State, and Federal agencies and the Water Sector.

J. Visibly support outreach and education efforts by informing citizens of the value/importance of water and water investments in a manner similar to fire-prevention and public health campaigns. Partnering with industry leaders and Water Sector associations would be a highly effective means of accomplishing this.

APPENDIX E.

COMPENDIUM OF PRIOR RECOMMENDATIONS

This appendix provides a listing of recommendations—previously released by the NIAC and other organizations—related to resilience in the Water Sector. The Council leveraged the knowledge and expertise of these organizations for the current NIAC study by identifying potentially significant insights from several associated studies. Exhibit E-1 provides a timeline of prior recommendations that are most closely tied to the recommendations submitted by the Council in this study. These recommendations are further detailed in this appendix, organized into seven main themes:

- **Cross-Sector Interdependencies**
  - Identifying Interdependencies
  - Cross-Sector Engagement and Partnerships
- **Strategically Improving Water and Wastewater Infrastructure**
  - Adopting Existing Frameworks for Resilience
  - Addressing Regulatory Policies Affecting Recovery
  - Focusing on Regional Needs
  - Facilitating Infrastructure Investments and Incentives
- **Complementary Public and Private Resilience Building**
  - Improving Public-Private Partnerships
  - Fostering Senior Executive-Level Partnerships
- **Emergency Planning and Response**
  - Conducting Cross-Sector Emergency Planning Exercises
  - Enhancing Critical Infrastructure Simulations and Analysis
  - Facilitating Regional Resilience Planning
  - Incorporating Lifeline Sectors in Emergency Operation Centers
  - Developing Access-Credentialing Solutions
- **Information Sharing**
  - Improving Intelligence Information Sharing
  - Understanding Infrastructure Intelligence needs
- **Cybersecurity**
- **Capabilities to Address Emerging Issues**
  - Examining Social Media Capabilities
  - Developing Simulation and Modeling Tools
  - Developing Design Standards and Best Practices

Exhibit E-1. Prior Recommendations from NIAC and Other Water Sector Sources

	Prior NIAC Recommendations	Prior Water Sector Recommendations
2010	DHS IP should lead a national effort to improve the understanding of resilient activities and how they are implemented in support of combined infrastructure and community resilience. *(NIAC, Recommendation 1, Optimization of Resources, 2010, p. 19)* The NIAC should prepare a follow-up report to the July 2009 Framework for Dealing with Disasters and Related Interdependencies and progress on the recommendation for DHS to elevate water services to its own ESF within the NRF to achieve higher prioritization of water systems during emergency response *(NIAC, Recommendation 6, Optimization of Resources, 2010, p. 24)*	
2013	The Secretary of Homeland Security should facilitate efforts with governors, mayors, and local government officials to identify or develop regional, public-private, cross-sector partnerships, led by senior executives, to coordinate lifeline sector resilience efforts within a given region. *(NIAC, Recommendation 2, Regional Resilience, 2013, p. 5)*	State and local emergency operations centers must establish clearly defined roles and responsibilities for Water Sector support. Representation can be physical or virtual, but should include a member from WARN. *(AWWA, Recommendation 6, WARN: Superstorm Sandy After Action Report, 2013, p. 3)* Raise awareness of the Water Sector as a lifeline sector and recognize the priority status of its needs and capabilities, and support the development and deployment of tools, training, and other assistance to enhance preparedness and resiliency. *(CIPAC Water Sector Strategies Working Group, Roadmap to a Secure and Resilient Water Sector, 2013)*
2014	Determine the role of policies, regulation, and consolidation within industries and its impact on resilience, security, innovation, and resilience. *(NIAC, Recommendation 1.3, CISR R&D Plan, 2014, p. 25)*	Federal agencies and utilities should work together to better inform the public and communities about the need for resilience in water systems. *(AMWA and NACWA, Recommendation 3.a, Water Resilience Summit, 2014, p. A-4)* Document Federal agencies with responsibilities for resilience, as well as existing partnerships involving Federal agencies and local utilities and communities. Analyze the Federal landscape for potential redundancies in resilience efforts and identify potential areas for collaboration. *(AMWA and NACWA, Recommendation 4.a, Water Resilience Summit, 2014, p. A-4)* Federal and State agencies and utilities must look more holistically at regulations to ensure flexibility for resilience and to leverage opportunities that capitalize on multiple benefits for innovation (e.g., biosolids for energy). *(AMWA and NACWA, Recommendation 2.a, Water Resilience Summit, 2014, p. A-4)*
2015	Incorporation of CEO-relevant roundtables to sector-specific or national exercises which will assist them to identify decisions or issues that their companies, and a sector as a whole, will need to manage from a financial, regulatory, operational, and reputational corporate risk level. *(Recommendation 8.4. CEO Engagement, 2015, p.30)*	

I. CROSS-SECTOR INTERDEPENDENCIES

The understanding of sector interdependencies—how events impacting one sector can cascade across other sectors, often in unexpected ways—is essential component for preparing for large-scale events. This area covers the identification of interdependencies, and the cross-sector engagements and partnerships to build the understanding needed to address these interdependencies.

IDENTIFYING INTERDEPENDENCIES

- The President should task the NIAC to identify the highest-priority cross-sector risks affecting national security and resilience and produce a written report to the President within 18 months recommending potential executive-level, cross-sector action. (NIAC, Recommendation 1.3. *Regional Resilience*, 2013, p. 5)
- Emphasize cross-sector interdependencies and collaboration through the Sector Partnership Model:
    - The U.S. Department of Homeland Security (DHS) and other Federal organizations should increase resources to conduct cross-sector studies and analysis, guided by private sector knowledge of infrastructure operations.
    - Increase understanding of cross-sector interdependencies and capabilities, led by the sectors that have a well-established partnership and a strong security posture. (NIAC Recommendation 6 (with selected bullet point), *CI Partnership Strategic Assessment*, 2008, p. 11)
- The national laboratories should focus their interdependency modeling and research on the regions and sectors whose failure would have the highest impact on the economy and national security. The Study Group suggests starting with modeling the telecommunications and energy sectors and the interdependencies among them and other critical infrastructure. In addition, existing research and development (R&D) studies need to be indexed and cross-referenced so that these materials are accessible to appropriate parties. (NIAC, Recommendation 9, *Cross Sector Interdependencies*, 2004, p. 11)
- The DHS Office of Infrastructure Protection (IP) should expand the provision of scalable, low-cost tools and techniques for community-level identification and assessment of infrastructure interdependencies. (NIAC, Recommendation 3, *Optimization of Resources*, 2010, p. 21)
- The NIAC should prepare a follow-up report to the July 2009 Framework for Dealing with Disasters and Related Interdependencies and progress on the recommendation for DHS to elevate Water Services to its own Emergency Support Function (ESF) within the National Response Framework (NRF) to achieve higher prioritization of water systems during emergency response (NIAC, Recommendation 6, *Optimization of Resources*, 2010, p. 24)
- The interoperability of communication systems needs to see continued consideration based on vulnerability to service outages that can compromise operations and response effectiveness. This includes maintaining radio communication networks such as 900-MHz

systems. (American Water Works Association (AWWA), *Water/Wastewater Agency Response Network (WARN): Superstorm Sandy After-Action Report*, 2013, p. 4)

CROSS-SECTOR ENGAGEMENT AND PARTNERSHIPS

- The Secretary of Homeland Security should facilitate the development of cross-sector partnerships within selected regions to improve the regions' resilience to very large-scale events that could impact national security, resilience, and economic stability. (NIAC, Recommendation 2.1, *Regional Resilience*, 2013, p. 5)
- Document Federal agencies with responsibilities for resilience, as well as existing partnerships involving Federal agencies and local utilities and communities. Analyze the Federal landscape for potential redundancies in resilience efforts and identify potential areas for collaboration. (Association of Metropolitan Water Agencies (AMWA) and National Association of Clean Water Agencies (NACWA), *Water Resilience Summit: Summary & Next Steps*, 2014, p. 4)
- Develop an intergovernmental partnership to address Water Sector adaptation and resilience needs in the face of changing weather patterns. (NACWA, W*ater Resources Utility of the Future: A Call for Federal Action*, 2013, p. 3)

II. STRATEGICALLY IMPROVING WATER AND WASTEWATER INFRASTRUCTURE

Strategic decisions about the development, implementation, and application of regulations and investments directly impact the sector's resilience. Recommendations in this category recognize the complexity of this decision-making, and are organized into four focus areas:

- Adopting existing frameworks for resilience
- Addressing regulatory policies affecting recovery
- Focusing on regional needs
- Facilitating infrastructure investments and incentives

ADOPTING EXISTING FRAMEWORKS FOR RESILIENCE

- Promote the use of the NIAC-developed framework for setting resilience goals in the critical infrastructure and key resources (CIKR) sectors and for providing a common way to organize resilience strategies within the Federal Government, State governments, and CIKR sectors. (NIAC, Recommendation 5, *Establishing Resilience Goals*, 2010, p. 52)
- Fortify government policy framework to strengthen critical infrastructure resilience:
    - The President should adopt the NIAC definition for resilience for development of resilience policy.

    - Government should establish a collaborative dialogue with CIKR owners and operators in each sector to develop a commonly agreed-upon set of outcomes-focused goals for each sector.
    - The President should issue a Homeland Security Presidential Directive (HSPD)-level authority to develop a national policy on resilience in a manner similar to and consistent with the HSPD-7 policy for protection, but also ensure the authorities under this guidance and public-private infrastructure protection partnership is retained. (NIAC, Recommendation 1 (with selected bullet points), *Critical Infrastructure Resilience*, 2009, pp. 16–18)
- All critical infrastructure sectors should consider adopting the industry self-governance model exemplified by the Institute of Nuclear Power Operations and the North American Transmission Forum to enable the private sector to collaborate on industry-wide resilience and security issues outside the regulatory compliance process. (NIAC, Recommendation 4, *Establishing Resilience Goals*, 2010, p. 52)
- Ensure that the implementation of the U.S. Environmental Protection Agency's (EPA's) Integrated Planning & Permitting Framework fully accounts for Utility of the Future (UOTF)-type activities. (NACWA, *Water Resources Utility of the Future: A Call for Federal Action*, 2013, p. 3)

ADDRESSING REGULATORY POLICIES AFFECTING RECOVERY

- A process for identifying and addressing statutory, regulatory, and policy impediments to recovery:
    - DHS should institutionalize processes and provide funding as needed to systematically develop and maintain at the Federal, State, and local (especially major metropolitan) government levels, catalogs of specific laws and regulations that may need to be suspended or modified during different disaster scenarios to improve CIKR recovery efforts.
    - The Executive Branch should work with Congress and State legislatures to pass legislation with provisions that allow the executive branches in government, at the Federal and State levels, to grant blanket waivers for statutes and regulations identified as impeding recovery efforts during an emergency or disaster-type event. (NIAC, Recommendation 1 (with selected bullet points), *Framework for Dealing with Disasters and Related Interdependencies*, 2009, pp. 20–21)
- Potential Federal, State, and local action to address statutory, regulatory, and policy impediments to disaster recovery/preparedness:
    - To address the lengthy waiver process for Environmental Impact Statements (EIS), DHS should ask Congress to validate the "Alternative Arrangements" rule the Council on Environmental Quality has used to expedite EIS requirements during emergencies.

  - DHS should work with the relevant Sector-Specific Agencies (SSAs) and regulators to identify a process for emergency waivers for document filing deadlines with regulatory agencies on processes that need to be expedited during a disaster.
  - DHS should ask Congress to consider legislation authorizing the waiver of Federal and State restrictions on the interstate movement of motor vehicles responding to a disaster.
  - The Federal Emergency Management Agency (FEMA) and DHS IP should collaborate to develop a structured, commonly applicable best practices decision-making process for authorities to use for credentialing CIKR workers and granting access to a disaster area during an emergency. (NIAC, Recommendation 2 (with selected bullet points), *Framework for Dealing with Disasters and Related Interdependencies*, 2009, pp. 21–23)
- Determine the role of policies, regulation, and consolidation within industries and its impact on resilience, security, innovation, and resilience. (NIAC, Recommendation 1.3, *CISR R&D Plan*, 2014, p. 25)
- The Water Infrastructure Network (WIN) recommends Congress pass legislation and the President sign it, and provide funding for its provisions that:
  - Creates a long-term, sustainable, and reliable source of Federal funding for clean and safe water.
  - Authorizes capitalization of the next generation of State financing authorities to distribute funds in fiscally responsible and flexible ways, including grants, loans, loan subsidies, and credit assistance.
  - Focuses on critical “core” water and wastewater infrastructure needs and nonpoint source pollution.
  - Streamlines Federal administration of the funding program and encourages continuous improvement in program administration at both the Federal and State levels.
  - Adequately finances strong State programs to implement the Clean Water Act and the Safe Drinking Water Act.
  - Establishes a new program for clean and safe water technology and management innovation to reduce infrastructure costs, prolong the life of America’s water and wastewater assets, and improve the productivity of utility enterprises.
  - Provides expanded, targeted technical assistance to communities most in need. (WIN, *Water Infrastructure NOW: Recommendations for Clean and Safe Water in the 21st Century*, 2001, p. 4)
- Federal/State/local policy for emergency management must clearly elevate the Water Sector to top-level priority for response and recovery as recommended by the NIAC. Water utilities should continue to work with their critical response partners and customers to ensure that Water Sector response activities are coordinated, awareness exists with regard

to backup power and fuel needs, and coordination of credentialing and site access controls is done in advance. (AWWA, *WARN: Superstorm Sandy After-Action Report*, 2013, p. 3)

- Federal and State agencies and utilities must look more holistically at regulations to ensure flexibility for resilience and to leverage opportunities that capitalize on multiple benefits for innovation (e.g., biosolids for energy). (AMWA and NACWA, Recommendation 2.a, *Water Resilience Summit*, 2014, p. A-4)
- The President of the United States should consider issuing an Executive Order that (a) creates a Federal Interagency Task Force on Water Reuse to coordinate all Federal water reuse initiatives, and (b) sets a goal for minimum percentages of reclaimed water for all new Federal installations (similar to the Federal goal for recycled paper). (NACWA, Water Environment Research Foundation (WERF), and Water Environment Federation (WEF), *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 18)
- Support a Congressional Clean Water Technology & Innovation Caucus that can bring a focus to UOTF priority issues. (NACWA, WERF, and WEF, *Water Resources Utility of the Future: A Call for Federal Action*, 2013, p. 3)
- Consider and explore a new 21st Century Watershed Act that can drive the Water Sector toward the emerging UOTF model. (NACWA, *Water Resources Utility of the Future: A Call for Federal Action*, 2013, p. 3)
- Support an Executive Order on water reuse/recycling that coordinates Federal reuse policies and programs, and stimulates innovation. (NACWA, *Water Resources Utility of the Future: A Call for Federal Action*, 2013, p. 3)
- Make the case for streamlined permitting requirements and flexibility in addressing regulatory requirements with Federal agencies, including lengthened permit terms, to allow for longer term resilience planning. (AMWA and NACWA, *Water Resilience Summit: Summary & Next Steps,* 2014, p. 4)
- Congress should relax the private-use test for publicly owned and operated energy recovery or production projects as long as the issuer first satisfies 100 percent of its own energy needs before selling excess production. (NACWA, WERF, and WEF, T*he Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 16)
- With Congressional authorization as needed, EPA and the States should reform the Total Maximum Daily Load (TMDL) process to achieve reliable, least-cost loadings reductions regardless of source and/or other in-stream actions to restore ambient water quality goals, with appropriate financial support where needed, monitoring, and enforcement. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 13)
- EPA should amend its TMDL regulations and guidance to formally incorporate adaptive management as part of the TMDL approach. Until it does, EPA should issue guidance to State regulators that encourages States to pursue these voluntary processes based on the Wisconsin model. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 14)

- Congress should support greater adoption of watershed-based solutions by explicitly encouraging trading in the Clean Water Act and extending permit terms for facilities that are participating in these processes. Similarly, EPA should work with delegated States to promote viable and flexible trading programs. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 13)
- Congress should consider three amendments to the Clean Water Act to acknowledge water recycling and reuse where it is feasible and desirable locally: 1) redefine publicly owned treatment works (POTW) to identify its ability to be a resource provider, 2) extend permit terms for projects that employ resource recovery activities such as water recycling, 3) name water reuse as eligible for Federal financial assistance. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, pp. 17-18)
- Support statutory changes to the Clean Water Act and Safe Drinking Water Act that bolster the important role recycled water can play in public health and safety. (NACWA, *Water Resources Utility of the Future: A Call for Federal Action*, 2013, p. 3)
- EPA should revise the March 2011 sewage sludge incineration rule to exclude sewage sludge incinerators that use biosolids to generate energy. More broadly, EPA should work with clean water authorities to formulate procedures that account for multimedia assessment of energy and resource recovery alternatives at their facilities, so that future rules can take a broader, more holistic perspective of all environmental benefits and risks. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 15)
- Using materials that they have already developed, EPA should support local stormwater management entities in initiatives designed to educate the public about the value of, and equitable ways to pay for, stormwater management as one component of integrated management plans for all water resources within local watersheds. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 19)
- Consistent with the findings of the National Academy in its recent study on water reuse, Congress should amend the Safe Drinking Water Act to make explicit certain safeguards (e.g., advanced treatment, increased monitoring) that are needed to assure that potable reuse can indeed be safe. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 17)
- An appropriate organization of the 50 States such as the Council of State Governments should formulate a program of reciprocal technology certification, where once tested and permitted in one State, the burden of proof to deny a permit for that technology in any other State falls to the regulatory agency based on guidelines agreed by all 50 States. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 25)
- State legislatures should amend their Renewable Portfolio Standard (RPS) eligibilities to include energy recovery projects from biosolids. To help legislatures understand why such changes would generate triple bottom-line benefits, the wastewater industry should educate State legislatures on this matter. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 16)

- States should clarify use rights associated with, and rules governing groundwater storage of, reclaimed wastewater so that private developers and public agencies would have stronger incentives to engage in nonpotable reuse of wastewater. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 17)
- States in which additional water reuse would help meet future demand for water supplies safely and at least cost should amend State Revolving Fund (SRF) eligibilities to include wastewater reuse. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 17)

FOCUSING ON REGIONAL NEEDS

- The President should require that Federal agencies: a) explicitly consider and address the differences among regions when promulgating security and resilience rules, programs, or guidance; and b) expressly state how they have customized implementation to each region if there is not generic applicability. (NIAC, Recommendation 3.3, *Regional Resilience*, 2013, p. 6)
- The President should designate the Energy, Communications, Water and Wastewater Systems, and Transportation Systems Sectors as lifeline sectors and direct SSAs to examine their policies, procedures, and programs to determine the extent to which they recognize the priority of the lifeline sectors and the individuality of regions, amending or revising those that do not. (NIAC, Recommendation 3, *Regional Resilience*, 2013, p. 6)
- The Secretary of Homeland Security should initiate a pilot program with State and local governments in select regions to conduct regional joint exercises, develop risk maps of critical sector interdependencies, and extract lessons learned on regional needs and gaps for government and sector partners. (NIAC, Recommendation 2.2, *Regional Resilience*, 2013, p. 5)
- There is a need for better information regarding the scope and magnitude of forecasted disasters impacting potable water:
    - It would be beneficial to promote State-wide and regional exercises that specifically consider water outages.
    - Multiagency emergency water supply plans should include an assessment as to recovery periods being extended due to critical spare parts not being available for long durations and the time periods for restoring critical infrastructure to functional condition. (EPA, *Planning for an Emergency Drinking Water Supply*, 2011, p. 31)
- Regional governments should consider creating joint water/wastewater/stormwater utilities that can manage all water within their jurisdictional boundaries as a single resource. Further, these unified water management enterprises would be better equipped to coordinate more effectively with land-use, transport, housing, energy, and other local authorities that use or affect water. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 20)

- State and local emergency operations centers must establish clearly defined roles and responsibilities for Water Sector support. Representation can be physical or virtual, but should include a member from WARN. (AWWA, *WARN: Superstorm Sandy After-Action Report*, 2013, p. 3)

FACILITATING INFRASTRUCTURE INVESTMENTS AND INCENTIVES

- Explore the potential for creating tax incentives or other instruments to incentivize the private sector to enhance the resilience of critical infrastructure. (NIAC, Recommendation 8, *Cross Sector Interdependencies*, 2004, p. 11)
- To help fill the relative cost gap and generate other economic and environmental benefits of wastewater reuse, the wastewater industry should advocate for wastewater reuse investment tax credits to attract private investment, expanded grants to cover costs of facility feasibility studies, and/or loan guarantees for reuse projects that serve rural or low-income communities that could not afford to repay market rates. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 26)
- Develop, clarify, and expand tax credit and incentive programs that will encourage clean water agencies and their private sector partners to engage in UOTF-related activities, especially in energy conservation and production, water reuse, resource recovery, and green infrastructure. (NACWA, *Water Resources Utility of the Future: A Call for Federal Action*, 2013, p. 3)
- The President should direct the Council of Economic Advisors and the Office of Science and Technology Policy to work with Federal agencies to create a strong and enduring value proposition for investment in resilient lifeline infrastructure—and its underlying physical and cyber systems, functions, and assets—and accelerate the adoption of innovative technologies in major infrastructure projects. (NIAC, Recommendation 6, *Regional Resilience*, 2013, p. 7)
- Within one year, U.S. Department of Energy (DOE), in conjunction with the Council of Economic Advisors and the White House Office of Science and Technology Policy, should complete a pilot analysis of the value proposition for investment in infrastructure grid modernization and recommend any incentives or alternative mechanisms for cost recovery that may be needed to encourage long-term investment in the modernization of lifeline infrastructure. Using the Energy Sector as the vanguard, all lifeline-sector SSAs should work with their sector partners to establish the value proposition for investment and financing in other critical sectors. (NIAC, Recommendation 6.1, *Regional Resilience*, 2013, p. 8)
- DHS should work through Federal research organizations, academic institutions, and the national laboratories to develop Applied Centers of Excellence for Infrastructure Resilience to provide an operating environment to test and validate innovative technologies and processes that build resilience into new large-scale infrastructure projects, integrate next-generation R&D, and share results with other designers in other regions. By partnering with lifeline sector owners and operators, these centers will leverage opportunities for real-world

testing, raise awareness of new capabilities, and speed commercialization of emerging technologies. (NIAC, Recommendation 6.3, *Regional Resilience*, 2013, p. 8)

- Encourage resilience using appropriate market incentives:
    - Government should partner with CIKR owners and operators to leverage their understanding of market forces, incentives, and disincentives in order to apply appropriate action that will strengthen infrastructure resilience. (NIAC, Recommendation 5 (with selected bullet point), *Critical Infrastructure Resilience*, 2009, pp. 26–27)
- Research and analyze the labyrinth of regulations and policies across all levels of government that impede and dis-incent investments in security and resilience. (NIAC, Recommendation 1.1, *CISR R&D Plan*, 2014, p. 24)
- Identify essential elements of enabling policies and regulations that would encourage and facilitate owner and operator investment and gain public acceptance of such investments, particularly for many of the lifeline sectors, for which rates and return on investment are determined through State and Federal commissions. (NIAC, Recommendation 1.2, *CISR R&D Plan*, 2014, p. 25)
- Identify and establish the elements for business and public justification for investments from lessons learned. (NIAC, Recommendation 2.1, *CISR R&D Plan*, 2014, p. 25)
- Develop an effective model of shared industry funding. (NIAC, Recommendation 2.2, *CISR R&D Plan*, 2014, p. 26)
- Create a program for early stage technology and innovation investment for the Water Sector similar to programs that exist in the energy sector. (NACWA, *Water Resources Utility of the Future: A Call for Federal Action*, 2013, p. 3)
- Advocate leveraging existing Federal funds from agencies with programs that benefit drinking water and clean water utilities for projects that advance resilience goals (e.g., SRFs, Water Infrastructure Finance and Innovation Act (WIFIA), Farm Bill, U.S. Department of Energy (DOE) grants and U.S. Department of Housing and Urban Development (HUD) Community Block Grants). (AMWA and NACWA, *Water Resilience Summit: Summary & Next Steps*, 2014, p. 4)
- Congress should establish and fund Advanced Research Projects Agency (ARPA)-W to work with industry to define high-risk, high-reward R&D needs, solicit proposals from public and private enterprises that had solutions at various stages of commercialization, and manage information flow about the research for the benefit of the industry and the Nation. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 23)
- Congress should establish within ARPA-W, a special development facility for consortia of clean water agencies, universities/research centers, and technology developers, who together would jointly apply for federally subsidized private insurance that would offset utility costs in the event that piloting innovative technologies was unsuccessful. This facility also could provide tax credits to private corporations that partnered with a grant recipient

to help offset risks associated with developing and commercializing its technology. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action, 2013*, p. 24)

- Clean water agencies should take advantage of any unobligated grant funds and to the extent they are eligible, loans from the 29 States that established revolving loan funds using State Energy Program (SEP) grants. On the basis of strong performance of the 2009 American Recovery and Reinvestment Act (ARRA) funding, the wastewater community should advocate for continued funding under these programs, with explicit acknowledgement that clean water agencies should be priority recipients of funding assistance. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, pp. 21-22)
- The Bureau of Reclamation should focus Federal grants on reuse projects, without which returns would be insufficient to attract private co-investment and where they deliver high net economic and social benefits. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action, 2013*, p. 21)
- Refocus existing Federal grant programs to support UOTF initiatives. (NACWA, *Water Resources Utility of the Future: A Call for Federal Action*, 2013, p. 3)
- The wastewater community should advocate for a continuation, if not an expansion of these EPA programs. Continued Federal funding not only preserves the intergovernmental partnership embedded within the Clean Water Act, it creates jobs and accounts for the "public goods" benefits that all clean water utilities deliver when they ship cleaner water to downstream users; reduce greenhouse gas emissions through energy efficiency, methane reduction, and renewable energy production; and reduce runoff from green infrastructure. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 22)
- The U.S. Department of Agriculture (USDA) should take steps to assure that a greater proportion of their conservation program assistance funds nutrient reduction programs. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 23)
- Create and support market-based approaches to efficiently and more equitably address watershed-scale water quality challenges. (NACWA, *Water Resources Utility of the Future: A Call for Federal Action*, 2013, p. 3)
- The Water Sector should work with Congress to examine these programs to assure that they do not exclude or limit their participation and where it does or can, they should work with Congress to amend authorizing language to ensure that private investors have every incentive to partner with clean water authorities to extract energy from wastewater and biosolids, and to ensure that renewable energy from these facilities however generated is eligible to participate in markets for renewable energy. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 15)
- There are multiple ways to prevent these negative consequences described in this report. Possible preventive measures include spending more on existing technologies, investing to

develop and then implement new technologies, and changing patterns in where and how we live. All these solutions involve costs. Separately or in combination, these solutions will require action at the national, regional, and private levels, and will not occur automatically. (American Society of Civil Engineers (ASCE), *Failure to Act: The Economic Impact of Current Investment Trends in Water and Wastewater Treatment Infrastructure*, 2011, p. 42)

III. COMPLEMENTARY PUBLIC AND PRIVATE RESILIENCE BUILDING

Achieving critical infrastructure security and resilience requires close collaboration between the public and private sectors. Sectors cannot singularly understand, prepare for, or manage the complexities inherent in securing and making the Nation's interdependent and complex infrastructure more resilient. The recommendations in this category include practical ways to address the need for resilience on a massive scale, and are organized into two focus areas: improving public-private partnerships and fostering senior executive-level engagement.

IMPROVING PUBLIC-PRIVATE PARTNERSHIPS

- Clarify roles and responsibilities of critical infrastructure partners:
    - Review current incident management documents including the National Response Framework (NRF) and the National Incident Management System (NIMS) and identify opportunities to expand training and outreach activities to CIKR owners and operators. Such activities provide Federal, State, and local entities a better understanding of the components of resilience during an event and allow for increased information sharing.
    - CIKR owners and operators and DHS should identify a mechanism to monitor and measure resilience at the CIKR sector level. This process should include establishment and support of a feedback mechanism to address CIKR owner and operator concerns in all critical infrastructure sectors and should specifically assess the adequacy of the supply chain to meet response and recovery needs. This process should be analogous to and in coordination with the National Infrastructure Protection Plan annual reporting process.
    - Government should develop a better understanding of the role that repair and maintenance funding can have on CIKR and prioritize funding for these activities, both as a component of its resilience activities and part of its broader funding support of public infrastructure. (NIAC, Recommendation 3 (with selected bullet points), *Critical Infrastructure Resilience*, 2009, pp. 19–21)
- Strengthen and leverage public-private partnership:
    - Government should collaborate with CIKR executive decision-makers throughout the resilience policy development process. Development must be an iterative process featuring bidirectional communication and a clear understanding of how to reach consensus.

    - Government should use the existing Sector Partnership Model to plan and implement resilience efforts in coordination with, and addition to, current protection activities.
    - DHS should implement the NIAC's recommendations contained within the *Framework for Dealing with Disasters and Related Interdependencies* that support needed changes for CIKR operator regulatory relief during a national crisis or incident, CIKR worker credentialing and access to a disaster area, and clarification of disaster recovery priorities and roles. This improved coordination among CIKR sectors and government will provide faster recovery times and more focus on restoring operations, order, and public safety.
    - Government should endeavor to better understand the role of design and construction in infrastructure resilience. Application of this understanding will help to shape the policy, R&D funding, and incentives that can spur technological innovation as well as the robust design and construction of critical infrastructure needed for resilience. (NIAC, Recommendation 4 (with selected bullet points), *Critical Infrastructure Resilience*, 2009, pp. 21–26)
- Increase flexibility in the sector partnership to better accommodate diverse sector needs:
    - DHS should encourage Sector Coordinating Councils (SCCs) to develop strategic roadmaps to enable sectors to articulate a variety of sector needs, identify sector priorities, and implement protection and resilience strategies. (NIAC, Recommendation 5 (with selected bullet point), *CI Partnership Strategic Assessment*, 2008, pp. 10–11)
- The Secretary of Homeland Security should facilitate efforts with governors, mayors, and local government officials to identify or develop regional, public-private, cross-sector partnerships, led by senior executives, to coordinate lifeline sector resilience efforts within a given region. (NIAC, Recommendation 2, *Regional Resilience*, 2013, p. 5)
- DHS IP should lead a national effort to improve the understanding of resilient activities and how they are implemented in support of combined infrastructure and community resilience. (NIAC, Recommendation 1, *Optimization of Resources*, 2010, p. 19)
- Federal agencies and utilities should work together to better inform the public and communities about the need for resilience in water systems. (AMWA and NACWA, Recommendation 3.a, *Water Resilience Summit*, 2014, p. A-4)
- Working more closely with the design engineering community to understand new stochastic approaches to performance and design of advanced technologies including biological nutrient reduction (BNR), State, and Federal permit writers need to incorporate results into new permits to assure that they have more realistic parameter limits that are still protective of the environment, but achievable at more appropriate costs. (NACWA, WERF, and WEF, *The Water Resources Utility of the Future: A Blueprint for Action*, 2013, p. 25)

- Increase participation in Water/Wastewater Agency Response Network (WARN) and representation in local and State emergency operation centers (EOCs). (AWWA, *WARN: Superstorm Sandy After-Action Report*, 2013, p. 2)
- Develop consistent damage assessment and system status criteria for use at the local, State, and Federal level in partnership with WARNs. Information requests from response partners for systems status should be connected with utility requests for resources to restore operations to support situational awareness and coordination of resources needed to repair the systems. (AWWA, *WARN: Superstorm Sandy After-Action Report*, 2013, p. 4)
- Increase awareness of Emergency Management Assistance Compact's (EMAC's) applicability in supporting Water Sector needs. (AWWA, *WARN: Superstorm Sandy After-Action Report*, 2013, p. 2)
- Water Sector requests for generator and fuel support must be shared with the WARN and the Emergency Support Function 3 – Public Works (ESF 3) desk in the EOC. In addition, the DOE must make restoration of power to Water Sector assets a top priority for all power distribution providers. Utilities should continue to assess their energy management strategies to continue normal operations after a power failure. A diverse set of strategies exists for utilities that should be customized for their specific conditions. (AWWA, *WARN: Superstorm Sandy After-Action Report*, 2013, p. 3)

FOSTERING SENIOR EXECUTIVE-LEVEL PARTNERSHIPS

- The President should direct the heads of the appropriate SSAs to form partnerships with senior executives from lifeline sectors, using a process modeled after the government's successful executive engagement with the Electricity subsector. (NIAC, Recommendation 1, *Regional Resilience*, 2013, p. 4)
- Within six months, the President should direct the heads of appropriate SSAs to convene a meeting with chief executive officers (CEOs) or other owner/operator leadership with equivalent decision-making authority from each lifeline sector to explore the formation of a partnership to address high-priority risks to the sector's infrastructure. (NIAC, Recommendation 1.1, *Regional Resilience*, 2013, p. 5)
- Incorporation of CEO-relevant roundtables to sector-specific or national exercises which will assist them to identify decisions or issues that their companies, and a sector as a whole, will need to manage from a financial, regulatory, operational, and reputational corporate risk level. (NIAC, Recommendation 8.4, *CEO Engagement*, 2015, p.30)

IV. EMERGENCY PLANNING AND RESPONSE

When a disaster occurs, effective emergency planning and response can mean the difference between life and catastrophic loss. While the NIAC framework for resilience, developed in the NIAC's 2010 study on establishing resilience goals, emphasizes a spectrum of activities—including planning, preparation, recovery and adaptability—the Council has frequently developed recommendations focused specifically on improving emergency planning exercises and operations to support Federal, State, local, and private sector efforts. Recommendations in this category are organized into five focus areas:

- Conducting cross-sector exercises
- Enhancing simulation and analysis tools
- Facilitating regional resilience planning
- Incorporating lifeline sectors in EOCs
- Developing access-credentialing solutions

CONDUCTING CROSS-SECTOR EMERGENCY PLANNING EXERCISES

- The Secretary of Homeland Security should facilitate efforts with governors, mayors, and local government officials to identify or develop regional, public-private, cross-sector partnerships, led by senior executives, to coordinate lifeline sector resilience efforts within a given region.
    - DHS should initiate a pilot program with State and local governments in select regions to conduct regional joint exercises, develop risk maps of critical sector interdependencies, and extract lessons learned on regional needs and gaps for government and sector partners. Each regional partnership should conduct a regional cross-sector exercise, with full participation by public and private sector partners at the executive and operational level, to simulate a catastrophic event across a large geographic region. The exercise should be led by the regional partners and supported by DHS experts, processes, and tools as needed. Such an exercise will allow participants to "experience" unprecedented events, identify coordination and communication challenges, and help expose hidden physical and cyber risks due to lifeline sector interdependencies. The results of the exercise should be used to create an action plan to address needs and gaps. (NIAC, Recommendation 2 (with selected bullet point), *Strengthening Regional Resilience*, 2013, p. 43)
- DHS IP should lead a continuing effort to enhance the transfer of expertise and lessons learned from national-level infrastructure planning and analysis to regional and community-level systems.
    - DHS IP should sponsor a series of regional exercises devoted specifically to the issue of the distribution of goods and services during a major event affecting community resilience. The purpose of these exercises is to bring together officials at all levels of government and private sector owners and operators to identify the specific resources that may be needed in such an event, where the resources may be available, and how they are to be distributed under emergency conditions. The results of these exercises should be compiled into a report and widely distributed as part of FEMA's community outreach program to aid in community resilience planning. (NIAC, Recommendation 4, *Optimization of Resources for Mitigating Infrastructure Disruptions*, 2010, p. 21-22)

- Implement government enabling activities and programs in concert with critical infrastructure owners and operators:
    - Engage CIKR owners and operators to conduct more cross-sector emergency planning exercises to identify interdependencies, improve preparedness, and establish relationships between sectors, local government, State government, and the Federal Government. Results of these exercises should be accessible to all related sectors and facets of government, regardless of whether or not they participated in the exercise, so that the full benefits of resilience and business continuity planning can be realized. (NIAC, Recommendation 6 (with selected bullet point), *Critical Infrastructure Resilience*, 2009, p. 27)

ENHANCING CRITICAL INFRASTRUCTURE SIMULATION AND ANALYSIS

- Develop and integrate modeling and simulation tools.
    - Develop, scale and integrate interdependency and consequence modeling, and simulations to support operational decisions to predict and prevent cascading failures. Research and development should be performed to develop a comprehensive and functional simulated environment that can be used to analyze the effects of infrastructure failure in the wake of a disaster. This environment will allow users to see how clear and present threat scenarios would affect infrastructure, and how the disruption of those essential services would affect other vital services. Such a tool would be utilized by communities and institutions and government at all levels for planning, coordination, and focused investments to act on lessons learned and improve preparedness. (NIAC, Recommendation 4 (with selected bullet point), *CISR R&D Plan*, 2014, p. 29-30)
- DHS IP should expand the provision of scalable, low-cost tools and techniques for community-level identification and assessment of infrastructure interdependencies. Many effective tools and techniques are widely used on a national level to assess interdependencies and their potential impacts. Further development and transfer of infrastructure-based tools could demonstrably increase the ability of communities to establish and maintain an improved understanding of infrastructure assets and the associated community and infrastructure interdependencies. In turn, understanding of these interdependencies can improve the planning and use of resources in the event of disruptions. (NIAC, Recommendation 3, *Optimization of Resources for Mitigating Infrastructure Disruptions*, 2010, p. 21)
- DHS should support modeling and analysis studies of the cross-sector economic impacts of CIKR failures using tools such as input-output analysis. Many of the CIKR sectors are highly interconnected, which can improve resilience but also create new opportunities for problems to cascade across sectors, regions, and economic systems. Understanding the impact of sector failures is becoming more important as infrastructures become increasingly

interconnected. (NIAC, Recommendation 6, *A Framework for Establishing Critical Infrastructure Resilience Goals*, 2010, p. 52-53)

FACILITATING REGIONAL RESILIENCE PLANNING

- DHS IP should lead a national effort to improve the understanding of resilient activities and how they are implemented in support of combined infrastructure and community resilience.
    - DHS IP collaborating with FEMA should encourage regional organizations to develop Regional Infrastructure Protection Plans (RIPP) to support the coordination of regional all-hazards planning for catastrophic events. Regional plans should include the development of integrated protocols and procedures to manage a catastrophic event. An important component of regional plans should be the linkage of response operations and available resources. The NIAC encourages regional organizations to seek funding for RIPPs through the DHS Regional Catastrophic Preparedness Grant Program. (NIAC, Recommendation 1 (with selected bullet point), *Optimization of Resources for Mitigating Infrastructure Disruptions*, 2010, p. 19)

INCORPORATING LIFELINE SECTORS IN EMERGENCY OPERATIONS CENTERS

- The President should designate the Energy, Communications, Water, and Transportation Sectors as lifeline sectors, and direct SSAs to examine their policies, procedures, and programs to determine to what extent they recognize the priority of the lifeline sectors and the individuality of regions, amending or revising those that do not.
    - The FEMA National Response Coordination Center, Federal agencies, and State and local governments should modify their processes and plans for emergency operations to include the co-location of representatives of lifeline sectors in their EOCs during major disasters. The practice of including operational personnel from energy, communications, and other lifeline sectors in EOCs during Superstorm Sandy improved situational awareness, streamlined communications, and expedited response and recovery. (NIAC, Recommendation 3 (with selected bullet point), *Strengthening Regional Resilience*, 2013, p. 44)

DEVELOPING ACCESS-CREDENTIALING SOLUTIONS

- The Secretary of Homeland Security, working with heads of appropriate Federal agencies, should launch a cross-agency team within 60 days to develop solutions to site access, waiver, and permit barriers during disaster response and begin implementing solutions within one year. (NIAC, Recommendation 5, *Regional Resilience*, 2013, p. 7)
- DHS IP and FEMA should collaborate with State, local, tribal, and territorial governments and owners and operators to develop a commonly applied process or system to credential lifeline sector owners and operators and grant them access to disaster areas more effectively. (NIAC, Recommendation 5.1, *Regional Resilience*, 2013, p. 7)

- DHS should work with State and local government and infrastructure owners and operators to catalog the waivers and permits commonly required during a variety of disaster scenarios and develop a streamlined process for rapidly issuing those permits and waivers at the Federal, State, and local level. (NIAC, Recommendation 5.2, *Regional Resilience*, 2013, p. 7)
- The Water Sector should continue to work with Federal, State, and local response partners to ensure water utility crews are properly recognized and allowed access to their facilities. (AWWA, *WARN: Superstorm Sandy After-Action Report*, 2013, p. 3)

V. INFORMATION SHARING

Information sharing is an essential role of public-private partnerships across the entire spectrum of preparedness. Without sufficient information sharing, collaboration between various levels of government and critical infrastructure owners and operators would not work. Given the complexity of this issue, the NIAC and other organizations have spent considerable time assessing the various means and effectiveness of public-private information sharing. The recommendations in this category address information-sharing needs in two focus areas:

- Improving intelligence information sharing
- Understanding infrastructure intelligence needs

IMPROVING INTELLIGENCE INFORMATION SHARING

- Direct that DHS and the Office of the Director of National Intelligence (ODNI), in collaboration with other members of the U.S. Intelligence Community and the SSAs, prepare a quadrennial report on the state of intelligence information sharing for infrastructure protection and resilience. (NIAC, Recommendation 4.1.c, *Intelligence Information Sharing*, 2012, p. 44)
- DHS, with the guidance and aid of ODNI, should establish core teams of 3-4 intelligence specialists for each sector, as well as a team that focuses on cross-sector information issues. These specialists should 1) be drawn from the members of the Federal Intelligence Community, 2) have expertise in both intelligence processes and sector business and risk-management processes, and 3) be responsible for fusing varied intelligence information streams into products useful for owner and operator planning and decision-making. (NIAC, Recommendation 4.2.c, *Intelligence Information Sharing*, 2012, p. 46)
- Senior executive information-sharing mechanism: Develop a voluntary executive-level information-sharing mechanism between critical infrastructure CEOs and senior intelligence officers. (NIAC, Recommendation 1, *Public-Private Sector Intelligence Coordination*, 2006, p. 22)
- The Federal Government should ensure the availability of qualified, vetted security professionals. (NIAC, Recommendation 4, *Implementation of EO 13636 and PPD-21*, 2013, p. 18)

UNDERSTANDING INFRASTRUCTURE INTELLIGENCE NEEDS

- Direct the Federal Intelligence Community to consider infrastructure protection and resilience as a national priority; collect infrastructure intelligence needs; and prepare a National Intelligence Estimate to evaluate terrorist targets in the 18 critical infrastructure sectors and assess vulnerability to such attacks, including cross-sector interdependencies and risks. (NIAC, Recommendation 4.1.b, *Intelligence Information Sharing*, 2012, p. 44)
- The NIAC recommends that DHS work with each SSA to implement, for all 18 critical infrastructure sectors, a robust intelligence requirements process that 1) meets the information needs of owners and operators, 2) delivers these requirements to appropriate elements of the Intelligence Community, 3) is consistent with existing Intelligence Community processes, and 4) supports advocacy for critical infrastructure priority within the Intelligence Community. (NIAC, Recommendation 4.3, *Intelligence Information Sharing*, 2012, pp. 46–47)
- Within key intelligence agencies throughout the Intelligence Community, create “sector specialist” positions at both the executive and operational levels, as applicable. (NIAC, Recommendation 5, *Public-Private Sector Intelligence Coordination*, 2006, p. 25)

VI. CYBERSECURITY

Managing cyber risks to operations has become an increasing component of water utilities’ security and resilience portfolios. The Federal Government’s role in aiding utilities is broad, and includes increasing awareness and planning, developing secure control system standards, incentivizing technology development and investments, examining and sharing information about cyber risks and vulnerabilities, and pursuing cyber criminals. The recommendations in this category address these roles.

- Use the Federal Government’s procurement power to encourage information technology suppliers to develop cybersecurity framework–compliant hardware and software. (NIAC, Recommendation 3, *Implementation of EO 13636 and PPD-21*, 2013, p. 17)
- The Federal Government should leverage its purchasing power to incentivize enhanced security and resilience in core cybersecurity systems and programs (e.g., Information Technology, Industrial Automation, and Telecommunications Sectors). (NIAC, Recommendation 7.2, *Implementation of EO 13636 and PPD-21*, 2013, p. 19)
- The Federal Government should develop policies and apply resources to pursue and discourage global cyber criminals from attacking critical infrastructure facilities. (NIAC, Recommendation 7.4, *Implementation of EO 13636 and PPD-21*, 2013, p. 19)
- Recommendations for security as an enabler:
  - The President should establish a goal for all critical infrastructure sectors that no later than 2015, control systems for critical applications will be designed, installed, operated, and maintained to survive an intentional cyber assault with no loss of critical function.

  - DHS should promote uniform acceptance across all sectors that investment in control systems cybersecurity is a priority. For sectors with regulatory oversight of earnings and investments, DHS should promote inclusion of the costs of control systems cybersecurity as legitimate investments and expenses that deserve approval by their regulatory bodies. (NIAC, Recommendations for Security as an Enabler (with selected bullet points), *Convergence of Physical and Cyber Security*, 2007, p. 18)

- Recommendation for market drivers:
  - DHS and the SSAs should encourage the application of existing security and security-relevant standards and criteria in the development and implementation of secure control systems. (NIAC, Recommendations for Market Drivers (with selected bullet point), *Convergence of Physical and Cyber Security*, 2007, p. 20)

- Recommendation for executive leadership awareness:
  - To improve executive leadership awareness of the cyber risk to control systems, the NIAC recommends that DHS work with SSAs to implement a program for control systems cybersecurity executive awareness outreach. (NIAC, Recommendations for Executive Leadership Awareness (with selected bullet point), *Convergence of Physical and Cyber Security*, 2007, p. 22)

- Recommendation for information sharing:
  - DHS should enhance existing program activities to create the ability to integrate and track understanding of the cyber risk for critical infrastructure control systems using all available sources.
    - This collaborative program should collect, correlate, integrate, and track information on the following:
      - Threats, including adversaries, toolsets, motivations, methods/mechanisms, incidents/actions, and resources.
      - Consequences, including potential consequences of compromise to sector, industry, and facility-specific control systems.
      - Vulnerabilities in control systems or their implementations in the information technology infrastructure that adversaries could exploit to gain access to critical infrastructure control systems.
    - This capability is a DHS operations function, and it will include input and expertise from the following: critical infrastructure owners and operators and other relevant parties in the private sector regarding consequences and vulnerabilities, the Intelligence Community regarding threats, Carnegie Mellon's Computer Emergency Response Team Coordination Center and other sources regarding incidents, and DHS (including the United States Computer Emergency Readiness Team) regarding cyber vulnerabilities.

    - DHS will communicate resulting warning information to control systems owners and operators to ensure protection of U.S. critical infrastructure. (NIAC, Recommendation 6, *Convergence of Physical and Cyber Security*, 2007, p. 27)

- Direct lead agencies to work with each of the critical sectors to more closely examine the risks and vulnerabilities of providing critical services over network-based systems. (NIAC, Recommendation 1, *Prioritizing Cyber Vulnerabilities*, 2004, p. 10)
- Direct DHS to sponsor cross-sector activities to promote a better understanding of the cross-sector vulnerability impacts of a cyberattack. (NIAC, Recommendation 4, *Prioritizing Cyber Vulnerabilities*, 2004, p. 10)
- Direct Federal agencies to include cyberattack scenarios and protective measures in their disaster recovery planning. Encourage sector coordinating groups to include cyberattack scenarios and protective measures in their disaster recovery planning. (NIAC, Recommendation 5, *Prioritizing Cyber Vulnerabilities*, 2004, p. 11)
- Security should be designed to be built in to systems, rather than layered on top of systems. (NIAC, Recommendation 7.1, *Implementation of EO 13636 and PPD-21*, 2013, p. 19)
- Develop real-time cybersecurity risk-analysis and management tools. (NIAC, Recommendation 3.1, *CISR R&D Plan*, 2014, p. 27)
- Establish new architectures to "bake in" self-healing and self-protected cyber systems. (NIAC, Recommendation 3.2, *CISR R&D Plan*, 2014, p. 27)
- Develop automated security analysis and data collection tools and methods. (NIAC, Recommendation 3.3, *CISR R&D Plan*, 2014, p. 28)
- Understand cross-sector connections that could cause cascading effects. (NIAC, Recommendation 3.4, *CISR R&D Plan*, 2014, p. 28)
- Measure the effectiveness of security. (NIAC, Recommendation 3.5, *CISR R&D Plan*, 2014, p. 28)

VII. CAPABILITIES TO ADDRESS EMERGING ISSUES

Resilience occurs in a dynamic environment. The Nation enhances resilience through a continual process of implementation, review, and improvement. Recommendations in this category highlight evolving capabilities and tools to address emerging issues related to resilience, organized into three focus areas:

- Examining social-media capabilities
- Developing simulation and modeling tools
- Developing design standards and best practices

EXAMINING SOCIAL-MEDIA CAPABILITIES

- FEMA and the Federal Communications Commission (FCC) should convene a task force of senior emergency managers from lifeline sector SSAs and representatives of leading private sector social media and technology firms—such as Twitter, Facebook, and Google—to examine how new and emerging social media apps, platforms, and capabilities can be used to support emergency notification and response and provide greater value to the public. The task force should publish its findings in a report on best practices. (NIAC, Recommendation 4.1, *Regional Resilience*, 2013, p. 6)

DEVELOPING SIMULATION AND MODELING TOOLS

- Scale risk assessment and, management decision support tools for local communities and individual institutions. (NIAC, Recommendation 4.1, *CISR R&D Plan*, 2014, p. 28)
- Develop, scale and integrate interdependency and consequence modeling, and simulations to support operational decisions to predict and prevent cascading failures. (NIAC, Recommendation 4.2, *CISR R&D Plan*, 2014, pp. 28-29)
- Continue research and development for managing "big data." (NIAC, Recommendation 4.3, *CISR R&D Plan*, 2014, p. 29)

DEVELOPING DESIGN STANDARDS AND BEST PRACTICES

- Determine design standards and best practices for the replacement, upgrading, and maintenance of critical infrastructure systems. (NIAC, Recommendation 2.3, *CISR R&D Plan*, 2014, p. 26)
- Identify innovative, cost-efficient, and accelerated approaches to "People Readiness" in developing a skilled workforce. (NIAC, Recommendation 2.4, *CISR R&D Plan*, 2014, p. 26)
- Determine factors and approaches to accelerate recovery following a disaster. (NIAC, Recommendation 2.5, *CISR R&D Plan*, 2014, pp. 26-27)
- Establish resilience metrics. (NIAC, Recommendation 2.6, *CISR R&D Plan*, 2014, p. 2)

APPENDIX F.
FEDERAL POLICIES, AGENCIES, AND ACTIVITIES

This appendix outlines the Federal agencies interacting with the Water Sector and describes Federal policy and actions that address Water Sector resilience. First, it identifies Federal policies related to water and wastewater system resilience, examining examples of Federal law, presidential directives and executive orders and other guidance. Second, it outlines the primary Federal agencies involved in the Water Sector. Third, it describes Federal programs and activities related to resilience in the Water Sector. Lastly, it provides an overview of the components of Federal funding.

I. FEDERAL POLICIES

A number of laws, statutes, directives, and guidance inform Federal policies related to Water Sector resilience. Federal policies then inform the initiatives, programs, projects, and activities designed to strengthen protection and resilience within the sector's infrastructure. There are two primary laws governing Water Sector systems and enforcement to protect human health and the environment: Safe Drinking Water Act and Clean Water Act.[68] Presidential directives and executive orders—such as PPD-21 Critical Infrastructure Security and Resilience—build on the pursuit of critical infrastructure security and resilience. In addition, Federal guidance and major funding mechanisms further support Water Sector resilience initiatives, programs, projects, and activities carried out by Federal agencies.

FEDERAL LAWS

There are four Federal laws that most impact water resilience. Two focus on water resilience and two address emergency response.

Safe Drinking Water Act (SDWA)

Established in 1974, the SDWA provides the basis for drinking water security by protecting water quality and underground sources of drinking water. It applies to public water systems, including pipes and other constructed conveyances. The SDWA authorizes the U.S. Environmental Protection Agency (EPA) to set national standards for drinking water quality and oversees the State, local, and water utility implementation of those standards. Under the SDWA, the National Primary Drinking Water Regulations (or "primary standards") set enforceable maximum levels for particular contaminants in public water systems. These primary standards include requirements for water systems to test for these contaminants and to ensure standards are achieved. In addition to setting these standards, EPA provides guidance and assistance on drinking water, collects data, and oversees State drinking water programs in pursuit of SDWA requirements.

The law allows States to request drinking water programs, giving them the authority (or "primacy") to oversee the program within its borders. Of the 50 States, 49 have "primacy", in addition to the Commonwealth of Puerto Rico, and the Navajo Nation. EPA regional offices administer the drinking

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[68] EPA, *2015 SSP*, 2016.

water programs for Wyoming, the District of Columbia, the Virgin Islands, Guam, America Samoa, and the Commonwealth of the Mariana Islands.

Federal Water Pollution Control Act (Clean Water Act)

The Clean Water Act (CWA) regulates the discharge of pollutants into waters and regulates surface water quality standards. It establishes standards for municipal waste treatment and numerous categories of industrial point-source discharges (e.g., discharges from fixed sources). It requires States and some tribes to enact and implement water quality standards in order to achieve designated water-body uses, address water pollutants, and regulate dredge-and-fill activities and wetlands. EPA and States with permitting authority have a number of enforcement authorities.[69]

Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act)

Typically, States are able to assist utilities during a major disruption but they may not have the resources to assist larger systems or regional outages. For large disasters, States seek assistance under the Stafford Act.[70] This Act provides the statutory authority for most Federal disaster activities. The Act authorizes the delivery of Federal technical, financial, logistical, and other assistance to States and localities during declared major disasters or emergencies. Federal assistance is provided if an event is beyond the combined response capabilities of State and local governments.[71]

Public Health Security and Bioterrorism Preparedness and Response Act

Title IV of this Act required drinking water facilities serving more than 3,300 customers to conduct a vulnerability assessment and develop an Emergency Response Plan (ERP) that addresses assessment findings. Facilities must identify plans, procedures, and equipment that can be used in event of a terrorist or intentional attack, or used to prevent or mitigate an attack. It also calls on EPA to conduct research studies in prevention, detection and response to intentional or terrorist acts that potentially disrupt drinking water supply or infrastructure.[72]

PRESIDENTIAL DIRECTIVES AND EXECUTIVE ORDERS

In addition to the abovementioned laws and statutes, the following presidential directives inform Federal policy related to critical infrastructure security and resilience.

Homeland Security Presidential Directive 5, Management of Domestic Incidents (February 28, 2003)

HSPD-5 directs the Secretary of Homeland Security to develop and administer a National Incident Management System (NIMS) to provide a consistent nationwide approach for Federal, State, and local governments to work effectively and efficiently together to prepare for, respond to, and recover from domestic incidents, regardless of cause, size, or complexity. HSPD-5 also directs the Secretary to develop and administer a National Response Plan (NRP) to integrate Federal

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[69] EPA, *2015 SSP*, 2016.

[70] EPA, *Planning for an Emergency Drinking Water Supply*, 2011.

[71] Ibid.

[72] EPA, *2015 SSP,* 2016.

Government domestic prevention, preparedness, response, and recovery plans into one all-discipline, all-hazards plan.

Presidential Policy Directive 8, National Preparedness (March 30, 2011)

PPD-8 calls on Federal agencies to work with the whole community to achieve the goal of a secure and resilient Nation through developed capabilities "to prevent, protect against, mitigate, respond to and recover from the threats and hazards that pose the greatest risk." It is organized around the following main elements: National Preparedness Goal (the end to achieve), National Preparedness System (the means to achieve the goal), National Planning Framework (describes how the whole community works together to achieve the goal), and National Preparedness Report (measures progress toward the goal).

Presidential Policy Directive 21, Critical Infrastructure Security and Resilience (February 12, 2013)

PPD-21 provides the national approach to protecting critical infrastructure. It defines critical infrastructure broadly, to include cyber, as well as physical structures. PPD-21 expands the view of critical infrastructure threats from the previous terrorism perspective to an all-hazards approach. It advances a national unity of effort to strengthen and maintain secure, functioning, and resilient critical infrastructure across the spectrum of prevention, protection, mitigation, response, and recovery.

Executive Order 13636, Improving Critical Infrastructure Cybersecurity (February 12, 2013)

EO 13636 addresses how the Federal Government will help prevent, mitigate, and respond to the rise of cyber intrusions into the United States' critical infrastructure while, at the same time, maintaining a cyber infrastructure that protects privacy and confidentiality.

Executive Order 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input (January 30, 2015)

EO 11988—Floodplain Management, issued in May 1977, requires Federal agencies to avoid—to the extent possible—long- and short-term adverse impacts associated with the occupancy of flood plains, in addition to avoiding direct/indirect support of floodplain development if there is a practicable alternative. It is designed to reduce the risk of flood loss; minimize the impact of floods on human safety, health, and welfare; and restore/preserve the flood plains. EO 11988 was amended by EO 13690 which established the Federal Flood Risk Management Standard (FFRMS) to improve resilience to current and future flood risks. It provides three approaches that Federal agencies can use to establish the flood elevation and hazard area for consideration in their decision-making: climate-informed science approach, adding two to three feet of elevation to the 100-year floodplain, and using the 500-year floodplain.

OTHER FEDERAL GUIDANCE

National Infrastructure Protection Plan 2013: Partnering for Critical Infrastructure Security and Resilience (NIPP 2013)

NIPP 2013 guides the national effort to manage risk to the Nation's critical infrastructure. NIPP 2013 builds upon previous plans by emphasizing the complementary goals of security and resilience for critical infrastructure. To achieve these goals, cyber and physical security and the resilience of critical infrastructure assets, systems, and networks are integrated into an enterprise approach to risk management. The national plan also establishes a vision, mission, and goals that are supported by a set of core tenets focused on risk management and partnership to influence future critical infrastructure security and resilience planning at the international, national, regional, State, local, tribal and territorial governments, and owner and operator levels. NIPP 2013 further organizes critical infrastructure into 16 sectors and designates a Federal department or agency as the lead coordinator—Sector-Specific Agency (SSA)—for each sector.[73]

National Response Framework (NRF)

The NRF is a component of the National Preparedness System mandated in PPD 8: National Preparedness of March 2011. PPD-8 defines five mission areas – prevention, protection, mitigation, response, and recovery – and mandates the development of a series of policy and planning documents to explain and guide the Nation's collective approach to ensuring and enhancing national preparedness. The NRF is a guide to how the Nation responds to all types of disasters and emergencies. It is built on scalable, flexible, and adaptable concepts identified in the NIMS to align key roles and responsibilities across the Nation.

The NRF is composed of a base document, Emergency Support Function (ESF) Annexes, Support Annexes, and Incident Annexes. The ESF Annexes describe the Federal coordinating structures that group resources and capabilities into functional areas that are most frequently needed in a national response. Support Annexes describe the essential supporting processes and considerations that are most common to the majority of incidents. Incident Annexes describe the unique response aspects of incident categories.

EPA participates in the NRF in multiple ways. EPA is the coordinator for ESF #10 – Oil and Hazardous Materials Response and is a support agency for several Emergency Support Functions, including:[74]

- ESF #3 – Public Works and Engineering
- ESF #4 – Firefighting
- ESF #5 – Emergency Management
- ESF #8 – Public Health and Medical Services
- ESF #11 – Agriculture and Natural Resources
- ESF #12 – Energy

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[73] DHS, *NIPP 2013,* 2013.

[74] FEMA, *National Response Framework*, 2013.

- ESF #13 – Public Safety and Security
- ESF #14 – Long-Term Community Recovery
- ESF #15 – External Affairs

National Disaster Recovery Framework (NDRF)

The NDRF is a guide that enables effective recovery support to disaster-impacted States, Tribes, Territorial and local jurisdictions. The NDRF provides a flexible structure that enables disaster recovery managers to operate in a unified and collaborative manner. It also focuses on how best to restore, redevelop and revitalize the health, social, economic, natural and environmental fabric of the community and build a more resilient Nation.[75]

In September 2012, two-thirds of the United States was affected by drought. The President convened the White House Rural Council to address efforts to mitigate the impact of the drought by utilizing all resources. The NDRF was used to coordinate the response. In June 2013, the President released his Climate Action Plan. Later in that year the National Drought Resilience Partnership (NDRP) was formed as part of that effort.[76]

National Earthquake Hazards Reduction Program (NEHRP)

The National Institute of Standards and Technology (NIST) is designated by Congress as the Lead Agency for the NEHRP. The NEHRP Office oversees several programs and projects, including those seeking to understand the dynamic of earthquakes and their impact on critical infrastructure and to develop and deploy improved prescriptive seismic provisions in U.S. model building codes and standards. EPA works with NIST to help citizens prepare for an earthquake, with an emphasis on water safety and security.[77]

II. FEDERAL AGENCIES

In addition to State and local agencies, Federal agencies share in the mission to protect public health and the environment. This section outlines the primary Federal agencies that maintain relationships and interactions with the Water Sector. EPA has the predominant role, with responsibility for the enactment of the Clean Water Act and Safe Drinking Water Act. In addition, it serves as the SSA for the sector. EPA regularly communicates and coordinates with the U.S. Department of Homeland Security (DHS) on Water Sector security, and works with DHS to implement presidential directives, executive orders, and statutes. The Water Sector, EPA, DHS, and other Federal agencies share in the mission to protect public health and the environment through secure and resilient drinking water and wastewater infrastructure.

The Water Sector Government Coordinating Council (GCC)—composed of Federal and State government representatives and national associations—is chaired by EPA, with DHS serving as co-chair. In addition to EPA and DHS, the Federal agencies listed under Other Federal Partners, serve on

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[75] FEMA, “National Disaster Recovery Framework,” 2015.
[76] NIDIS, “National Drought Resilience Partnership.”
[77] National Earthquake Hazards Reduction Program, “Background & History,” 2016.

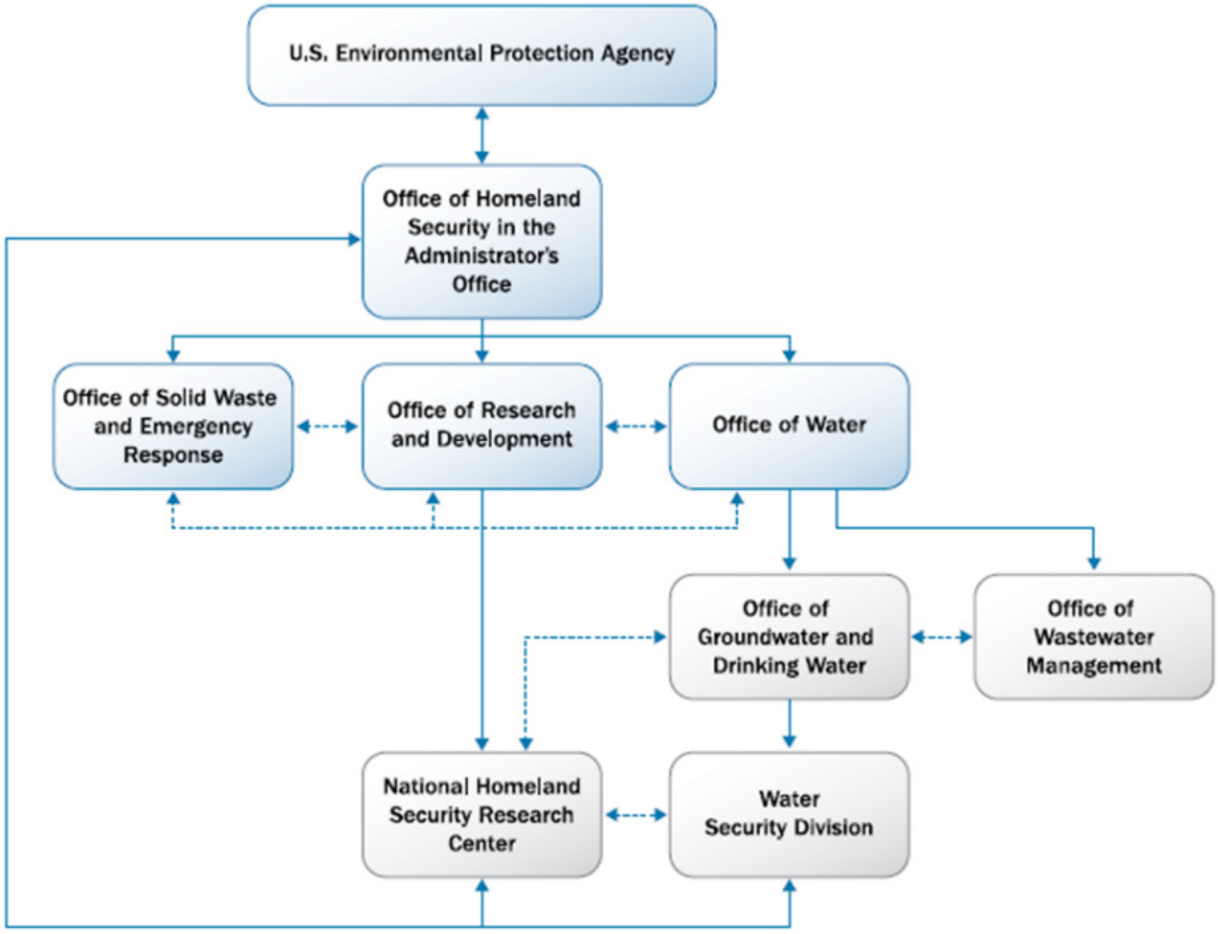
the GCC. These Federal agencies maintain relationships and interactions with the Water Sector in pursuit of Water Sector resilience, and are discussed in the following paragraphs.

The following sections discuss the roles of EPA and DHS—the GCC chair and co-chair along with the other agency representatives in the GCC.

U.S. ENVIRONMENTAL PROTECTION AGENCY

EPA is charged with executing SSA responsibilities for the Water Sector. Significant EPA components involved in Water Sector resilience include: EPA Headquarters, the Office of Water (OW), and the Office of Solid Waste and Emergency Response (OSWER). Exhibit F-1 shows the organizational structure for EPA, and where the Office of Water is located.

Exhibit F-1. EPA Organizational Chart for Water[78]



EPA Headquarters

Within EPA Headquarters, there are key offices which have programs related to Water Sector security and resilience. These include:

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[78] EPA, *2010 SSP*, 2010.

Office of Homeland Security (OHS), which provides Agency-wide leadership and coordination for homeland security policy, including EPA's planning, prevention, preparedness, and response for homeland security-related incidents.[79] Programs administered by OHS are:

- Homeland Security Collaborative Network
- Homeland Security strategic planning
- Pandemic flu preparedness and response
- Nuclear Incident Response Team Interagency Agreement

Office of Policy (OP), which has special expertise in five areas: regulatory policy and management, environmental economics, strategic environmental management, sustainable communities, and climate adaptation.[80] OP programs most relevant to resilience comprise climate-resilience programs. Examples include:

- Mainstream climate adaptation planning into EPA's programs, policies, rules and operations to ensure they are effective under future climatic conditions.
- Support climate-resilient investments by States, tribes, and local communities by integrating climate adaptation criteria into financial mechanisms (grants, cooperative agreements, contracts, and technical assistance agreements).
- Chair the Federal Agency Adaptation Work Group established by the White House Council on Climate Preparedness and Resilience to support the development and implementation of all agencies' climate change adaptation plans.

EPA Office of Water

The Office of Water (OW) ensures drinking water is safe, and restores and maintains oceans, watersheds, and their aquatic ecosystems to protect human health, support economic and recreational activities, and provide healthy habitat for fish, plants and wildlife. OW is responsible for implementing the CWA and SDWA, and several other statutes.

Several offices within OW have important programs related to Sector security and resilience. These include:

- **Immediate Office of the Assistant Administrator for Water (IO)**, which produced a study on The Importance of Water to the U.S. Economy[81] and which addresses Climate Change in the Water Sector. EPA's climate change program is extensive and links to various aspects of the program may be found on the IO Climate Change Website.[82]
- **Office of Ground Water and Drinking Water (OGWDW)**, which has programs and projects dealing with Drinking Water Contaminants, Drinking Water Basics, Drinking Water Standards, Local Drinking Water, Public Drinking Water Systems, Small Public Drinking

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[79] EPA, "About the Office of Homeland Security (OHS)," 2016.

[80] EPA, "About the Office of Policy (OP)," 2016.

[81] EPA, *The Importance of Water to the U.S. Economy*, 2013.

[82] EPA, "Addressing Climate Change in the Water Sector," 2016.

Water Systems, Source Water Protection, Sustainable Water Infrastructure, Underground Injection Control, Water Security, and Private Drinking Water Wells.[83] Within this office, the Water Security Division works to prevent, respond to, and recover from hazards, including maintaining a resilient infrastructure.

- **Office of Science and Technology (OST)**, which is responsible for developing sound, scientifically defensible standards, criteria, advisories, guidelines and limitations under the CWA and SDWA OST produces regulations, guidelines, methods, standards, science-based criteria, and studies that are critical components of national programs that protect people and the aquatic environment.
- **Office of Wastewater Management (OWM)**, which supports the FCWA, by promoting effective and responsible water use, treatment, disposal and management and by encouraging the protection and restoration of watersheds. Important programs managed by OWM include Biosolids, Combined Sewer Overflows and Sanitary Sewer Overflows, Green Infrastructure, Municipal Technologies, National Pollutant Discharge Elimination System (NPDES) program, Septic (Decentralized) Systems, Wastewater in Small Communities, Stormwater, Sustainable Water Infrastructure, and the WaterSense Program.[84]
- **Water Infrastructure and Resiliency Finance Center** identifies financing approaches to help communities make better informed decisions for drinking water, wastewater, and stormwater infrastructure that are consistent with local needs. The center seeks to accelerate and improve the quality of water infrastructure by promoting:
    - Effective use of Federal funding programs
    - Leading edge financing solutions
    - Innovative procurement and partnership strategies
    - Collaborative financial guidance and technical assistance efforts
    - Data and learning clearinghouses that support effective decision-making[85]

EPA Office of Solid Waste and Emergency Response (OSWER)

The OSWER provides policy, guidance, and direction for EPA's emergency response and waste programs. The Office develops guidelines for the land disposal of hazardous waste and underground storage tanks, as well as provides technical assistance to all levels of government to establish safe practices in waste management.[86] Emergency management and response is managed by OSWER. This important program is responsible for responding to oil spills, chemical, biological, radiological releases, and large-scale national emergencies under the National Response System. EPA also provides additional response assistance when State and local first-responder capabilities have been exhausted or when additional support is requested.[87]

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[83] EPA, “About the Office of Water,” 2016.

[84] EPA, “About the Office of Wastewater Management,” 2016.

[85] EPA, “About the Water Infrastructure and Resiliency Finance Center,” 2016.

[86] EPA, “About the Office of Land and Emergency Management (OLEM),” 2016.

[87] EPA, “Emergency Response,” 2016.

EPA Regional Offices

EPA has 10 regional offices responsible for executing the agency's programs in States and territories.[88] Under the SDWA, States can request authority to oversee their drinking water programs, also known as primacy. There are 49 States, the Commonwealth of Puerto Rico, and the Navajo Nation have primacy. EPA regional offices administer drinking water programs for other entities that do not have primacy including other sovereign tribal nations, Wyoming, the District of Columbia, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Mariana Islands.[89]

U.S. DEPARTMENT OF HOMELAND SECURITY

EPA communicates and coordinates with DHS to implement presidential directives, executive orders, and statutes related to Water Sector security and resilience. The DHS Office of Infrastructure Protection is the primary point for EPA communication and coordination on critical infrastructure security and resilience activities.

EPA has a designated liaison to DHS, who helps to coordinate and share information between EPA, DHS, and other Federal sector partners on issues pertaining to drinking water and wastewater systems. The liaison helps to provide insight on vulnerability and consequence issues that directly impact Water Sector utilities. This coordination improves DHS' ability to interpret water-related threat information and to develop and distribute timely and accurate threat-warning products that are relevant to the Water Sector. The DHS Protective Security Advisors conduct assessments of nationally significant critical infrastructure, including those in the Water Sector, through security surveys, site assistance visits, and incident response. In addition, EPA and FEMA have close collaboration in a number of key areas, including activities within the NRF and the incorporation of sustainability and smart growth practices into communities' hazard mitigation and long-term disaster recovery efforts.[90]

OTHER FEDERAL PARTNERS

The following are the six Federal agencies that serve on the Water Sector GCC in addition to the EPA (chair) and DHS (co-chair).

Federal Bureau of Investigation (FBI)

The FBI interacts with the Water Sector through threat information sharing. The FBI works closely with EPA, DHS, and the WaterISAC to share intelligence and threat warnings related to physical and cyberattacks and to contamination incidents. Drinking water and wastewater utilities, as well as State agencies overseeing Water Sector activity, have been encouraged by EPA to coordinate security activities with local FBI offices nationwide.

U.S. Army Corps of Engineers (USACE)

The U.S. Department of Defense (DOD) primarily interacts with EPA through USACE. USACE is responsible for maintaining the Nation's commercial waterways and operates the dams and locks; a

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[88] EPA, "About EPA," 2016.

[89] EPA, *2015 SSP*, 2016.

[90] DHS and EPA, *Memorandum of Agreement*, 2010.

large number of drinking water systems use dammed reservoirs as their primary water sources. Dam safety and protection is, therefore, a critical issue for the Water Sector. Employees of the USACE Engineering Research and Development Center sit on EPA National Homeland Security Research Center's Distribution System Research Consortium. Military facilities with their own drinking water and wastewater systems are regulated under the SDWA and CWA and, where applicable, must complete and submit vulnerability assessments to EPA.

U.S. Department of Agriculture (USDA)

The USDA provides funding and support for small, rural drinking water and wastewater utilities. With issuance of Homeland Security Presidential Directive 9 (HSPD-9): Defense of the United States Agriculture and Food, USDA expanded its role with EPA to build on and increase current monitoring and surveillance programs that provide early detection and awareness of disease, pest, and poisonous agents.

U.S. Department of Health and Human Services (HHS)

Water and wastewater utilities coordinate with public health agencies during emergency response and other water quality-related events, in addition to providing water services necessary for the operations of medical and other healthcare facilities. EPA has issued guidance for water utility emergency response plans, identifying healthcare facilities and hospitals as particularly critical users. Common practice entails water utilities and healthcare facilities working together to develop effective plans to sustain hospital functions when water supplies are disrupted.[91]

U.S. Department of the Interior (DOI)

EPA coordinates with DOI on dam security and water quality. The National Park Service (NPS) maintains drinking water and wastewater utilities, under their purview, that are regulated by the SDWA and CWA. The Bureau of Land Management (BLM) plays a role in managing the Western water supply—some drinking water sources reside on BLM-managed public lands.

U.S. Department of State

Several major rivers, which are used as drinking water sources in the United States, cross Canada and Mexico borders. In addition, some Water Sector utilities obtain their treatment chemicals from Canada. The U.S. Department of State collaboratively works with other countries to ensure the protection of Water Sector infrastructure and water sources with an international nexus.

III. FEDERAL ACTIVITIES

Federally supported resilience activities in the Water Sector support the Sector's vision, mission, goals and objectives for resilience, as well the priority activities described in the *2015 Water and Wastewater Systems Sector-Specific Plan* (2015 SSP).[92] EPA is the Sector-Specific Agency (SSA) for the sector and as such, most Federal resilience activities in the Water Sector take place under EPA.

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[91] CDC and AWWA, *Emergency Water Supply Planning Guide for Hospitals and Health Care Facilitie*s, 2012; and Welter, et al, "Cross-Sector Emergency Planning for Water Providers and Healthcare Facilities," 2010.

[92] EPA, *2015 SSP,* 2016.

EPA ACTIVITIES

The following describe major EPA activities related to resilience planning and assistance.

EPA Strategic and Programming Planning

EPA has several strategic and planning documents to advance its priorities and mission to protect human health and the environment. The fiscal year 2014-2018 Strategic Plan references resilience in support of the President's Climate Action Plan (June 2013); specifically, to build resilience for extreme weather events.[93] One of the five agency FY 2016-2017 Agency Priority Goals is to "advance resilience in the nation's water infrastructure, while protecting public health and the environment, particularly in high-risk and vulnerable communities." To achieve this, EPA will provide technical assistance and tools to 25 urban communities to advance green infrastructure to improve local climate resilience. EPA will also provide resilience tools and training (on regional-based threats) to 1,000 small water utilities.[94] In addition, the Water Security Initiative (WSi) is an EPA program that addresses the risk of contamination of drinking water distribution systems. Its implementation includes the development of practical guidance and outreach to promote voluntary national adoption of effective and sustainable drinking water contamination warning systems.[95]

National Water Program (NWP) 2012 Strategy: Response to Climate Change (December 2012)

The first EPA NWP Strategy was published in 2008 and identified more than 40 key actions that could be taken in the near-term to understand and address the potential impacts of climate change on water resources. The 2012 NWP Strategy describes long-term goals for the management of sustainable water resources and identifies strategic actions that would need to be taken to achieve those goals. As such, the 2012 Strategy is a roadmap to guide future programmatic planning within EPA.

Coordination with Emergency Management Agencies

EPA developed two documents to help further the coordination and integration of the Water Sector and emergency management community.

- *Coordination of the Water and Emergency Services Sector* discusses the value of water to the emergency management community, and provides recommendations on how utilities can work together with their local emergency management agency.[96]
- *Bridging the Gap* focuses on the relationships between State drinking water primacy agencies and State emergency management agencies.[97]

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[93] EPA, *FY 2014-2018 EPA Strategic Plan*, 2014.

[94] EPA, Office of the Chief Financial Officer, *FY 2017 EPA Budget in Brief*, 2016.

[95] EPA, "Drinking Water and Wastewater Resilience," 2016.

[96] EPA, *Coordination of the Water and Emergency Services Sectors*, 2012.

[97] EPA and ASDWA, *Bridging the Gap*, 2013.

Water Infrastructure and Resiliency Finance Center Activities

The Center provides objective financial advice to help communities make informed decisions on financing drinking water, wastewater, and stormwater infrastructure projects. Current activities include:[98]

- **Regional Finance Forums**: These forums bring together communities with water infrastructure financing needs in an interactive peer-to-peer networking format. Attendees hear how local utilities have financed resilient water infrastructure projects and have the opportunity to meet key regional funding and technical assistance contacts.
- **WaterCARE Program**: The Community Assistance for Resiliency and Excellence (WaterCARE) program supports communities in developing resilient and sustainable finance planning strategies for drinking water and wastewater infrastructure to meet long-term local needs. Project successes are shared to support decision-making for other communities that have similar water infrastructure financing needs.
- **Innovative State Revolving Fund Financing**: The Center is launching a State Revolving Fund (SRF) Peer-to-Peer Learning Program with the Council of Infrastructure Financing Authorities (CIFA) and engaging in other SRF outreach on state-of-the-art practices.
- **Partnerships**: The Center is initiating a Water Infrastructure Public-Private Partnership Study and Local Government Training with the University of North Carolina Environmental Finance Center and West Coast Exchange. The Center is working with its partners to promote new tools such as EPA Region 3's "Community-Based Public-Private Partnerships Guide for Local Governments" to explore alternative market-based tools for integrated green stormwater infrastructure.
- **Stormwater Financing Clearinghouse**: The Center is focusing on stormwater financing by developing a clearinghouse of information to support communities to develop dedicated sources of revenue for stormwater programs.

EPA Water Security Division Activities

Most of the current and projected programs of EPA Water Security Division (WSD) for fiscal year 2016 focus on actions designed to support the implementation of one or more of the Water Sector's priority activities (as outlined in the 2015 SSP). These activities include:

- Supporting coordination with other sectors to improve relationships, develop mitigation and response plans, and improve response and recovery following an incident.
- Holding workshops and training focused on community-based water resilience, including how to use tools available to assess current levels of preparedness.
- Coordinating and facilitating exercises with WARN and at the State level to highlight the importance of cross-agency coordination and the criticality of water during a major incident.
- Working at the regional level with clusters of utilities facing a common hazard to implement mitigation measures.

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[98] EPA, "About the Water Infrastructure and Resiliency Finance Center," 2016.

- Developing educational materials, training, and guidance for State primacy agencies, utilities, and decision-makers on cybersecurity and mitigation measures.

DHS COLLABORATION: SECTOR RESILIENCE ACTIVITIES

The following are key examples of major collaborative activities supported by DHS.

CIPAC Projects and Activities to Support a Secure and Resilient Water Sector (March 1, 2010)

The Critical Infrastructure Partnership Advisory Council (CIPAC) Emergency Preparedness, Response, and Recovery Workgroup produced a document of projects and activities to support Water Sector Strategic Planning Working Group priorities. The Workgroup identified some 35 projects and activities, including the following top ten:

- Improve Emergency Response Plan (ERP) Guidance
- Outreach Targeted to Utility Managers
- Fact Sheet(s) on ERP Requirements, Hazards & Consequences
- Checklist for Coordination with Local Emergency Management
- Develop an Enhanced Crisis Communication Workbook
- Produce Business Case for Preparedness
- Create an Emergency Operations Center (EOC) Water Desk Manual
- Improve Opportunities for Mutual Aid Across State Lines
- Fact Sheet on Utilities being First Responders
- All-Hazard Example Decision Trees for Specific Incidents

Contamination Warning System CIPAC Workgroup: Final Report (March 2012)

The CIPAC Contamination Warning System Workgroup produced a report of 10 findings, in addition to specific objectives and priorities, within two charge areas: 1) the structure of a national program to promote adoption of CWS practices, and 2) the gaps identified in the current development and understanding of CWS components. This document is a primary source of recommendations dealing with national contamination warning issues.

CIPAC Roadmap to a Secure & Resilient Water Sector (May 2013)

Developed by the CIPAC Water Sector Strategic Priorities Working Group, the Roadmap establishes a strategic framework that articulates the priorities of industry and government in the Water Sector to manage and reduce risk. It also produces an actionable path forward for the Water Sector Government Coordinating Council (Water Sector GCC), Water Sector Coordinating Council (Water SCC), and government and private sector security partners in the Sector to improve the Sector’s security and resilience within the next five years. The 2015 SSP identifies this document as a blueprint to be used for enacting the priorities and goals with the Water Sector.

The Roadmap establishes three top priority activities for the Water Sector: 1) Advance the development of sector-specific cybersecurity resources; 2) Raise awareness of the Water Sector as a lifeline sector and recognize the priority status of its needs and capabilities; and 3) Support the development and deployment of tools, training, and other assistance to enhance preparedness and resilience. The Roadmap further describes the opportunities, challenges to implementation, efforts needed to achieve these goals, and roles and responsibilities within the Sector to successfully implement each of the priority activities.

CIPAC Water Sector Cybersecurity Strategy Workgroup: Final Report & Recommendations (April 2015)

The CIPAC Water Sector Cybersecurity Strategy Workgroup generated recommendations related to the *NIST Framework for Improving Critical Infrastructure Cybersecurity* (Cybersecurity Framework).[99] The report identifies gaps in available guidance, tools, and resources for addressing the Cybersecurity Framework in the Sector; and identifies measures of success that can be used by Federal agencies to indicate the extent of use of the Cybersecurity Framework in the Water Sector. It provides specific recommendations to achieve each of the four objectives above. Although EPA is responsible for regulating the security of critical infrastructure in the Water Sector, EPA believes that the voluntary partnership model is the best approach for implementing the Cybersecurity Framework in the Sector and therefore participated in and supported the CIPAC workgroup cybersecurity report.

Water and Wastewater Systems Sector-Specific Plan (2015 SSP)

The 2015 SSP addresses risk-based critical infrastructure protection strategies for drinking water and wastewater utilities, regulatory primacy agencies, and technical assistance partners. This includes processes and activities to enable the protection, and increased resilience, of the Sector's infrastructure. The 2015 SSP serves as a blueprint to be used for enacting the priorities and goals outlined within the *Roadmap to a Secure and Resilient Water Sector* and NIPP 2013, and provides an overarching framework for integrating sector critical infrastructure and key resource protection efforts into a unified program.

IV. FEDERAL FUNDING

There are two primary sources of Federal funds. EPA provides funding to address water-quality goals, and DHS through FEMA provides grants for disaster mitigation. For the latter, water services are only one of the many areas that qualify for support.

ENVIRONMENTAL PROTECTION AGENCY FUNDING

Clean Water State Revolving Fund

The Clean Water State Revolving Fund (CWSRF) is a partnership between EPA and the States to help States finance water infrastructure projects. Under the program, Congress appropriates funding to EPA that then provides grants to the States, which must contribute an additional 20 percent to

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[99] NIST, *Framework for Improving Critical Infrastructure Cybersecurity*, 2014.

match the Federal grants. From this pool of money, the States finance low interest loans for eligible water infrastructure projects. As loans are repaid, the money goes into the State programs to finance new projects.[100] Using a combination of Federal and State funds, State CWSRF programs provide loans to eligible recipients to:

- Construct municipal wastewater facilities
- Control nonpoint sources of pollution
- Build decentralized wastewater treatment systems
- Create green infrastructure projects
- Protect estuaries
- Fund other water quality projects

Drinking Water State Revolving Fund

Similar to the CWSRF, the Drinking Water State Revolving Fund (DWSRF) is a partnership between the Federal Government and State governments to help finance water infrastructure projects focused on providing safe drinking water. Under the program, Congress appropriates money for the fund, EPA awards grants to each State. The grant amount is based on the results of the Drinking Water Infrastructure Needs Survey and Assessment. States must provide a 20 percent match of any funding received, and as loans are repaid they flow back into the pool of money used to fund additional loans and projects.[101] Eligible projects include:

- Improving drinking water treatment
- Fixing leaky or old pipes (water distribution)
- Improving source of water supply
- Replacing or constructing finished water storage tanks
- Other infrastructure projects needed to protect public health

Water Infrastructure Finance and Innovation Act (WIFIA)[102]

WIFIA (authorized in 2014) establishes a new financing mechanism for water and wastewater infrastructure projects under EPA. It was modeled after the Transportation Infrastructure Finance and Innovation Act (authorized in 1998, amended in 2005) and is designed to fill market gaps and leverage private co-investment.

Although separate from the SRF programs, the WIFIA program works in coordination to provide low-interest loans for up to 49 percent of the costs of projects that are nationally or regionally significant. It is intended to increase flexibility for non-Federal interests and leverage private sector investments to increase the effect of Federal funding. The new SRF provisions provide loan flexibility, lower interest rates and extended repayment periods of 30 years. Examples of

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[100] EPA, "Learn about the Clean Water State Revolving Fund (CWSRF)," 2016.

[101] EPA, "How the Drinking Water State Revolving Fund Works," 2015.

[102] EPA, "Learn About the Water Infrastructure Finance and Innovation Act Program," 2015.

eligible projects include projects to enhance energy efficiency at drinking water and wastewater facilities, and desalination, aquifer recharge, and water recycling projects. Qualifications include:

- Funded projects must be nationally or regionally significant
- Individual projects must be reasonably anticipated to cost no less than $20 million

A. U.S. DEPARTMENT OF HOMELAND SECURITY FUNDING[103]

Hazard Mitigation Grant Program (HMGP)[104]

The HMGP assists States, Tribes, and local communities in implementing long-term hazard mitigation measures following a major disaster declaration. The program's objectives are to significantly reduce or permanently eliminate future risk to lives and property from natural hazards; provide funds to implement projects in accordance with priorities identified in State, Tribal, or local hazard mitigation plans; and enable mitigation measures to be implemented during the recovery from a disaster.

The HMGP can be used to fund projects to protect either public or private property, as long as the project fits within State and local government mitigation strategies to address areas of risk and complies with HMGP guidelines. Examples of projects include: acquiring and relocating structures from hazard-prone areas; retrofitting structures to protect them from floods, high winds, earthquakes, or other natural hazards, and constructing certain types of minor and localized flood control projects. HMGP funding is also available following a major disaster declaration if requested by the Governor.

Pre-Disaster Mitigation (PDM) Grant Program[105]

The PDM Grant Program is designed to assist States, territories, federally recognized tribes, and local communities in implementing a sustained pre-disaster natural hazard mitigation program. The goal is to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on Federal funding in future disasters. This program awards planning and project grants and provides opportunities for raising public awareness about reducing future losses before disaster strikes.

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[103] DHS, *Congressional Budget Justification (FY 2017)*

[104] FEMA, "Hazard Mitigation Assistance," 2016.

[105] FEMA, "Pre-Disaster Mitigation Grant Program," 2016.

APPENDIX G.
BASELINE RESILIENCE IN THE WATER SECTOR

Resilience is part of the Water Sector's culture, because the safe and reliable delivery of water and wastewater services, particularly under normal, nonstressed conditions, is ingrained in the sector's business model. However, throughout the sector there is wide variability in the degree to which Water Sector utilities have implemented specific resilience practices to respond to stressed conditions. Determining factors for resilience level include utility size, area of responsibility, and scale; complexity of the utility's operations; public versus private ownership; and the nature of perceived threats and risks.

This appendix includes an overview of the sector's components, risks, aspects of resilience, and resilience practices.

I. SECTOR OVERVIEW

The infrastructure of the Water Sector is complex, but its principal infrastructure can be grouped into drinking water and wastewater categories of varying sizes and ownership types.[106] This section provides an overview of drinking water and wastewater systems, the underlying value to the Nation's public health and economy, and the extensive role of collaboration in aligning public and private interests.

Most of the larger public drinking water systems and treatment works, which serve the major of Americans, are owned and operated by municipal entities. However, private water companies own nearly 16 percent of the Nation's Community Water Systems, and around 2,000 government entities contract with private companies to provide water and/or wastewater service in a public-private partnership.[107]

DRINKING WATER

Key infrastructure in the public drinking water systems of the Sector include:[108]

- **Raw Water Supply (e.g., surface water, groundwater)**: Surface water includes lakes, reservoirs, and rivers. Groundwater primarily includes water held in aquifers.
- **Raw Water Transmission (e.g., conduits, pipelines, catch basins)**: Conduits are covered tunnels and pipelines conveying raw water to treatment facilities. Pipelines include the entire system of pipes, interconnections, and valves that may be underground, above ground, or across rivers. Catch basins are used in combined sewer systems to catch excess wastewater and stormwater where it is held for later treatment and disposal.
- **Raw Water Storage (e.g., reservoirs, tanks)**: Reservoirs may be located in remote or urban areas, and vary widely in size. Storage tanks are also used to hold water prior to treatment.

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[106] EPA, *2015 SSP*, 2016.

[107] NAWC, "The Truth about Private Water Service Providers," 2010.

[108] EPA, *2015 SSP*, 2016.

- **Water Treatment Facility**: Includes a wide range of facilities that provide safe, potable water for domestic use; adequate water under sufficient pressure for fire protection and other emergencies; and industrial water for manufacturing. Steps to treat water include clarification, coagulation, sedimentation, filtration, and the use of chemicals in disinfection and fluoridation.
- **Treated/Finished Water Storage**: Includes water towers, standpipes, and covered and uncovered reservoirs that store treated water for a short period of time until it can be distributed to users.
- **Treated Water Distribution System**: Includes main water transmission pipes, water service lines to end users, water distribution pumping stations, fire hydrants, booster disinfection facilities to add additional disinfectant to treated water, backflow preventers to prevent contaminated water from entering the distribution network, and meters to track consumption of water.
- **Treated Water Monitoring System**: Includes facilities to monitor treated water quality for contaminants, and can include sensors to monitor water pressure and water quality.
- **Treated Water Distribution Control Center**: Includes central control facilities that monitor and operate the distribution system. Often, the facilities house supervisory control and data acquisition (SCADA) systems as part of an integrated control system. Some centers utilize electronic networks to connect monitoring systems and controls to a central display and operations room.

There are approximately 153,000 Public Water Systems (PWSs) in the United States.[109] These systems provide water for human consumption through pipes or other constructed conveyances to at least 15 service connections, or serve an average of at least 25 people, for at least 60 days annually. Community Water Systems (CWSs), which serve people year-round in their residences, is the largest group of service providers. Exhibit G-I shows the number of community water systems by size.

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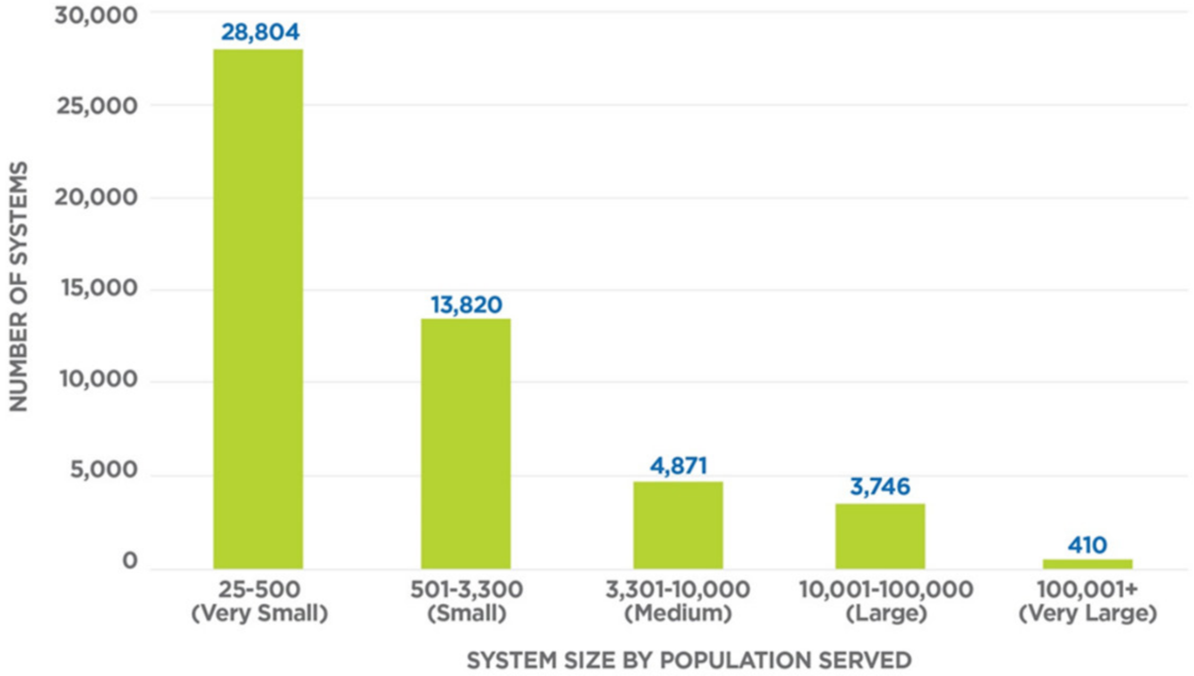
[109] EPA, *2015 SSP*, 2016.

Exhibit G-I. Number of Community Water Systems and System Size[110]



WASTEWATER

Key infrastructure in the public wastewater systems of the Sector include:[111]

- **Wastewater Facility (e.g., wastewater collection systems, sewers, inverted siphons, manholes, combined sewer/overflow outfall locations, lift/pump stations, and catch basins)**: Wastewater collection systems are the network of pipes that conveys wastewater from the source to the treatment plant. In some older cities, the wastewater and stormwater collection systems are integrated (combined sewer systems). In these older systems, flooding can result in the combined effluent being discharged directly to the receiving body (e.g., river or bay), bypassing the treatment plant.
- **Wastewater Raw Influent Storage**: Includes facilities to store raw sewage prior to treatment, including tanks or impoundments.
- **Wastewater Treatment Plant**: Provide a combination of physical and biological processes that are designed to remove organic matter from solution and treat the water to a degree that it can be released to the environment. Processes include screening, grit removal, flotation, flocculation and sedimentation, aeration, clarification, disinfection, chemical coagulation, and filtration. The processes are applied to the plant influent to reduce pollutant levels to the concentrations specified in the National Pollutant Discharge Elimination System (NPDES) permit, in the case of a direct discharger, or other specified discharge limits, in the case of an indirect discharger.

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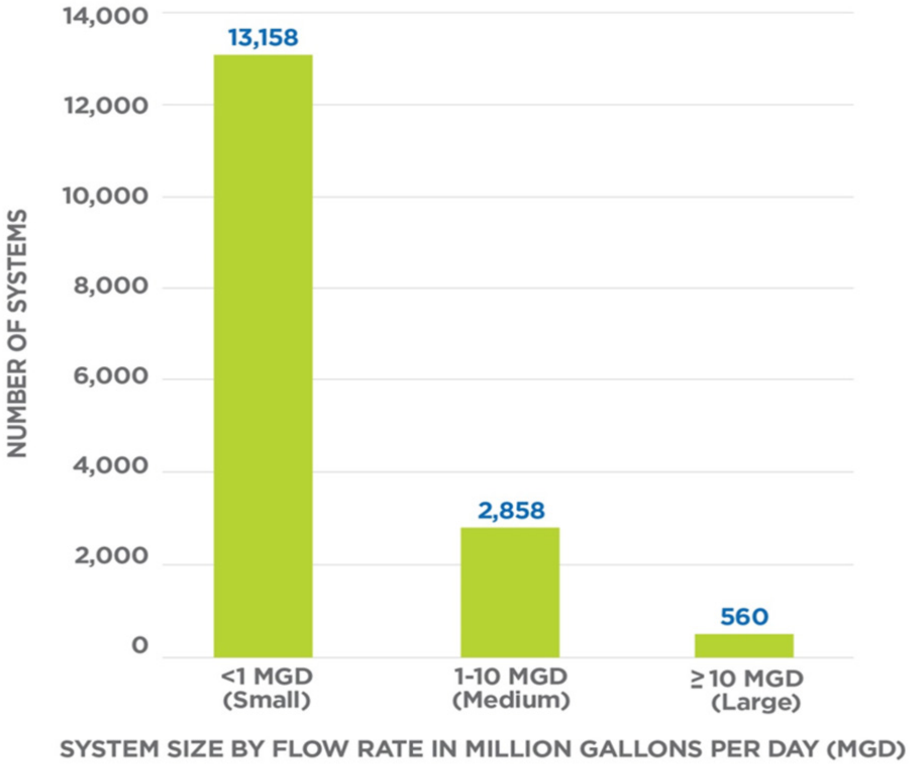
[110] EPA, *2015 SSP*, 2016.

[111] Ibid.

- **Treated Wastewater Storage**: Includes facilities where treated wastewater is held prior to discharge.
- **Treated Wastewater Discharge System**: Includes facilities that discharge treated wastewater to a surface water body (directed discharger), or to a POTW collection system (indirect discharger).
- **Treated Wastewater Monitoring System**: Includes facilities that monitor a range of physical properties (e.g., flow rates and water-quality indicators) and detect levels of contaminants before, during, and after wastewater treatment.
- **Wastewater Control Center**: Includes central control facilities that monitor and operate the wastewater system. Some systems utilize electronic networks, often including wireless communication, to link the monitoring system and the controls for the treatment and distribution systems to a central display and operations room. SCADA systems are part of an integrated control system.

Wastewater is predominantly treated by Publicly Owned Treatment Works (POTWs); there are approximately 16,500 POTWs in the United States. There are also a small number of private facilities, such as industrial plants. The majority of wastewater utilities treat less than 1 million gallons per day and provide services to fewer than 23 million people in total. [112] Exhibit G-2 shows the number of publicly owned treatment facilities by size.

Exhibit G-2 Number of Publicly Owned Treatment Works and System Size[113]



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[112] EPA, *2015 SSP,* 2016.

[113] Ibid.

THE VALUE OF WATER

Disruptions to drinking water and wastewater services have far-reaching public health, economic, environmental, and psychological impacts as shown in Exhibit G-3. These impacts demonstrate the need for improved understanding and support for Water Sector criticality and resilience efforts.

Exhibit G-3. Water Disruption Impacts

WHAT HAPPENS WHEN WATER SYSTEMS ARE DISRUPTED?

The Water Sector represents one of the critical lifeline sectors; safe and reliable water services are absolutely fundamental to our way of life. Disrupting these water systems would have far-reaching adverse public health, economic, environmental, and psychological impacts. Further, these impacts would not be confined to one location but would ripple across the Nation and threaten public confidence in the Nation's drinking water and wastewater service.

Without Water or Wastewater Services the following activities are not possible:

Individual Use

- Drink water.
- Brush your teeth or shower.
- Use toilet facilities.
- Prepare meals (e.g., boiling food, washing fruits and vegetables).
- Wash clothes and dishes.
- Maintain private pools and water tanks.
- Respond to medical emergencies (e.g., flushing skin/eyes with water to remove a toxin).
- Water lawns, plants, or gardens.

Public Supply Use

- Treat water and wastewater for any use.
- Maintain public pools, parks, gulf courses, nurseries, cemeteries, or provide water for any landscape-watering use.
- Operate critical public health and safety facilities, e.g., hospitals or firefighting capabilities.
- Keep public spaces (e.g., community centers, shopping malls), government offices, or businesses open.
- Irrigate for agricultural purposes. The animals (e.g., cows, chickens) depending on this food supply will also be affected.

Industry Supply Use

- Operate thermoelectric power facilities, including for power cooling.
- Maintain major commodity industries that use large amounts of water (food, paper, chemicals, refined petroleum, or primary metals).
- Incorporate water into any product, such as for processing, washing, diluting, cooling, or transporting a product.
- Extract minerals.
- Maintain livestock systems (watering, feeding, farm needs, sanitation, and waste-disposal).

(*Source: USGS, "Water Use in the United States," 2016*.)

Public Health Impacts

Without a safe, clean, and reliable water supply, public health will suffer. Impacts will vary depending on the cause of the disruption, such as contaminants in the water system or a lack of drinking water and wastewater services. The contaminant type or length of disruption are also key variables in the degree of health impact.

Case in Point

On January 9, 2014 in Charleston, West Virginia, about 10,000 gallons of a chemical called 4-methylcyclohexane methanol (MCHM) leaked from a storage tank into the Elk River. The chemical amount overwhelmed the filtration system in the West Virginia American Water (WVAW) treatment plant about a mile downstream.[114] Later that day, the WVAW issued a 'do not use' water order and the West Virginia Poison Center began receiving calls from people reporting rashes, nausea, vomiting, diarrhea, and other symptoms. Little is known about MCHM and its human health effects. Studies have only been conducted on animals and they show that when laboratory animals are exposed to high doses of MCHM, it causes problems with the liver, kidneys, blood, and the brain.

On January 21, 2014, it was discovered that another chemical (propylene glycol phenyl ether (PPH)), with health effects similar to MCHM, was part of the January 9 release. The most common way people were exposed to the contaminants was bathing, showering, washing hands, and other skin contact. A study of emergency department visits showed that 356 of 369 people were treated and released from the hospital between January 9 and January 23, 2014, with 3.5 percent or people hospitalized.[115] Long-term public health impacts are unknown. The incident is an example of the need to safely and reliably communicate public health risks.[116]

Economic Impacts

Businesses are unable to operate without a safe water supply or wastewater services. Facilities such as work places, restaurants, shopping malls, and public areas would be forced to shut down. This would result not only lost business revenue for the individual companies, but could generate larger adverse impacts to the local, State, or national economy.

Case in Point

Southern California water services are principally served by the California Aqueduct, which could be shut down due a major disaster (e.g., earthquake). In addition to the major disruption to water utility services, a 12-month shutdown of the aqueduct water supply would amount to economic losses of as much as 550,000 jobs and $55.6 billion in Gross Domestic Product (GDP) to the Los Angeles County Economy. A 24-month disruption could lead to a total two-year loss of 742,000 job-years of employment, $75 billion of GDP, and $135 billion of sales revenue for businesses in the county.[117]

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[114] Friend, "Water in American: Is It Safe to Drink?" 2014.

[115] WV DHHR, "Elk River Chemical Spill," 2014.

[116] Manuel, "Crisis and Emergency Risk Communication," 2014.

[117] Rose, et al., *Total Regional Economic Losses from Water Supply Disruptions to the Los Angeles County Economy*, 2012.

Environmental Impacts

Water disruptions have the potential to impact the broader environment through the pollution of water. For example, a sewage overflow or contaminant release can negatively impact plant and animal species, affecting the water quality, habitat, and species themselves.

Case in Point

Superstorm Sandy generated many critical infrastructure impacts. Due to the storm, power was lost, and approximately 80 sewage treatment systems in New Jersey were damaged. One system that was damaged was the Passaic Valley Sewerage Commission. During the five days the plant was out of commission, approximately 2.75 billion gallons of untreated waste flowed from the plant into the nearby bay.[118] From the hardest hit States, 11 billion gallons of untreated and partially-treated sewage flowed into the aquatic environment (rivers, bays, canals). Untreated sewage can negatively impact the aquatic ecosystem by depleting available oxygen, creating nutrient imbalance, and promoting sudden plant growth such as algae blooms, chasing away normal aquatic life.[119]

Psychological Impacts

A water incident does not have to generate major public health, economic, or environmental impacts to result in a major disruption. The loss of public confidence in the water services and the threat of spreading fear and panic in the community impacted and across the Nation would adversely impact the Water Sector. An unreliable, unclean, and unsafe water supply creates lasting fears (e.g., fears of an unknown contaminant's health effects). A prolonged incident could also affect the government's ability to maintain order, deliver public services, and ensure public health and safety.

Case in Point

In August 2014, Toledo was affected from a large algae bloom in Lake Erie, an event that has long-troubled the lake. Toxic levels of microcystin meant residents could not use the water supply since boiling the water only increased the concentration of toxin. Even after the "Do Not Drink" advisory was lifted, the confidence in the water supply did not bounce back. A year later (August 2015), another algae bloom threatened the area. Even though the microcystin levels were low and very manageable by the water treatment utility, residents began to stockpile bottle water and planned to not use tap water—a move that suggests damaged public confidence.[120] Toledo continues to build on efforts to regain public confidence; however, restoring public confidence (even with the appropriate decontamination) requires significant effort.

SECTOR COLLABORATION

Public water and wastewater systems are predominantly owned and operated by municipal entities, with the Federal Government role most prominent in the regulation of water quality. The sector has a long, productive history of collaboration through associations and geographic clusters of utilities. This collaboration has produced a wealth of information, mutual-support relationships, and tools. For example, the American Water Works Association (AWWA) developed standard J100-10 (R13)

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[118] Manuel, "The Long Road to Recovery: Environmental Health Impacts of Hurricane Sandy," 2013.
[119] Kenward, et al., "Sewage Overflows from Hurricane Sandy," 2013.
[120] Henry, "Toxic algae struggles leave Toledo's reputation hanging in the balance," 2015.

Risk and Resilience Management of Water and Wastewater Systems, the first voluntary consensus standard encompassing an all-hazards risk and resilience management process for use specifically by water and wastewater utilities.

Water Sector Coordinating Councils

The Federal Government built on this tradition of collaboration by using the partnership model, specified in *Homeland Security Presidential Directive 7 (*HSPD-7*): Critical Infrastructure Identification, Prioritization, and Protection*, *Presidential Policy Directive 21 (*PPD-21*): Critical Infrastructure Security and Resilience*, and the *2013 National Infrastructure Protection Plan* (NIPP 2013) to bring public and private sector participants into the planning and implementation of sector protection. EPA organized the Water Government Coordinating Council (GCC) including Federal, State, and local entities; and the owners and operators of water utilities organized the Water Sector Coordinating Council (Water SCC).

WATER SECTOR COORDINATING COUNCIL MISSION

"The Water Sector Coordinating Council shall serve as a policy, strategy, and coordination mechanism and shall recommend actions to reduce and eliminate significant critical infrastructure security and resilience vulnerabilities to the Water and Wastewater Sector through the interactions with the Federal Government and other critical infrastructure sectors."

The GCC is co-chaired by EPA, the Water SSA, and DHS. The Water Sector GCC coordinates policy, strategy, and activities across government entities within the Water Sector, with membership drawn from Federal and State government representatives and leaders in water protection and resilience issues.[121] The Water SCC member associations serve as liaisons between the broader water services community and the government partners represented by the GCC. The current list of Water GCC and SCC member organizations is included in Exhibit G-4.

The Water Sector GCC and SCC often meet under the umbrella of the Critical Infrastructure Partnership Advisory Council (CIPAC), established by DHS to provide a forum in which the government and private sector entities, organized as coordinating councils, can jointly engage in activities to support and coordinate critical infrastructure security and resilience efforts. Under CIPAC, the Water Sector GCC and SCC have formed several working groups to address specific issues of security and resilience concern to the sector.[122] In 2015 these working groups included:[123]

- Cybersecurity Working Group
- Drinking Water Contamination Warning System Working Group
- Risk Assessment Methodology / Standard Examination Working Group
- Strategic Planning Working Group

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[121] EPA, *2015 SSP,* 2016.

[122] EPA, "Water Sector Government Coordinating Council Charter," 2014; and Water SCC, "Charter of the Water Sector Coordinating Council," 2014.

[123] DHS, "Water and Wastewater Systems Sector Working Groups."

Exhibit G-4. Water Sector Coordinating Council and Government Coordinating Council Membership[124]

Water Sector Government Coordinating Council	Water Sector Coordinating Council
• Association of State Drinking Water Administrators • Association of State and Interstate Water Pollution Control Administrators • Association of State and Territorial Health Officials • Environmental Council of the States • National Association of County & City Health Officials • National Association of Regulatory Utility Commissioners • U.S. Department of Agriculture • U.S. Department of Defense • U.S. Department of Health and Human Services • U.S. Department of Homeland Security • U.S. Department of the Interior • U.S. Department of Justice • U.S. Department of State	• American Water • American Water Works Association • Artesian Water Company • Association of Metropolitan Water Agencies • Bean Blossom-Patricksburg Water Corporation • Boston Water and Sewer Commission • Breezy Hill Water and Sewer Company • California Water Service Co. • County of King (Washington) Department of Natural Resources and Parks • District of Columbia Water and Sewer Authority • National Association of Clean Water Agencies • National Association of Water Companies • National Rural Water and Sewer Authority • Northeast Ohio Regional Sewer District • Onondaga County Water Authority • Prince William County Service Authority • Spartanburg Water • Symantec Corporation • Trinity River Authority of Texas • United Water • Water Information Sharing and Analysis Center

II. RISKS TO THE WATER SECTOR

Secure and resilient water and wastewater infrastructure is essential to daily life and in ensuring the economic vitality of the Nation and public confidence in the Nation's drinking water and wastewater services. This level of criticality demands the need for effective risk management to successfully navigate a broad range of potential disruptions. In fact, emergency response planning is inherent to the sector; enabling continuity of such critical operations and sustaining public health and environmental protection.[125] In addition, each of the following risks may share other contributing factors, such as:

- Capabilities in managing an area-wide loss of water services may be deficient.
- Although the Water Sector is recognized as a lifeline sector, its lifeline criticality is not commonly recognized among all relevant stakeholders. This generates a challenging situation, as the lack of recognition can escalate consequences during area-wide events.

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[124] DHS, "Water and Wastewater Systems Sector: Council Charters and Membership," 2016.

[125] EPA, *2015 SSP*, 2016.

- The economic costs of preparation and response may mean that there are insufficient funds to prepare for and address risks ahead of time and to the level at which the risk requires.
- Inadequate information sharing and resources for the full resilience spectrum of prevention, protection, mitigation, response, and recovery.
- An aging workforce, resulting in lost institutional knowledge as employees retire.
- Reduced water consumption and conservation results in less revenue available to maintain level of service and undertake infrastructure projects.

Drinking water and wastewater systems rely on a chain of linked components, each of which must function well if service is to be provided to the customer. If any of these components or operations is disrupted for more than a short period of time, the entire system will shut down. This makes water utilities highly vulnerable by nature, and the complexity of their interlinked operations make redundancy of many major components almost impossible.

The Water Sector is proactive in identifying and prioritizing risks to its infrastructure. This enables the sector to implement risk-reduction activities through a partnership approach whereby the government and the sector share the responsibility for improving Water Sector resilience by identifying joint priorities and engaging in coordinated action. At the national level, DHS produces risk assessments of the primary risks to each critical infrastructure sector to inform sector owners and operators in developing and implementing their risk-management activities. At the sector and national level, common significant risks include natural disasters and cyberattacks.

In 2013, the Water Sector Strategic Priorities Working Group identified the sector’s most critical risks, organized into categories of most significant, high, and medium. The 2015 SSP reaffirmed the continued validity of these risks, as shown in full risk profile listed in Exhibit G-5. Only a few of the risks were covered in the body of the report. The risks are not limited to physical or cyber events, but rather encompass a much broader spectrum of risk that impacts the sector’s overall security and resilience and its ability to provide needed water services to the Nation.

Exhibit G-5. Water Sector Risks[126]

MOST SIGNIFICANT RISKS

- Natural disasters (such as impacts on water quality and quantity from floods, hurricanes, earthquakes, ice storms, pandemic flu, and other geographic catastrophes)
- Economic implications of aging infrastructure
- Cyber events
- Capability in managing an area-wide loss of water
- Although the Water Sector has been defined as a lifeline sector, this is not commonly recognized among all relevant stakeholders, a situation that can escalate consequences during area-wide events.

HIGH RISKS

- Economic costs of preparation and response: The Water Sector can create a large economic risk in a disaster, but there are insufficient funds to prepare for and address risks ahead of time.
- Ignorance about the consequences of inaction and apathy from some stakeholders in utilities, the customer base, State and local government, Federal Government and Congress
- Inadequate coordination and information sharing during preparation, response, and recovery
- Intentionally malicious acts
- Limited resource availability: Many utilities are faced with competing needs (e.g., regulatory, aging infrastructure, environmental, and public health protection, and workforce succession requirements) that are immediate, concrete, and can limit resource availability for implementing preparedness and resilience improvements
- Unenforced and outdated requirements that do not address evolving threats

MEDIUM RISKS

- Lack of mutual aid agreements, effective education and outreach to emergency management, and lack of best practices for emergency response planning
- Technology interoperability issues that create information-sharing challenges during response
- Insufficient communication to water utility boards of the definition, management, and prioritization of critical assets and needs

DHS assesses the overall risk to the Water Sector as “vulnerable to a variety of all-hazard threats including contamination with deadly agents, insider threats, physical attacks using improvised explosive devices (IEDs), cyberattacks, and natural hazards. Successful attacks on a drinking water or wastewater system could result in large numbers of illness, casualties, and denial of service, which

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[126] EPA, *2015 SSP,* 2016, Figure 4, p. 10.

could severely impact the Nation's public health and economic vitality."[127] DHS further identifies the most serious risks to the Sector:

- **Chemical, Biological, or Radiological (CBR) Contamination**. Most public water supplies are monitored and treated to prevent the distribution of contaminated drinking water. The risk of CBR contamination stems from both the terrorist threat to contaminate the U.S. water supply and the serious health impacts that could result from an undetected contaminant. These impacts could vary depending on the type of substance, route of exposure (ingestion, absorption, inhalation), and amount of time before the contaminant is detected.
- **Natural Hazards**. Natural hazards (e.g., hurricanes, tornadoes, floods, earthquakes, and drought) pose a serious and continuing risk for the Sector. Water infrastructure may be severely disrupted or destroyed by such hazards, which may further complicate an overall disaster emergency response due to multiple cross-sector interdependencies. Critical water shortages may also result from drought conditions and climate change, leading to water use restrictions and rationing.
- **Physical and Cyberattacks by Terrorists, Homegrown Extremists, or Disgruntled Insiders**. Physical attacks using improvised explosive devices (IEDs) on chemical storage tanks or other critical nodes in a drinking water or wastewater system could result in a release of hazardous materials or in a long-term loss of service should a single-point-of-failure be destroyed. Cyberattacks and intrusions on SCADA systems or other business systems pose a serious threat to the Water Sector, allowing malicious actors to manipulate or exploit control systems essential to operation of drinking water and wastewater utilities.

III. ASPECTS OF RESILIENCE

Improving resilience in the sector is perhaps best framed by two aspects: the activity and capability of the individual utilities and the development and sharing of information, tools, and practices through sector collaboration. The following discusses salient elements of each.

RESILIENCE AT THE UTILITY LEVEL

Resilience is part of the Sector's culture, because the dependable delivery of safe water and wastewater disposal services are inherent in the Sector's business model, whatever the size of the utility or jurisdiction managing its resources. The resilience of Sector assets and operations can never be taken for granted or allowed to lapse.

There is wide variability in the degree of resilience at the individual utility level, depending on such factors as the size of the utility or managing jurisdiction, its public or private ownership, and the scale and complexity of the individual system's operations. For example, the relatively few very large systems in the sector—serving the majority of the population—have strong resilience measures in place and are heavily monitored and regulated for safety and quality standards set by EPA and enforced by the States. However, smaller systems generally do not have access to the same level of

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[127] DHS OCIA, *Sector Risk Snapshots*, 2014.

resources as large systems and are not monitored as closely for the enforcement of safety and quality standards.

Some of the most important resilience measures—based on policy, plans, strategies, recommendations, and models—are implemented on a regional or local level through regional water districts and local utilities. While these measures have proven to strengthen resilience at the local or regional level, the practices are not cohesive across the country. Greater emphasis on increasing sector-wide availability of resilience practices could further increase resilience both at the utility level and the sector level.

COLLABORATION FOR RESILIENCE AT THE SECTOR LEVEL

Because of the sector's complexity and the many dependencies that exist in the processes and operations providing the public with drinking water and wastewater treatment, the Water Sector has robust risk-management procedures and tools in place to ensure the resilience of the sector's many assets and systems. Partly because of the resilience differentiation between larger and smaller utilities, EPA and associations representing the Water Sector have been very active in trying to develop models, tools, and best practices which are transferable to smaller systems. There are many examples of this resilience-building approach, as reflected in the Water Sector success stories recorded in the 2015 SSP.[128] Some examples of these resilience-building activities include:

- Developed *How to Develop a Multi-Year Training and Exercise Plan* to assist utilities in creating multiyear plans that can lead to increased emergency preparedness.
- The Water Information Sharing and Analysis Center (WaterISAC) published *10 Basic Cybersecurity Measures to Reduce Exploitable Weaknesses and Attacks*.
- Published the *Weather & Hydrologic Forecasting for Water Utility Incident Preparedness and Response* document to provide hazardous weather and forecasting resources for utility awareness and preparedness.
- Leveraged the CIPAC framework to develop sector priorities, build partnerships, and increase collaboration among public and private sector stakeholders, including the *2013 Roadmap to a Secure & Resilience Water Sector*, which represents the Water SCC/GCC priorities.
- The Water Research Foundation, AWWA, and EPA developed *Business Continuity Planning for Water Utilities: Guidance Document*.
- Developed the interactive guidance document *Flood Resilience: A Basic Guide for Water and Wastewater Utilities* to help water utilities understand their flooding threat and identify practical mitigation options to protect their critical assets.

The sector identifies and prioritizes programs, projects, and activities which together can strengthen sector resilience in the future. As demonstrated in this and the previous section, the sector has set specific goals and objectives, identified in detail the infrastructure in the sector, determined how risks can be assessed and analyzed, completed and planned a vast array of activities designed to

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[128] EPA, *2015 SSP*, 2016.

address and mitigate Sector risks, identified how to measure success in managing risk in the sector, and developed robust information-sharing mechanisms within the sector partnership. All of these steps combine to establish a solid baseline of resilience in the sector, while at the same time pointing to needed improvements that can be addressed on a priority basis.

Examples of resilience have been provided in this section in terms of the identification and prioritization of sector risks, which have been formalized and compiled by the CIPAC Water Sector Strategic Priorities Working Group in the *2013 Roadmap to a Secure and Resilient Water Sector*. Steps taken or to be taken by the sector in terms of its cybersecurity resilience have also been discussed above, in terms of the CIPAC Water Sector Cybersecurity Strategy Workgroup in its 2015 *Final Report & Recommendations.*

IV. RESILIENCE PRACTICES

The following highlights primary practices implemented at the utility and sector levels, along with specific challenges in fully realizing resilience. The practices are organized into categories consistent with components of the NIPP 2013 risk-management framework and core tenets: set goals and objectives, understand dependencies and interdependencies, assess and analyze risk, share information, and implement risk-management activities.

SET GOALS AND OBJECTIVES

The Water Sector is proactive in identifying and prioritizing goals to managing risks across the sector. Current goals and priorities driving the sector are derived from the *2013 Roadmap to a Secure & Resilient Water Sector* (2013 Roadmap) and the 2015 SSP. Commonalities across the documents include an increased focus on outreach and awareness campaigns; preparedness, recovery, and resilience strategies; and cybersecurity concepts and capabilities.

The 2013 Roadmap priorities are:

- Advance the development of sector-specific cybersecurity resources.
- Raise awareness of the Water Sector as lifeline sector and recognize the priority status of its needs and capabilities.
- Support the development and deployment of tools, training, and other assistance to enhance preparedness and resilience.

They are used by EPA and its public-private partnerships in the sector to focus on activities in a two to five year timeframe that can together strengthen the sector's ability to plan for effective response and recovery, maintain resilience during a calamitous event, and garner support for both disaster and risk-mitigation cost recovery.[129] The 2015 SSP's four strategic goals and 13 objectives are outlined in Exhibit G-6. They are used by the sector to develop, implement, and measure

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[129] CIPAC Water Sector Strategic Priorities Working Group, *Roadmap to a Secure and Resilient Water Sector*, 2013.

progress of protection and resilience activities designed to prevent, detect, respond to, and recover from all hazards.[130]

Exhibit G-6. Water Sector Goals and Objectives[131]

Goal 1: Sustain protection of public health and the environment. The Nation relies on sustained availability of safe drinking water and on treatment of wastewater to maintain public health and environmental protection. To protect public and environmental health better, the Water Sector works to ensure the continuity of both drinking water and wastewater services.	
Objective 1	Encourage integration of both physical and cybersecurity concepts into daily business operations at utilities to foster a security culture.
Objective 2	Evaluate and develop surveillance, monitoring, warning, and response capabilities to recognize and address all-hazards risks at water systems that affect public health and economic viability.
Objective 3	Develop a nationwide laboratory network for water quality protection that integrates Federal and State laboratory resources and uses standardized diagnostic protocols and procedures, or develop a supporting laboratory network capable of analyzing threats to water quality.

Goal 2. Recognize and reduce risk. With an improved understanding of the vulnerabilities, threats, and consequences, owners and operators of utilities can continue to thoroughly examine and implement risk-based approaches to protect, detect, respond to, and recover from all hazards better.	
Objective 1	Improve identification of vulnerabilities based on knowledge and best available information, with the intent of increasing the sector's overall protection posture.
Objective 2	Improve identification of potential threats through knowledge base and communications—with the intent of increasing overall protection posture of the sector.
Objective 3	Identify and refine public health and economic impact consequences of manmade or natural incidents to improve utility risk assessments and enhance the sector's overall protection posture.

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[130] EPA, *2015 SSP*, 2016.

[131] EPA, *2015 SSP,* 2016, Table 2, pp. 17-18.

Goal 3. Maintain a resilient infrastructure. The Water Sector will investigate how to optimize continuity of operations to ensure the economic vitality of communities and the utilities that serve them. Response and recovery from an incident in the sector will be crucial to maintaining public health and confidence.	
Objective 1	Emphasize continuity of drinking water and wastewater services as it pertains to utility emergency preparedness, response, and recovery planning.
Objective 2	Explore and expand implementation of mutual aid agreements/compacts in the Water Sector by encouraging utilities to join their State WARN. The sector has significantly enhanced its resilience through agreements among utilities and States; increasing the number and scope of these will further enhance resilience.
Objective 3	Identify and implement key response and recovery strategies. Response and recovery from an incident in the sector will be crucial to maintaining public health and confidence.
Objective 4	Increase understanding of how the Sector is interdependent with other critical infrastructure sectors. Sectors such as Healthcare and Public Health and Emergency Services are largely dependent on the Water Sector for their continuity of operations, while the Water Sector is dependent on sectors such as Chemical or Energy for continuity of its operations.

Goal 4. Increase communication, outreach, and public confidence. Safe drinking water and water quality are fundamental to everyday life. An incident in the Water Sector could have significant impacts on public confidence. Fostering and enhancing the relationships between utilities, government, and the public can mitigate negative perceptions in the face of an incident.	
Objective 1	Communicate with the public about the level of protection and resilience in the sector and provide outreach to ensure the public's ability to be prepared for and respond to a natural disaster or manmade incident.
Objective 2	Enhance communication and coordination among utilities and Federal, State, and local officials and agencies to provide information about threats by utilizing WaterISAC and other information-sharing networks.
Objective 3	Improve relationships among all Water Sector partners through a strong public–private partnership characterized by trusted relationships.

UNDERSTAND DEPENDENCIES AND INTERDEPENDENCIES

The level of resilience in the Water Sector is of fundamental importance to the Nation, because the sector is a lifeline sector. The lives and well-being of Americans and the efficient functioning of the U.S. economy depend on a continued and dependable supply of water and wastewater services. This fundamental importance can easily be seen in terms of the critical interdependencies between the Water Sector and other sectors. A more specific listing of how these sectors depend on each other is provided in the 2015 SSP.

Dependencies and interdependencies that exist between the Water Sector and other critical sectors have been identified and extensively documented in after-action reports on the cascading effects of past major events. The *2013 WARN Superstorm Sandy After-Action Report* serves as one of the most influential after-action reports for the sector, because it identified key actions related to dependencies that could reduce consequences and increase resilience in the Water Sector in the future. These recommended actions were organized into several categories: Interstate Mutual Aid & Assistance, Elevating the Priority Status of Water Infrastructure, Energy and Water Nexus in Disasters, Site Access, Coordination, Situational Awareness, and Communications.[132]

Interdependencies of the Water Sector with the Energy and Healthcare and Public Health Sectors are of most prominence during recent major events. For example, in collaboration with the Healthcare and Public Health Sector, the Water Sector has helped develop plans, protocols, and processes to assist the dependent sector to prepare for emergencies. Nonetheless, and as illustrated by the lack of clear understanding of all the ramifications of the Energy-Water nexus, there remains a critical need to further develop the methodologies to collect and analyze relevant data to be better able to manage these types of complex interdependencies. An excellent example of the specificity required to achieve this level of coordinated response is the sector's efforts to reach out and assist healthcare facilities with their emergency planning in the event of an emergency impacting their water supply. The following sections describe these interdependencies in greater detail.

Energy-Water Nexus[133]

The Energy and Water Sectors are closely linked with each other. Energy requires water in large quantities for mining, fuel production, hydropower, and power plant cooling. Water needs energy for pumping, treatment, and distribution of water and for collection, treatment, and discharge of wastewater. Estimates of the Nation's electricity contributing to moving and treating water and wastewater by public and private entities range between 4 and 13 percent, depending on how it is calculated. In some parts of the country, such as California, those estimates run as high as 19 percent.

As similar situation exists with the Energy Sector's need for water. Agriculture dominates U.S. water consumption at 71 percent; however, the Energy Sector (including biofuels, thermoelectric, and fuel production) is the second-largest consumer at 14 percent, while domestic and public uses are third at 7 percent. More than 80 percent of U.S. electricity is generated at thermoelectric facilities that depend on cooling water; these facilities withdraw 143 billion gallons of freshwater per day. In 2005, thermoelectric cooling represented 41 percent of water withdrawn nationally, and 6 percent of water consumed nationally. Water availability issues—such as regional drought, low-flow, or intense competition for water—are critical for hydroelectric and thermoelectric generation. However, the Energy Sector's need for water varies widely across the sector. In some cases, such as fuel production, the byproduct is wastewater. Wastewater (often saline) brought to the surface by oil

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[132] AWWA, *WARN: Superstorm Sandy After-Action Report*, 2013.

[133] Copeland, *Energy-Water Nexus: The Water Sector's Energy Use*, 2014; and Carter, *Energy-Water Nexus: The Energy Sector's Water Use*, 2013.

and gas wells represent the largest byproduct of fuel production. Approximately 2.3 billion gallons are produced daily from onshore oil and gas wells in the United States.

A Congressional Research Service (CRS) study noted several areas requiring additional research before the energy-water nexus could be more fully understood. The research areas included:[134]

- Data that could help decision-makers and users fill what is now an incomplete picture of energy needs for water uses are lacking. This is apparent across sectors and also within individual sectors. Data that exist are scattered and often are not available at a scale needed by decision-makers.
- More integrated research is needed on water and energy operations. Standards for data collection, coordination, and quality control are lacking.
- Research is needed on advanced technologies that save energy and save water, and partnerships between government and the private sector that move research and development from bench-scale to implementation are needed.
- Better understanding is needed of linkages between energy, water, land, and agriculture and risks of climate change and extreme weather events on water availability and energy supply.
- Policies and approaches are needed to encourage the water and energy sectors to move toward integrated resource management.
- Analysis is needed of incentives, disincentives, and lack of incentives to investing in cost-effective energy or water efficiency measures. One area of interest is regulatory barriers to co-implementation of efficiency programs in the water and energy sectors.
- More education and outreach to all types of water users, the general public, and public officials are needed on the water-energy nexus and how improving efficiency involves the reciprocity of saving energy and saving water.

To address these and other issues surrounding the water-energy nexus, the U.S. Department of Energy (DOE) proposed a new energy-water nexus crosscutting activity for fiscal year (FY) 2016 that would analyze the relationships between energy and water use and conduct research on water and energy systems. DOE justified its new activity on the grounds that energy is a major user of the Nation's water and that extraction, distribution, and treatment of water requires large amounts of energy. Components of DOE participating in the crosscutting activity include several DOE offices: Energy Policy and Systems Analysis, International Affairs, Energy Efficiency and Renewable Energy, Fossil Energy, Indian Energy Policy and Programs, and Science.[135]

Water Supply and Healthcare Facilities

The energy-water nexus illustrates the close interdependencies between these two sectors. An example of a critical infrastructure sector dependency on water is the need for hospitals and healthcare facilities to access a reliable source of water during emergencies. Without water, the

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[134] Ibid.

[135] Holt, *Energy and Water Development: FY2016 Appropriations*, 2015.

facilities will shut down, and the lives of individuals needing their care may be in jeopardy. To address this life-critical issue, the CDC and AWWA collaborated in the development of the *Emergency Water Supply Planning for Hospitals and Healthcare Facilities* and the *Drinking Water Advisory Communication Toolbox*. Both of these documents reflect Water Sector resilience efforts in conjunction with the needs of a dependent sector.

The *Emergency Water Supply Planning for Hospitals and Healthcare Facilities* report provides a four-step process and detailed guide for the development of an Emergency Water Supply Plan (EWSP):[136]

1. Assemble the appropriate EWSP Team and the necessary background documents for your facility;
2. Understand your water usage by performing a water use audit;
3. Analyze your emergency water supply alternatives; and
4. Develop and exercise the EWSP.

The Drinking Water Advisory Communication Toolbox provides a protocol and practical toolbox for communicating with stakeholders and the public about water advisories. It focuses on water systems and addresses the range of situations that generate drinking water advisories.[137] The Toolbox is based on more than 500 documents, protocols, regulations, and other resources related to the issuing of drinking water advisories, as well as nearly 100 interviews conducted with water systems, primacy agencies, and local public health departments in the United States and Canada. The toolbox includes instructions on how to prepare before an event, what to do during an event, templates and tools to use, and recommendations for follow-up actions and assessments after an event. The purpose of the toolbox is to enable water systems to communicate effectively with partners and the public in order to protect public health.

ASSESS AND ANALYZE RISK

The vulnerability of Water Sector systems, coupled with their essential life supporting services, necessitates that sector owners and operators (publicly and privately owned) pay exceptionally close attention to risk management in the sector. Historically, water and wastewater utilities have incorporated protection and emergency preparedness initiatives into their operating protocols, with a traditional goal of continuously improving their infrastructure protection, security, dependability, and resilience. The assessment of risk to individual utilities and their specific infrastructure is conducted primarily by the utilities themselves. However, there are challenges in providing vulnerability assessments to those outside the utility. Obstacles to the sharing of this kind of detailed vulnerability information has limited the Federal Government's ability to compile on a national level an accurate and complete assessment of the sector's security and resilience status.

Drinking water and wastewater utilities are encouraged to conduct or update risk assessments as well as to prepare or revise Emergency Response Plans (ERP) on a regular basis. EPA's Vulnerability Self-Assessment Tool (VSAT) provides Water Sector utility owners and operators with qualified and

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[136] CDC and AWWA, *Emergency Water Supply Planning Guide for Hospitals and Health Care Facilities*, 2012.
[137] CDC, and et al., *Drinking Water Advisory Communication Toolbox*, 2013.

quantified risk assessment processes to measure risk at the asset and system level; prioritize utility investments and efforts to mitigate risk; and track utility risk-management performance and investment over time. VSAT uses consistent vulnerability, consequence, and threat information within the Risk Analysis and Management for Critical Asset Protection framework, also known as RAMCAP. EPA's Water Health and Economic Analysis Tool (WHEAT) is a generalized (threat-neutral) consequence analysis tool, designed to assist drinking water and wastewater utility owners and operators in quantifying public health consequences, utility-level financial consequences, direct and indirect regional economic consequences, and the downstream impacts of an adverse event that pose risks to the Water Sector. The WHEAT tool includes modules for drinking water and wastewater systems.

Examples of regional and local resilience measures, aimed at managing assessed risk, from the Los Angeles area include:

- The Metropolitan Water District of Southern California (MWD) assists local southern California communities to develop local sources of water and utilize groundwater banking and transfers. MWD also promotes and invests in conservation and water use efficiency programs as a way to help the region adapt to current and anticipated shortages of imported water from Northern California and the Colorado River.[138]
- Facing aging infrastructure of its system, the Los Angeles Department of Water and Power (LADWP) developed a Capital Improvement Program with a 10-year horizon to maintain and replace existing components of the water system, as well as substantial updates or construction of new facilities.[139]
- LADWP's water conservation programs includes providing incentives for installation of more than 1.8 million water-saving showerheads, more than 1.27 million water-efficient toilets, and more than 80,000 high efficiency clothes washers. Water saving from the more efficient toilets themselves save the City more than 14 billion gallons of water each year. As well as instituting a "Cash in Your Lawn" program, whereby residents of the City have replaced over 15 million square feet of traditional grass with low-water-using "California Friendly landscaping," saving 540 million gallons of water per year.[140]
- The City of Los Angeles adopted the "One Water LA 2040 Plan" (One Water LA). Coordinated by a multiagency implementation team, One Water LA is a collaborative approach to develop an integrated framework for managing the City's watersheds, water resources, and water facilities in an environmentally, economically, and socially beneficial manner.[141]

SHARE INFORMATION

Information sharing plays an essential role in the security and resilience of the Water Sector. The sector leverages the resources and capabilities of four primary information-sharing mechanisms to

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[138] Metropolitan Water District of Southern California, *Integrated Water Resources Plan,* 2016.

[139] LADWP, "Water Infrastructure Plan," 2015.

[140] Ibid.

[141] City of LA, "One Water LA."

support resilience across the sector: the Water Information Sharing and Analysis Center (WaterISAC), Water/Wastewater Agency Response Network (WARN), and trade associations.

Water Information Sharing and Analysis Center (WaterISAC)

Established as a nonprofit organization in 2001, the WaterISAC is the primary information-sharing and operational arm of the Water Sector. Through a secure Webportal, twice-weekly e-newsletters, alerts, and Webinars, the WaterISAC delivers physical and cyber threat information; guidance on risk management, mitigation and resilience; contaminant databases; and other information. Members include hundreds of utilities serving more than 200 million people in the United States, as well as Federal, State, and local agencies and consulting firms.[142] The WaterISAC is supported by fees charged to its users.

- WaterISAC Pro-members receive a wide range of services, including a vast library of sensitive threat information, best practices, articles, exercise guides, vulnerability assessments, and other resources on security and emergency management; contaminant databases with information on health effects, treatment and lab methods; a bi-annual Water Sector threat analysis; urgent physical and cyber threat alerts; and free Webcasts on current water security and emergency response topics.
- BASIC members are granted access to a library of open-source information about security and emergency response and threat alerts.[143]

Water/Wastewater Agency Response Network (WARN)

WARN is an intrastate network of utilities helping utilities to respond to and recover from emergencies by sharing resources with each other. WARN enables participating agencies to maintain contact with one another for emergency purposes, providing expedited access to specialized resources, and facilitating training on resource exchange. WARNs are volunteer-based, utility-to-utility networks that prepare for disasters, and then help member utilities respond and recover more quickly by getting the specialized utility resources (e.g., equipment and personnel) whenever and wherever needed. AWWA hosts a WARN Webpage that provides contact information for WARN representatives around the Nation, as well as links to situational reports prepared by WARN during emergencies, such as Hurricane/Superstorm Sandy.[144] In 2014, there were a total of 50 WARNs in the United States and 2 WARNs in Canada.

Water Sector Associations

Water Sector associations play a vital role in the information-sharing aspects of resilience. Some of AWWA’s efforts in this have already been mentioned: the 2013 Roadmap and support of the WARN Website. A few further examples of association activities which seek to enhance sector resilience include:

- The Association of State Drinking Water Administrators (ASDWA) in 2014 released a report documenting a yearly shortfall of at least $230 million between the resources available in

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[142] National Council of ISACs, “Join Your Sector’s Information Sharing and Analysis Center,” 2015.

[143] WaterISAC, “About Water ISAC.”

[144] AWWA, “Water/Wastewater Agency Response Network.”

States (from all sources – both Federal and State) and those needed by States to administer minimum required programs.[145]

- The Association of Metropolitan Water Agencies (AMWA) has a program to assist publicly owned utilities to adapt to climate change. One example is its monthly Sustainability and Security Report.[146]
- The National Association of Clean Water Agencies (NACWA) is active in next generation Water Sector issues, such as the energy-water nexus, green infrastructure, watershed-based solutions, and water resources utility of the future.[147]
- The National Association of Water Companies (NAWC) has many programs supporting public and private investment in water infrastructure. Its State-by-State summary of water investments is a useful tool for both advocates as well as policy makers.[148]

IMPLEMENT RISK MANAGEMENT ACTIVITIES

As highlighted in the 2015 SSP sector partners develop and disseminate guides, tools, training, and exercises aimed at managing risk.[149] Several of these practices are organized below according to NIAC's definition of resilience: robustness in preparing for an event; resourcefulness through training, exercises, and drills; rapid recovery; and adaptability through incorporating lessons learned. Additional examples of resilience activities in the Water Sector can be found in Appendix I. Collaborative Tools and Practices.

Robustness in Preparing for an Event

- Published *Weather & Hydrologic Forecasting for Water Utility Incident Preparedness and Response* to provide hazardous weather and forecasting resources for utility awareness and preparedness
- Developed the interactive *Flood Resilience: A Basic Guide for Water and Wastewater Utilities* to help utilities know their flooding threat and identify practical mitigation options to protect critical assets
- Published *10 Basic Cybersecurity Measures to Reduce Exploitable Weaknesses and Attacks* (WaterISAC)
- Developing a method to coordinate cyber and physical risk-assessment tools to enhance management decision-making
- Updating the *All-Hazards Consequence Management Plan* to create a better understanding of current threats and vulnerabilities and strategies to reduce the impacts of an emergency event

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[145] ASDWA, "Press Release: Insufficient Resources for State Drinking Water Programs," 2014.

[146] AMWA, "Sustainability and Security Report," 2016.

[147] NACWA, "Issues: Utility of the Future," 2016.

[148] NAWC, *State Data Sheet 2013*, 2013.

[149] EPA, *2015 SSP,* 2016.

- Developed *Business Continuity Planning for Water Utilities: Guidance Document* (Water Research Foundation, AWWA, and EPA)
- Enhancing engagement with utilities during smaller emergencies and planned maintenance to assess emergency response plans
- Harnessing existing tools and guidance to develop an overarching tool/resource that defines key actions and procedures to help utilities enhance their preparedness and resilience
- Developing incentives—through grants, insurance, standards, and certification—to increase investment in Water Sector infrastructure
- Periodically assessing available resources, identifying current needs and gaps, and improving existing resources or develop new ones

Resourcefulness through Training, Exercises, and Drills

- Conducted training workshops in EPA Regions 2 and 5 to educate drinking water utilities on the design and implementation of contamination warning systems, such as those implemented under the Water Security Initiative
- Developed *How to Develop a Multi-Year Training and Exercise Plan* to assist utilities in creating multiyear plans that can lead to increased emergency preparedness
- Developed the "Don't Get Soaked" video for utility managers, board members, and elected/appointed officials to help them understand the benefits of investing in preparedness, prevention, and mitigation activities
- Conducting State and local exercises, tabletop exercises, and workshops that improve understanding of Water Sector interdependencies, sector criticality, and impacts of loss of service during a disaster
- Developing and implementing an education and awareness campaign that helps utilities to communicate the importance of the Water Sector in emergency planning and to describe the costs and benefits of risk-reduction investments to States and public commissions using sector risk assessment and consequence analysis tools
- Developing and implementing public messaging to gain consumer support in addition to Federal, State, and local support for pre-disaster risk-reduction and resilience activities

Rapid Recovery

- Developed "Federal Funding for Utilities – Water/Wastewater – in National Disasters" (Fed FUNDS) tool to provide tailored information to utilities about applicable Federal disaster funding programs
- Published a report documenting the findings from an EPA evaluation of commercially available water quality event detection systems
- Determining the applicability of FEMA assistance criteria to address Water Sector needs and ensure the criteria are clear and well understood

- Integrating Water Sector considerations into all-hazards preparedness and response tools designed to support wide-area urban contamination incident response
- Developed the "How Can Water Utilities Obtain Critical Assets to Support Decontamination Activities" fact sheet
- Integrating Water Sector considerations into emergency response planning to ease access and credentialing issues for water utility personnel during an event

Adaptability through Incorporating Lessons Learned

- Performing after-action analyses after large events that highlight economic implications for the Water Sector
- Demonstrating the capabilities of existing tools and developing case studies to communicate their success
- Leveraging tools and best practices from interdependent sectors to understand their potential application to the Water Sector
- Developing Federal incentives for State drinking water programs and emergency management programs to support hazard mitigation investments
- Developing a tool consistent with the AWWA J100-10 standard to help utilities update all-hazards risk assessments, and then leverage them to update emergency response and risk-management plans; perform after-action analyses; and incorporate lessons learned following an event
- Examining climate change adaptation strategies to identify "no regret" measures that offer multiple types of benefits

APPENDIX H.
THE FLINT WATER CRISIS

Flint, Michigan—a city of about 99,000 people—lost access to safe, reliable drinking water due to a confluence of factors—"government failure, intransigence, unpreparedness, delay, inaction, and environmental injustice," according to the Flint Water Advisory Task Force Final Report.[150] The Flint water crisis underscores the importance of water to daily life, the impact on people who are unable to access safe drinking water, and the long-lasting consequences such contamination can have on residents, particularly children and other vulnerable members of the community.

For this study, the NIAC was tasked with assessing the security and resilience of water infrastructure, uncovering key resilience issues with that infrastructure, and identifying potential opportunities to address issues. The Flint water crisis demonstrates the underlying vulnerability of systems that are not properly maintained and managed.

Additional information is likely to emerge as the causes and consequences of the crisis are investigated. As of May 2016, there are multiple ongoing investigations including congressional hearings, the U.S. Environmental Protection Agency's (EPA) Flint Safe Drinking Water Task Force, and a multiagency investigation through the U.S. Attorney's Office with the Federal Bureau of Investigation. In May, the Michigan State Attorney General charged two State regulators and a city employee in connection with the incident.[151]

> "The bad news is that this should not have happened in the first place. And even though the scope of the response looks sort of like the efforts we're used to seeing after a natural disaster, that's not what this was. This was a manmade disaster. This was avoidable. This was preventable."
>
> *President Barack Obama, May 4, 2016, Flint, Michigan*

This appendix provides a brief overview of the facts of the incident, as they are known today; underlying deficiencies that contribute to infrastructure failures; and how the NIAC's recommendations, if implemented, could help prevent future situations like that in Flint.

I. INCIDENT OVERVIEW

The Flint crisis started in April 2014 when the city switched its water source from Lake Huron (treated by Detroit Water and Sewerage Department) to the Flint River (treated by the Flint Water Treatment Plant). The Michigan governor and President of the United States declared states of emergency to free up State and Federal resources to help in response.[152] Cases of bottled water and filters were distributed to residents and lawmakers have called for additional Federal funding to be provided to aid Flint and other cities with similar situations to replace the lead pipes and provide resources to support the people affected by lead contamination.

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[150] Flint Advisory Task Force, *Final Report*, 2016.

[151] Householder and White, "3 Officials charged in Flint water crisis; more predicted," 2016.

[152] The White House, "President Obama Signs Michigan Emergency Declaration," 2016.

The Flint water crisis arose from contamination of the drinking water serving Flint, Michigan, when the water source was switched from Lake Huron water to more corrosive the Flint River water. [153] Required corrosion control treatment was never put in place when the switch was implemented, causing the untreated water to corrode the lead feeder pipes that connect homes to the underground water main, causing lead to leach into the drinking water.[154] After the contamination was brought to light, Flint re-connected to the Detroit Water and Sewerage Department in October 2015.

II. UNDERLYING DEFICIENCES

Although a rare incident, the features of the Flint water crisis are not unique. Underlying deficiencies such as planning and investment constraints, poor management, and insufficient government coordination and collaboration led to resilience failures. In the process, public confidence in the water supply erodes and public health and the environment is damaged. The underlying deficiencies revealed in the Flint water crisis are present throughout this report on Water Sector resilience. The information below describes these themes in relation to the Flint water crisis.

CONDITION OF INFRASTRUCTURE

America's water infrastructure is aging and is in dire need of reinvestment. Aging infrastructure is one of the main contributors to lead in the water supply.[155] In 1986, Congress banned new lead pipes—"use of any pipe, any pipe or plumbing fitting or fixture, any solder, or any flux, after June 1986, in the installation or repair of (i) any public water system; or (ii) any plumbing in a residential or nonresidential facility providing water for human consumption, that is not lead free."[156] However, some U.S. water distribution systems still contain lead pipes and fixtures (typically, those built before the 1980s) and some major cities still have 100 percent lead piping bring water from the water utility to the homes and businesses.[157] American Water Works Association (AWWA) estimates there are about 6.5 million lead service lines in the United States, while EPA estimates the number is closer to 10 million.[158] Comprehensive reinvestment in public drinking water and wastewater systems—not just for lead pipe replacement—is necessary for safe, clean, and resilience water services.

PLANNING AND INVESTMENT CONSTRAINTS

Declining populations and increased conservation of water can lead to a decline in revenue sources. The water system in Flint was built for a city of 200,000 people; however, today's population is half of that. As populations decline, the remaining people must share the full cost for water services and investment, while municipalities must make ends meet with a smaller tax base.[159] Infrastructure

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[153] Adams, "Closing the valve on history: Flint cuts water flow from Detroit after nearly 50 years," 2014.

[154] Edwards, "Test Update: Flint River water 19X more corrosive," 2015; and Office of the Auditor General, *Questions and Answers to Senator Ananich*, 2015.

[155] EPA, "Basic Information about Lead in Drinking Water."

[156] EPA, "Section 1417 of the Safe Drinking Water Act," 2015.

[157] EPA, "Basic Information about Lead in Drinking Water."

[158] Householder and White, "3 Officials charged in Flint water crisis; more predicted," 2016.

[159] Semeuls, "A Tale of Two Water Systems," 2016.

cannot be easily downsized to meet the needs of a smaller population and acceptable level of services cannot be reduced to counteract the population decline.[160]

The residents of Flint also have some of the highest water rates in the nation, averaging $76 per month. Michigan law restricts city governments' ability to raise property and income taxes. As a result, the city government relied on its water and sewer revenues to counteract a reduced tax base and reductions in State funding.[161] As a result, the Flint residents were having to pay more to maintain operations, the funds that would have been available for infrastructure improvements were being diverted, and investment decisions were not being determined with long-term resilience in mind.

GOVERNMENT COORDINATION AND COLLABORATION

The Flint Water Advisory Task Force's Final Report highlights the government failures that precipitated and lengthened the water crisis:[162]

- The Michigan Department of Environmental Quality (MDEQ), which has primacy authority, failed to effectively enforce drinking water regulations, and dismissed efforts to bring issues of unsafe water, lead contamination, and increased cases of Legionnaires' disease to light.
- The Michigan Department of Health and Human Services (MDHHS) failed to adequately and promptly act to protect public health.
- With the City of Flint under State-appointed emergency management, the Flint Water Department rushed into full-time operation of the Flint Treatment Plant without applying corrosion control needed to use the Flint River.
- EPA delayed enforcement of the Safe Drinking Water Act (SDWA) and Lead and Copper Rule (LCR).
- The Governor's Office failed to reverse poor decisions made by MDEQ and emergency managers despite senior staff members raising concerns and suggesting intervention.

III. WATER RESILIENCE RECOMMENDATIONS APPLIED TO FLINT

The Flint water crisis reinforces the critical role that water plays in our lives and the devastating impact on communities when water services are compromised. This report makes several recommendations that if applied would improve resilience within the Water Sector, and help water and wastewater systems avoid situations like Flint.

The NIAC Resilience Framework encourages those who manage critical infrastructure create robust systems that can absorb the shock of an incident and continue to provide clean safe water;

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[160] Hoornbeek and Schwarz, "Sustainable Infrastructure in Shrinking Cities," 2009.
[161] Snider, "Flint's other water crisis: Money," Politico, March 7, 2016,
[162] Flint Advisory Task Force, *Final Report*, 2016.

resourceful in managing an incident to continue to provide services; quickly restore compromised service and return to normal; and adapt to a changing environment and risks.

The NIAC's recommendations call on the Federal Government, its public and private sector partners, and water utilities to:

- **Analyze and map complex risks**. The NIAC recommends that the Federal Government work with the Water Sector to identify tools, guidance, and mitigation measures and increase distribution across the sector. By clearly understanding risks, and having access to tools, models, checklists, and other resources, decision-makers could have a better understanding of the impacts and consequences of actions, such as switching water sources.
- **Fortify response and recovery.** This recommendation calls on the Federal Government to formalize and improve response and recovery capabilities at all levels of the Water Sector. Flint was a manmade disaster, but the response is similar to what happens following a natural disaster (e.g., emergency declaration, Federal funding assistance). But in Flint, once the problem was identified, the response was delayed. Creating a more formal response and recovery process, including reinforcing effective mutual aid models such as WARN, can provide water utilities and communities with the skills, information, and resources they need to quickly respond following an incident (whether it's a natural or manmade disaster).
- **Increase Federal funding, investment, and incentives to improve water infrastructure resilience**. Water utilities must often balance day-to-day operations with long-term infrastructure investments. For Flint, and communities in similar situations, access to innovative financing options can help utilities make these needed investments. The NIAC also recommends the creation of a Federal financial assistance program to reduce the burden on low-income communities from water rate increases.
- **Increase technical and financial resources available to the Water Sector.** If utilities have access to technical resources, such as local universities, workforce training, tools and life-cycle assessment models, they will have the capabilities to prepare and respond to existing and emerging risks, and to improve resilience.
- **Strengthen Federal leadership coordination, and support.** As illustrated in Flint, there were failures of government at the Federal, State, and local level that have a role in oversight of water services. Better coordination and communication across all levels of government is crucial for maintaining safe and effective water services. This coordination starts at the Federal level.

APPENDIX I.
COLLABORATIVE TOOLS AND PRACTICES

Enhanced collaboration between Water Sector partners has accelerated progress in attaining secure and resilient drinking water and wastewater infrastructure. The success stories summarized below represent the benefits of greater collaboration from improved sharing of resources; expanded use of new tools, knowledge, and training; and the improved characterization of emerging threats such as cyber intrusions and extreme-weather events.

I. SHARING RESOURCES

The **Emergency Management Assistance Compact (EMAC)** is an interstate mutual aid agreement that facilitates the sharing of assistance among States during emergency events, including natural and manmade disasters. Ratified by the U.S. Congress in 1996, EMAC is the most widely adopted mutual aid arrangement in the United States; it has been adopted by all 50 States, the District of Columbia, Puerto Rico, Guam, and the U.S. Virgin Islands. It provides a structured approach through which a State can request aid—including personnel, services, equipment, and supplies—from other States during an emergency. EMAC establishes responsibility for reimbursement between States, and also addresses liability, compensation, and licensing issues for personnel deployed pursuant to an EMAC request.[163]

The **Water and Wastewater Agency Response Network (WARN)** is a network of utilities helping other utilities to respond to and recover from emergencies. Through this network, water/wastewater utilities that have sustained damages from natural or manmade events can obtain emergency assistance from other water/wastewater utilities. Assistance includes personnel, equipment, materials, and other associated services as necessary. Formalizing the existing capability to provide mutual aid and assistance provides the sector with a degree of resilience against natural or manmade disasters to ensure continuity of service to customers.[164]

To expedite communication of Water Sector resource needs during an incident, the American Water Works Association (AWWA) developed the **Water & Wastewater Mutual Aid & Assistance Resource Typing Manual**, which uses EMAC for interstate mutual aid deployments. This manual was developed with extensive input from water utility owners/operators and is based on the team/mission approach to incident response for intra- and interstate mutual aid and assistance.[165]

The **Virginia Pooled Financing Program**, established in 2003, provides financing to local governments for essential products. Pooled loan programs are a cost-effective mechanism for borrowers to participate in a larger transaction to access capital markets. Since the program's inception, more than 100 local governments in Virginia have utilized the program to finance/re-finance over $2 billion in infrastructure projects, including water projects.[166]

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[163] EMAC, "Homepage."
[164] AWWA, "WARN."
[165] AWWA, *Water & Wastewater Mutual Aid & Assistance Resource Typing Manual*, 2008.
[166] Virginia Resources Authority, "Virginia Pooled Financing Program."

II. ACCESSING TOOLS, KNOWLEDGE, AND TRAINING

The ***AWWA G430-14: Security Practices for Operations and Management*** guide can help utilities to develop a protective security program that promotes the protection of employee safety, public health, public safety, and public confidence. The guide defines standard, minimum requirements for a protective security program and builds on the long-standing practice among utilities of utilizing a multiple barrier approach for the protection of public health and safety. The requirements outlined in the standard are designed to support a protective utility-specific security program that results in consistent and measurable outcomes to address the full spectrum of risk management from organizational commitment, physical and cybersecurity, and emergency preparedness. The standard received SAFETY Act designation from the U.S. Department of Homeland Security (DHS).[167]

The ***AWWA G440-11 Emergency Preparedness Practices*** guide is one of several in a Utility Management series designed to cover the principal activities of a typical water and/or wastewater utility. It defines the minimum requirements for emergency preparedness for a water or wastewater utility and expands upon the requirements outlined in the AWWA G430 guides. Minimum practices include the development of an emergency response plan (hazard evaluation, hazard mitigation, response planning, and mutual aid agreements), the evaluation of the emergency response plan through exercises, and the revision of the emergency response plan after exercises.[168]

The ***Business Continuity Plans for Water Utilities: Guidance Document*** guide provides sector-specific guidance—jointly developed by the Water Environment Research Foundation (WERF), AWWA, and the U.S. Environmental Protection Agency (EPA) on behalf of the Water Sector Coordinating Council (Water SCC)—for utilities to develop a business continuity plan, including a Disaster Response Plan.[169]

The ***CIPAC Water Sector Cybersecurity Strategy Workgroup: Final Report and Recommendations*** recommends training and outreach approaches to promote the use of the *NIST Framework for Improving Critical Infrastructure Cybersecurity*;[170] identifies gaps in available guidance, tools, and resources for addressing this framework; and identifies measures of success that can be used to indicate the extent to which the framework is being used by the Water Sector. It also provides recommendations to achieve each of these areas.[171]

A number of agencies and organizations have developed stormwater and **Green Infrastructure Calculating Tools** to assist design professionals in stormwater management and green infrastructure planning, costing, and comparison of various best management practices. A compiled list of calculators currently available from EPA, Center for Neighborhood Technologies, Sustainable

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[167] AWWA, *AWWA G430-14: Security Practices for Operations and Management*, 2015.

[168] AWWA, *AWWA G440-11 Emergency Preparedness Practices*, 2011.

[169] WERF, EPA, and AWWA, *Business Continuity Planning for Water Utilities*, 2013.

[170] NIST, *Framework for Improving Critical Infrastructure Cybersecurity*, 2014.

[171] CIPAC Water Sector Cybersecurity Strategy Workgroup, *Final Report and Recommendations*, 2015.

Technologies Evaluation Program, WERF, and State and municipal governments is available online from a manufacturer of interlocking concrete paver materials.[172]

Information Sharing and Analysis Centers (ISACs) help critical infrastructure owners and operators protect their facilities, personnel, and customers from cyber and physical security threats and other hazards. ISACs reach deep into their sectors, communicating critical information far and wide and maintaining sector-wide situational awareness. ISACs collect, analyze, and disseminate actionable threat information to their members and provide members with tools to mitigate risks and enhance resilience.[173] **WaterISAC**, a nonprofit organization established in 2001, is the information sharing and operational arm for water and wastewater utilities. The organization helps members strengthen their cyber and physical security, recover from natural and manmade disasters and improve overall preparedness and resilience. Through a secure Webportal, twice-weekly e-newsletters, alerts and Webinars, WaterISAC delivers a rich and thorough physical and cyber threat information; guidance on risk management, mitigation, and resilience; and contaminant databases. Members include hundreds of utilities serving more than 200 million people in the United States, as well as Federal, State, and local agencies and consulting firms.[174]

The **Water Environmental Research Foundation (WERF)**, an independent scientific research organization dedicated to wastewater and stormwater issues, provides tools and knowledge to water managers and urban planners.[175] One example is the **Integrated Urban Water Model (IUWM)**, a mass balance model that provides a tool for water managers to forecast water demand, waste, and associated costs for various water management scenarios. In addition, WERF developed an information brief, **Tools for Evaluating the Benefits of Green Infrastructure for Urban Water Management**, which provides overviews for two analysis methods gaining popularity in the urban planning field—life-cycle cost analysis and triple bottom line—as they apply to stormwater and urban water management.[176]

New York City's Green Infrastructure Program is a multiagency effort led by the Department of Environmental Protection (DEP) to design, construct and maintain a variety of sustainable green infrastructure practices for city-owned property (e.g., streets, sidewalks, schools, and public housing). The program promotes practices that mimic the natural flow of water to manage stormwater runoff from streets, sidewalks, parking lots and rooftops to engineered systems that typically feature soils, stones, and vegetation. This process prevents stormwater runoff from entering the city's sewer systems. DEP is also building green infrastructure in compliance with the New York Department of Environmental Conservation requirements to reduce combined sewer overflow discharges into the city's water bodies through the use of a separate storm sewer system.

The Green Infrastructure Toolkit, designed by the New York City DEP, educates homeowners, community gardeners, and others interested in stormwater management techniques to minimize the effects of rainfall on water bodies in cities with combined sewers and other places that

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[172] Uni-Group USA, "Green and Stormwater Calculators."

[173] National Council of ISACs, "About ISACs."

[174] WaterISAC, "About Water ISAC."

[175] Sharvelle, *Development of the Integrated Urban Water Management Too*l, 2012; and Weinstein, T*ools for Evaluating the Benefits of Green Infrastructure for Urban Water Management*, 2012.

[176] Weinstein, *Tools for Evaluating the Benefits of Green Infrastructure for Urban Water Management,* 2012.

experience flooding and storm water problems. The photographs, detail drawings, material lists, and text provide a starting point for those interested in utilizing these practices in their homes, gardens and communities. The toolkit also includes a printable version of green infrastructure techniques.[177]

Developed by the CIPAC Water Sector Strategic Priorities Working Group, the ***2013 Roadmap to a Secure & Resilient Water Sector*** establishes a strategic framework that articulates the priorities of industry and government in the Water Sector to manage and reduce risk, and also produces an actionable path forward for the Water Sector Government Coordinating Council, Water Sector Coordinating Council, and government and private sector security partners in the sector to improve the sector's security and resilience within the next five years. The roadmap establishes three top priority activities for the Water Sector: 1) Advance the development of sector-specific cybersecurity resources; 2) Raise awareness of the Water Sector as a lifeline sector and recognize the priority status of its needs and capabilities; and 3) Support the development and employment of tools, training, and other assistance to enhance preparedness and resilience.[178]

M19 Emergency Planning for Water Utilities, Fourth Edition, developed by AWWA, provides guidelines and procedures that can be used by utilities of any size to develop an emergency preparedness plan, identify vulnerabilities in the water system, and determine how a disruption would likely impact service. Originally issued in 1973 and updated most recently in 2001, revisions of the manual are in progress to reflect current the state of knowledge regarding emergency preparedness and the AWWA G440 guides.[179]

The **Water and Wastewater Treatment Technologies Appropriate for Reuse (WAWTTAR)**, a predictive program developed by Humboldt University, enables planners to select suitable water and wastewater treatment options appropriate to the material and manpower resources available to particular communities throughout the world. The localized performance and cost of a large number of possible systems can be estimated with WAWTTAR for any location and condition for which basic information on the problem to be solved is available. While the initial target audience was outside the United States, WAWTTAR has found considerable utility by engineers involved in small community project planning in the United States.[180]

The National Association of Clean Water Agencies (NACWA), the WERF, and the Water Environment Federation (WEF) collaborated on ***The Water Resources Utility of the Future: A Blueprint for Action***. This report captures a fundamental shift in the way clean water utilities in the United States define their role in society (i.e., from managers of waste to managers of valuable resources). The blueprint provides examples of initiatives in energy and materials recovery and reuse, water reuse, and green infrastructure, and a new openness on the part of clean water utilities to partner with developers of technology, design engineers, and the public and private finance community.[181]

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[177] NYC DEP, "NYC Green Infrastructure Program;" and Grow NYC, "Green Infrastructure Toolkit."

[178] CIPAC Water Sector Strategic Priorities Working Group, *Roadmap to a Secure and Resilient Water Sector*, 2013.

[179] AWWA, *M19 Emergency Planning for Water Utilities, Fourth Edition*, 2001.

[180] WAWTTAR, "Homepage."

[181] NACWA, et al, *Water Resources Utility of the Future: A Blueprint for Action*, 2013.

The **WaterLex Toolkit**'s budgeting tool assists development partners to develop a budget for their program to ensure that water and sanitation services are supplied in a financially sustainable manner. The tool focuses on assessing financial capabilities, developing a financing plan, and making decisions about capital and recurring expenditures.[182]

III. CHARACTERIZING EMERGING THREATS

The ***AWWA J100-10 (R13) Risk and Resilience Management of Water and Wastewater Systems (RAMCAP)*** guide documents a process for identifying and communicating security vulnerabilities and provides methods to evaluate the options for improving these weaknesses. It includes methodology to identify, analyze, quantify, and communicate the risks of specific terrorist attacks and natural hazards against critical water and wastewater systems. In addition, it establishes requirements for the risk and resilience assessment and management process that inform decisions on where to allocate resources to reduce risk and enhance resilience through countermeasures and mitigation strategies. This standard received SAFETY Act designation from DHS.[183]

The U.S. Water Alliance's **One Water Management** program supports and enhances a more holistic approach to water management. The approach—in both policy and practice—is expanding across the sector because it is recognized as necessary to support sustained sector-wide resilience. Examining water management in an integrated way across water sources and water uses is key to a sustainable and resilient water future. As such, the Alliance is building a network of leaders representing research foundations, national trade associations, Federal agencies, companies, and nongovernmental organizations to unite for integrated water management. The Alliance's One Water Management vision is closely aligned with and builds upon the extensive national and global work on Integrated Water Resources Management (IWRM).[184]

EPA National Homeland Security Research Center and AWWA prepared the ***Planning for an Emergency Drinking Water Supply*** report to respond to the 2002 Bioterrorism Act that directed EPA to conduct "a review of the methods and means by which alternative supplies of drinking water could be provided in the event of destruction, impairment or contamination of public water systems" (42 U.S.C. 300i-4 (b)." This report details options and plans to provide drinking water in situations where public water systems are compromised.[185]

Produced by AWWA, ***Process Control System Security Guidance for the Water Sector*** provides a consistent and repeatable course of action to reduce vulnerabilities in process control systems and identifies specific recommended cybersecurity practices for the sector.[186] It builds and expands upon the *2008 Roadmap to Secure Control Systems in the Water Sector*, developed by the Water Sector Coordinating Council Cyber Security Working Group with AWWA sponsorship.[187]

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[182] WaterLex, "Budgeting Tool: Budgeting sustainable water and sanitation services."

[183] AWWA, *AWWA J100-10 (R13) Risk and Resilience Management of Water and Wastewater Systems*, 2010.

[184] U.S. Water Alliance, "One Water Hub."

[185] EPA, *Planning for an Emergency Drinking Water Supply*, 2011.

[186] AWWA, *Process Control System Security Guidance for the Water Sector*, 2014.

[187] Water SCC Cybersecurity Working Group, *Roadmap to Secure Control Systems in the Water Sector*, 2008.

After-Action Reports (AARs) issued following a variety of disasters and emergencies share successes and areas for improvement. The ***WARN Superstorm Sandy After-Action Report*** is based on information shared by impacted utilities, State and Federal partners, and WARNs in the impacted States. High priorities for improvement in the sector, identified by this AAR, include intrastate mutual aid and assistance, interstate mutual aid and assistance, the need to elevate the priority status of water infrastructure, the energy and water nexus in disasters, site access, coordination, situational awareness, and communications.[188]

EPA has drawn upon the WARN AAR as well as other post-Sandy studies to improve its response to major events impacting the Water Sector. Other important AARs include:

- New York City, *Hurricane Sandy After Action* (May 2013)[189]
- DHS, *Lessons Learned: Social Media and Hurricane Sandy* (June 2013)[190]
- FEMA, *Hurricane Sandy FEMA After-Action Report* (July 1, 2013)[191]
- NERC, *Hurricane Sandy Event Analysis Report* (January 2014)[192]

AMWA and NACWA hosted a **Water Resilience Summit** in April 2014, convening key Federal and municipal agency leaders to outline the collaborative actions to address climate change and enhance resilience. The summit focused on how to ensure the Water Sector becomes more resilient, while allocating resources and mitigating some of the enormous costs more effectively than in previous post-disaster recovery and relief efforts. Participants of the summit identified opportunities for Federal agencies, States and utilities to influence progress on resilience through planning, funding, and financing; permitting and regulatory flexibility; public education and community outreach; and partnerships and coordination at all levels of government.[193]

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[188] AWWA, *WARN Superstorm Sandy After-Action Report,* 2013.
[189] NYC. *Hurricane Sandy After Action*, 2013.
[190] DHS S&T, *Lessons Learned: Social Media and Hurricane Sandy*, 2013.
[191] FEMA, *Hurricane Sandy FEMA After-Action Report*, 2013.
[192] NERC, *Hurricane Sandy Event Analysis Report*, 2014.
[193] AMWA and NACWA, *Water Resilience Summit*, 2014.

APPENDIX J.

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APPENDIX K.
ACRONYMS

Acronym	Definition
AAR	After Action Report
ASDWA	Association of State Drinking Water Administrators
AER	Atmospheric and Environmental Research
AMWA	Association of Metropolitan Water Agencies
ANSI	American National Standards Institute
ARPA	Advanced Research Projects Agency
ASCE	American Society of Civil Engineers
ASDWA	Association of State Drinking Water Administrators
ASIWPCA	Association of State and Interstate Water Pollution Control Administrators
ASWM	Association of State Wetland Managers
AWWA	American Water Works Association
BLM	Bureau of Land Management
BNR	Biological Nutrient Reduction
CBR	Chemical, Biological, or Radiological
CBWR	Community-Based Water Resiliency
CEO	Chief Executive Officer
CDC	Centers for Disease Control and Prevention
CI	Critical Infrastructure
CIFA	Council of Infrastructure Financing Authorities
CIKR	Critical Infrastructure and Key Resources
CIPAC	Critical Infrastructure Partnership Advisory Council
CISR	Critical Infrastructure Security and Resilience
COBIT	Control Objectives for Information and Related Technology
CRS	Congressional Research Service
CSO	Combined Sewer Overflows
CWA	Clean Water Act
CWS	Commercial Water System
CWSRF	Clean Water State Revolving Fund
DEED	Minnesota Department of Employment and Economic Development
DEP	Department of Environmental Protection
DHS	U.S. Department of Homeland Security
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of Interior
DOT	U.S. Department of Transportation

Acronym	Definition
EIS	Environmental Impact Statements
EMAC	Emergency Management Assistance Compact
EO	Executive Order
EOC	Emergency Operations Center
EPA	U.S. Environmental Protection Agency
ERP	Emergency Response Plan
ESF	Emergency Support Function
EWSP	Emergency Water Supply Plan
FAST	Fixing America's Surface Transportation
FBI	Federal Bureau of Investigation
FCC	Federal Communications Commission
Fed FUNDS	Federal Funding for Utilities for Water/Wastewater in National Disasters
FEMA	Federal Emergency Management Agency
FFRMS	Federal Flood Risk Management Standard
FY	Fiscal Year
GCC	Government Coordinating Council
GDP	Gross Domestic Product
HEC	Hydrologic Engineering Center
HHS	U.S. Department of Health and Human Services
HMGP	Hazard Mitigation Grant Program
HSPD	Homeland Security Presidential Directive
HUD	U.S. Department of Housing and Urban Development
IDT	Infrastructure Data Taxonomy
IP	Office of Infrastructure Protection
ISAC	Information Sharing and Analysis Center
IT	Information Technology
ITIL	IT Infrastructure Library
IUWM	Integrated Urban Water Model
IWRM	Integrated Water Resources Management
LADWP	Los Angeles Department of Water and Power
LIHEAP	Lower Income Home Energy Assistance Program
MCHM	Methylcyclohexane methanol
MDEQ	Michigan Department of Environmental Quality
MDHHS	Michigan Department of Health and Human Services
Mn/DOT	Minnesota Department of Transportation
MWD	Metropolitan Water District of Southern California
NACWA	National Association of Clean Water Agencies
NAWC	National Association of Water Companies
NDRF	National Disaster Recovery Framework

Acronym	Definition
NEHRP	National Earthquake Hazards Reduction Program
NERC	North American Electric Reliability Corporation
NIAC	National Infrastructure Advisory Council
NIMS	National Incident Management System
NIPP	National Infrastructure Protection Plan
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Association
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRF	National Response Framework
NRWA	National Rural Water Association
NSC	National Security Council
NTSB	National Transportation Safety Board
NWP	National Water Program
OCIA	Office of Cyber and Infrastructure Analysis
OCS	Office of Community Services
ODNI	Office of the Director of National Intelligence
OGWDW	Office of Ground Water and Drinking Water
OHS	Office of Homeland Security
OLEM	Office of Land and Emergency Management
OMB	Office of Management and Budget
OP	Office of Policy
OST	Office of Science and Technology
OSWER	Office of Solid Waste and Emergency Response
OW	Office of Water
OWM	Office of Wastewater Management
PDM	Pre-Disaster Mitigation
POTW	Publicly Owned Treatment Work
PPD	Presidential Policy Directive
PPH	Propylene glycol phenyl ether
PWS	Public Water System
R&D	Research and Development
RAMCAP	Risk and Resilience Management of Water and Wastewater Systems
RIPP	Regional Infrastructure Protection Plans
RPS	Renewable Portfolio Standard
RRAP	Regional Resiliency Assessment Program
SCADA	Supervisory Control and Data Acquisition
SCC	Sector Coordinating Council
SDWA	Safe Drinking Water Act

Acronym	Definition
SEP	State Energy Program
SFPUC	San Francisco Public Utilities Commission
SLTT	State, Local, Tribal, and Territorial
SMART	Sustain and Manage American Resources for Tomorrow
SRF	State Revolving Fund
SSA	Sector-Specific Agency
SSP	Sector-Specific Plan
TMDL	Total Maximum Daily Load
UOTF	Utility of the Future
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
VRA	Virginia Pooled Finance
VSAT	Vulnerability Self-Assessment Tool
WARN	Water/Wastewater Agency Response Network
WAWTTAR	Water and Wastewater Treatment Technologies Appropriate for Reuse
WEF	Water Environment Federation
WERF	Water Environment Research Foundation
WHEAT	Water Health and Economic Analysis Tool
WIFIA	Water Infrastructure Finance and Innovation Act
WIN	Water Infrastructure Network
WRF	Water Research Foundation
WRRDA	Water Resources Reform and Development Act
Water SCC	Water Sector Coordinating Council
WSD	Water Security Division

Brian Allee

From: Lazenby, Bruce <bruce.lazenby@rosehills.com>
Sent: Tuesday, February 26, 2019 7:45 AM
To: Lanza, Jodie
Cc: Nordschow, Jeff
Subject: NOP input

Rose Hills considers recycled water an important local and sustainable resource and we support maximizing its beneficial use. Rose Hills is currently irrigating over 700 acres of cemetery lawn and landscape using recycled water. Recycled water is the appropriate resource and by committing to its' use Rose Hills conserves over 400,000,000 gallons of potable water each year. Over one million people visit Rose Hills each year. The healthy and well-manicured landscape has become an expectation. Our green lawns, thriving trees and landscape features provide comfort and respite for our families.
Rose Hills is supportive of the project objectives, increasing the use of recycled water at the same time sustaining the sensitive habits supported by treated effluent discharges .

Bruce A. Lazenby
Executive Director Business Development
562-463-4501 office
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ba.lazenby@rosehills.com

From: Tom Williams <ctwilliams2012@yahoo.com>
Sent: Tuesday, February 26, 2019 12:13 PM
To: Lanza, Jodie
Cc: Joan Licari; Charming Evelyn; Ywatson dslextreme.com; James Flournoy
Subject: Re: Thanks for scoping slides / Request for extension on Scoping Comments Deadline from San Districts

TO: Jodie Lanza jlanza@lacsd.org 562-908-4288 ext. 2707
Sanitation Districts of Los Angeles County 1955 Workman Mill Road Whittier, CA 90601

SBJT: San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse
RE: Comments on IS/Scoping and Requests for EIR

Thanks for the presentation and posting of slides.
As indicated in the Slides for the Presentation, "Please submit comments by March 9", as 0309 is a Saturday and the Initial Study and Presentation is complicated by "No Physical Project" **we request an extension to Monday 5pm March 11, 2019**

For the IS, Absence of discussion and backup for no impacts for 7.a.ii & .iii is a serious issue for pipe/flow systems and changing of flow volumes can be a significant change is risks and threat to project operations and dependent users.

Based on "statement" that 02/20/19 presentation materials would be placed on line for all to use in Scoping Comments, but with out further notices to attendees..
BUT it was posted before 1:13pm 02/25
at: https://www.lacsd.org/civicax/filebank/blobdload.aspx?blobid=15337

TW Comments #1 RE: NOP/Presentation - Inadequate and Incomplete...REDO

A, Scoping is for important resources, potential impact, alternatives, and mitigation BUT not stated/provided examples.
B. A single Mention of selection of the preferred alternative was made...without reference to current alternatives and the purpose of the Scoping is to also establish mitigative alternatives.

What was the PURPOSEs of the Meeting/presentation

Other comments and requests...

1. Need a full quantitative water flow model/diagram for basin, including recharges/evaporations, Low Impact Development, and "reject/brine sources" and their outfall piping/outlets.
Who gets more water and when...to 2045 based on SCAG projects for population, households, and employment within and by the service areas

2. Districts LID programs - sizes, direct irrigation and piped reuses, construction activities reuse, and recharge uses.

3. Project Objectives are not quantified - Increase...Maximize More efficient Sustain habitats

4. Include alternatives of a) 50% of proposed, b) 200% of proposed, c) 100% proposed with Direct Potable Reuse, and …..
Alternative was mentioned once with regard to selection of preferred alternative....therefore as MND or EIR consider Alternatives

5. No discussion of Mitigtn., Montrng. AND Repting. Plan required of an EIR...Provide draft MMRP in DEIR

6. Who benefits currently and future...golf courses and who pays more....renters = Environmental Justice

7. More Water Supply = more supply receivers = Growth Inducements

More to Come

Tom

On Monday, February 25, 2019, 12:30:56 PM PST, Joan Licari <jlicari2013@gmail.com> wrote:
Tom,
It was a very short meeting. There were only about 5-6 there from the public. Joan Holtz, James Flournoy, and I were there plus Popoff from Montebello Hills and another gentleman representing Heal the Bay and Waterkeepers. The San District are posting the Powerpoint program that they read and showed on the San District website. I did not find it on the San District website yet.

Joan L.

EIR Public Scoping Meeting for the San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse

Meeting Notes

February 20, 2019

I. Presentation

Vidal Cortes presented at 6:00 PM on February 20, 2019 in the LACSD Board Room.

II. Public Comments

1. Arthur Pugsley

- Supports moving forward with the Environmental Impact Report (EIR).

- Stated that he has met with Districts' staff twice since the draft Mitigated Negative Declaration (MND) was released and felt those meetings were productive. He looks forward to continuing the dialogue.

- Supports increased water recycling.

- He liked and agreed with the project objectives, but suggests modifying the 3rd Project Objective to state:

    - Sustain <u>and, where feasible, enhance</u> sensitive habitat supported by historical treated effluent discharges to the San Gabriel River (SGR) watershed.

- Would like to see reductions implemented downstream first (LCWRP, LBWRP, and SJC001) since there is less impacts to habitat.

- Hydrology

    - No need for LA River type study for this project.

- Would like to see analysis of reduction in flows vs beneficial uses, namely REC uses.

- Stated SGR is listed as REC-1 and REC-2 and would like to see analysis of impacts to REC along the entire river not just the Whittier Narrows area.
- States that the Adaptive Management Plan (AMP) in the MND was reactive and would like the AMP to be proactive rather than reactive in this EIR.
- The AMP should also look at habitat restoration opportunities.
  - Would like to see analysis of impacts on ALL species, not just rare species – example; algal mats in concrete lined portions do provide a food source for birds.
- Cumulative impacts
  - Would like to see an accounting of all water sources in SGR basin, but recognizes it is complicated.
- Wants Districts to evaluate the feasibility of habitat restoration and mitigation on USACE property. He recognizes the federal ownership of the property makes this complicated, but cited a court decision that such a complication is not a valid reason for omitting the evaluation of an alternative on USACE property.

2. **Jim Flournoy (Save Our Community)**

- Wants Districts to rescind the 270 AFY allotted to the Central Basin. He believes the Central Basin is using this water to benefit a private developer.
- Would like to see the Districts establish a policy or criteria to ensure agencies that are provided with recycled water only supply "green" projects or projects that benefit the public.
- Would like to see more recycled water directed to the Upper San Gabriel Basin.
- Believes the spreading grounds are not being fully utilized and are not full year-round.
- Wants the Districts to take control over all the water districts and companies.
- Supports purple pipe projects

3. **Michael Popoff (Private Citizen)**

- Would like to see an “Environmental Justice” component implemented to determine who gets recycled water.
- Wetlands east of Rosemead Blvd were drained years ago with the promise to refill them when and if water was available. Would like to see this water used to refill the wetlands.
- Would like to see the Districts have a policy to control to who the water agencies give the water.
- He believes the Central Basin is using recycled water for their financial gain and to benefit a private developer.
    - Believes the Central Basin is taking recycled water from low income school sites and diverting it to a private developer.
    - Opposes the Montebello Hill Specific plan development. They should not be getting recycled water.
- Supports groundwater recharge and believes the spreading basins are being underutilized.
- Would like to see stormwater stored and reused as grey water.

III. Adjournment

- LACSD to post presentation on webpage.

List of Attendees

No.	Name	Affiliation	Address	Contact Info
1	Arthur Pugsley	LAW/HTB	120 Broadway Suite 105 Santa Monica, CA 90401	Arthur@lawaterkeeper.org
2	Jim Flournoy	Save Our Community	548 N Darlington San Gabriel, CA	flurnet@hotmail.com
3	Michael Popoff	Private Citizen		Madrussian90640@yahoo.com
4	Brittany Liu	WRD	4040 Paramount Blvd Lakewood, CA	bliu@wrd.org
5	Kristin McCarthy	LAW/HTB	120 Broadway Suite 105 Santa Monica, CA 90401	kekrejmas@gmail.com
6	Tom Coleman	Rowland WD	3021 Fullerton Rd Rowland Heights, CA	tcoleman@rowlandwater.com
7	Joan Licari	Sierra Club	16017 Villa Flores Hacienda Heights, CA	Licari2013@gmail.com
8	Joan Holtz	Sierra Club	11826 The Wye El Monte, CA	jholtzhln@aol.com
9	Don Holtz	Sierra Club	11826 The Wye El Monte, CA	jholtzhln@aol.com
10	David Jallo	LA Co Dept of Parks	823 Lexington Gallatin Road South El Monte, CA 91733	djallo@parks.lacounty.gov

Appendix B1

Updated Biological Resources Report, San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse, July 2019

Updated Biological Resources Report

San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse

Prepared for
Sanitation Districts of Los Angeles County

July 2019

Updated Biological Resources Report

San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse

Prepared for
Sanitation Districts of Los Angeles County

July 2019

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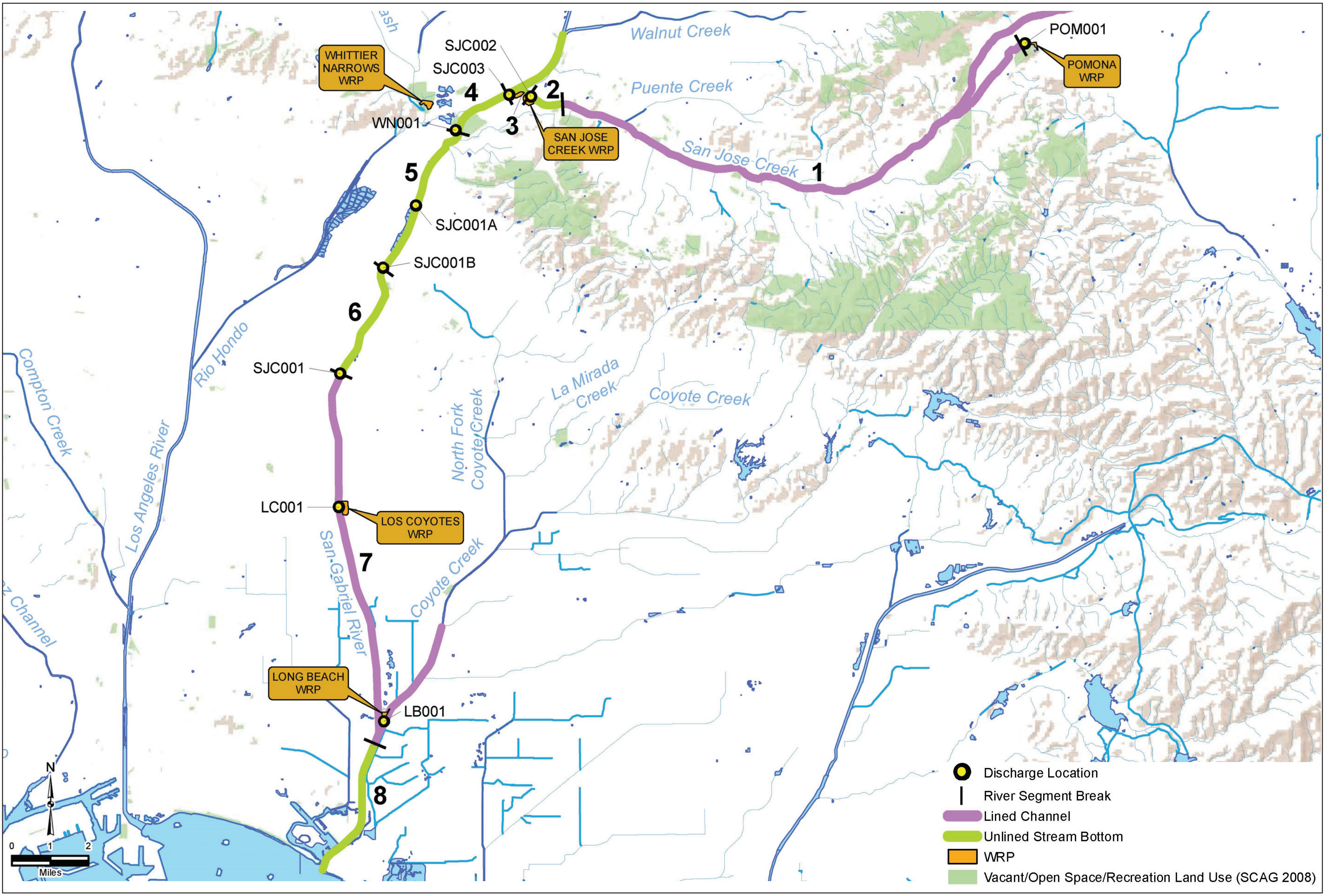
UPDATED BIOLOGICAL RESOURCES REPORT

San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse

1.0 Introduction

The Sanitation Districts of Los Angeles County (Sanitation Districts) serves the regional wastewater and solid waste management needs of Los Angeles County. The Sanitation Districts operate 10 water reclamation plants (WRPs) and the Joint Water Pollution Control Plant. Seventeen special districts that provide sewerage services in the metropolitan Los Angeles area are signatory to a Joint Outfall Agreement that provides for the regional, interconnected systems of facilities known as the Joint Outfall System (JOS). Under the Joint Outfall Agreement, Sanitation District No. 2 of the Los Angeles County (District) has been appointed managing authority over the JOS. Several of these WRPs discharge into rivers and creeks within the San Gabriel River watershed (**Figure 1**). A technical memorandum (ESA 2018a) was prepared that identified the biological resources within the river segments where several water reclamation plants currently discharge treated effluent. In 2018, ESA conducted reconnaissance-level surveys and vegetation mapping in the Whittier Narrows area and performed a review of available literature pertaining to the overall study area. The report provided an overview of the existing conditions and biological resources within the study area that included eight (8) segments, as shown on Figure 1.

The potential project effects of the treated effluent on various segments of the San Gabriel River and the San Jose Creek was assessed, in particular the connected areas located downstream from the effluent discharge points. In summary, Segment 1 is a concrete-lined portion of the San Jose Creek channel from the Pomona WRP to just upstream of the San Jose Creek WRP. Segments 2 through 6 are soft-bottomed, and Segment 7 is a concrete-lined portion of the San Gabriel River that discharges to the San Gabriel River Estuary, located approximately 20 miles downstream of the Whittier Narrows Dam. Segment 8 is a soft-bottomed segment of the San Gabriel River that is subject to tidal influence over a 3.75-mile length of the segment, from the ocean outlet up to the convergence with Segment 7. There is a “mixing zone” where Segments 7 and 8 converge immediately downstream southern end of Segment 7, where freshwater flows into, and mixes with, the estuarine waters in Segment 8. The study area is defined as Segments 1 through 8, as well as, the Whittier Narrows Recreation Area (WRNA) and the Zone 1 Ditch.



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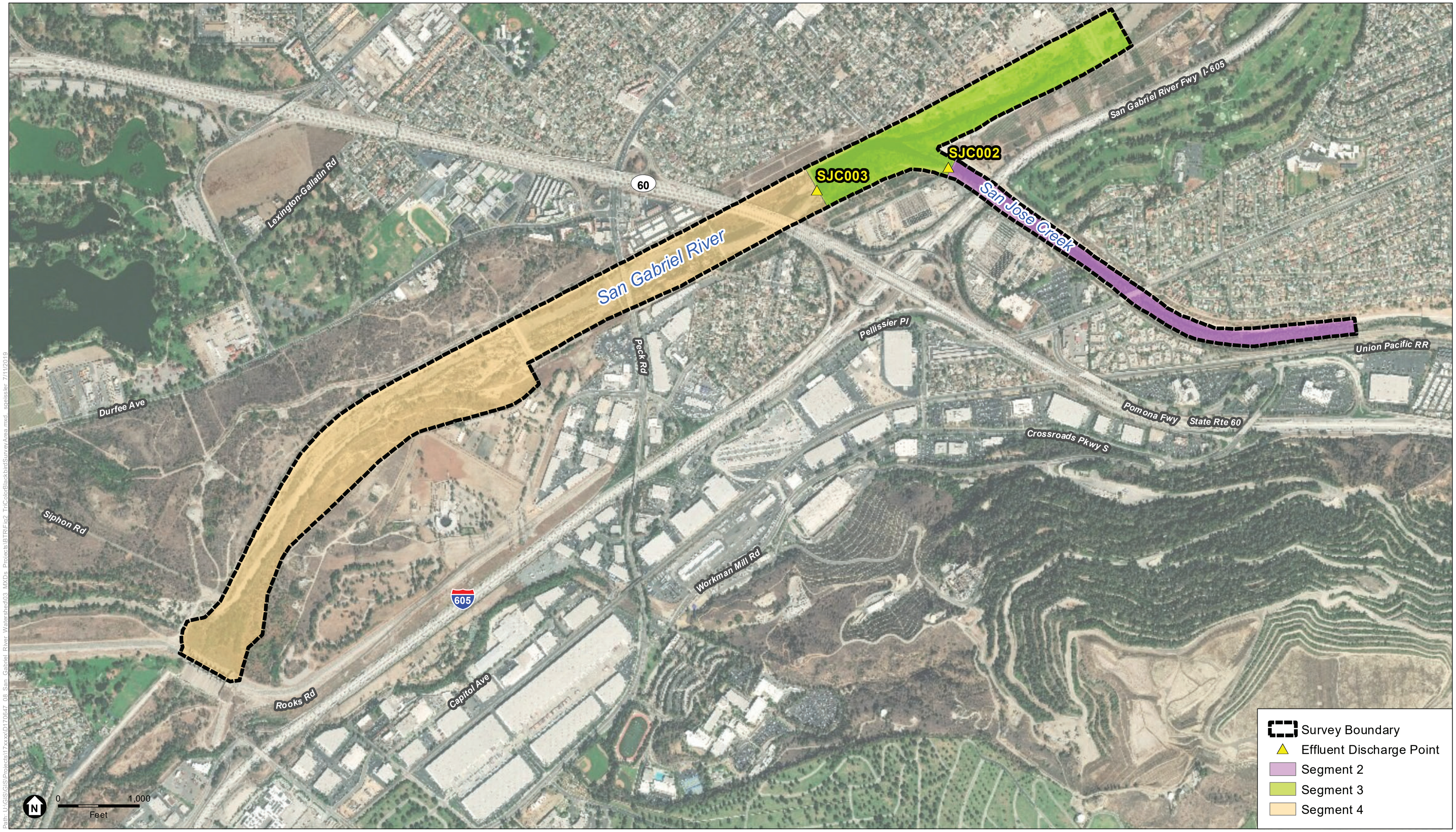
SOURCE: Clearwater EIR Segment Map

San Gabriel River Watershed Project to Reduce River Discharge
in Support of Increased Recycled Water Reuse

Figure 1
Regional Location & River Segments Map

ESA



SOURCE: ESRI

San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse

Figure 2
Survey Area

ESA

This updated technical memorandum provides new information on the baseline conditions and biological resources within three river segments, Segments 2, 3 and 4, located along the San Gabriel River and San Jose Creek, downstream of existing discharge points SJC002 and SJC003 (**Figure 2**). Segments 2, 3 and 4 of the San Gabriel River and San Jose Creek are the focus of the biological resources impact discussion since they are soft-bottomed channels and have the potential to support sensitive biological resources; whereas the other segments are cement-lined and do not provide habitat for aquatic or terrestrial wildlife and are devoid of vegetation. Further, California Department of Fish and Wildlife (CDFW) provided comments and biological survey recommendations on the Final Initial Study/Mitigated Negative Declaration for the project prepared by ESA in July 2018 (ESA 2018b), which included conducting focused surveys for tri-colored blackbird (*Agelaius tricolor*), bats (*Chiropter* sp.) and western pond turtle (*Emys marmorata*) upstream and downstream of the San Gabriel River and San Jose Creek confluence as suitable habitat is present at these locations. This updated technical memorandum documents the findings of focused surveys for tri-colored blackbird, fish, bats, and western pond turtle within Segments 2, 3 and 4 at the recommendation of the CDFW, as well as vegetation that was mapped within the study area (Chambers 2016, Wood 2018).

1.2 Project Description

The Sanitation Districts are proposing to incrementally reduce discharges of recycled water from five WRPs, including the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP, each of which currently discharges into the San Gabriel River, San Jose Cree, or Coyote Creek. The diverted water would supply recycled water programs implemented by other agencies. The proposed reduction in water discharges would occur over time, and would not involve any construction activities or other physical changes to the environment other than decreased volume of discharge. **Figure 3** identifies the location of WRPs and discharge points mentioned in this analysis.

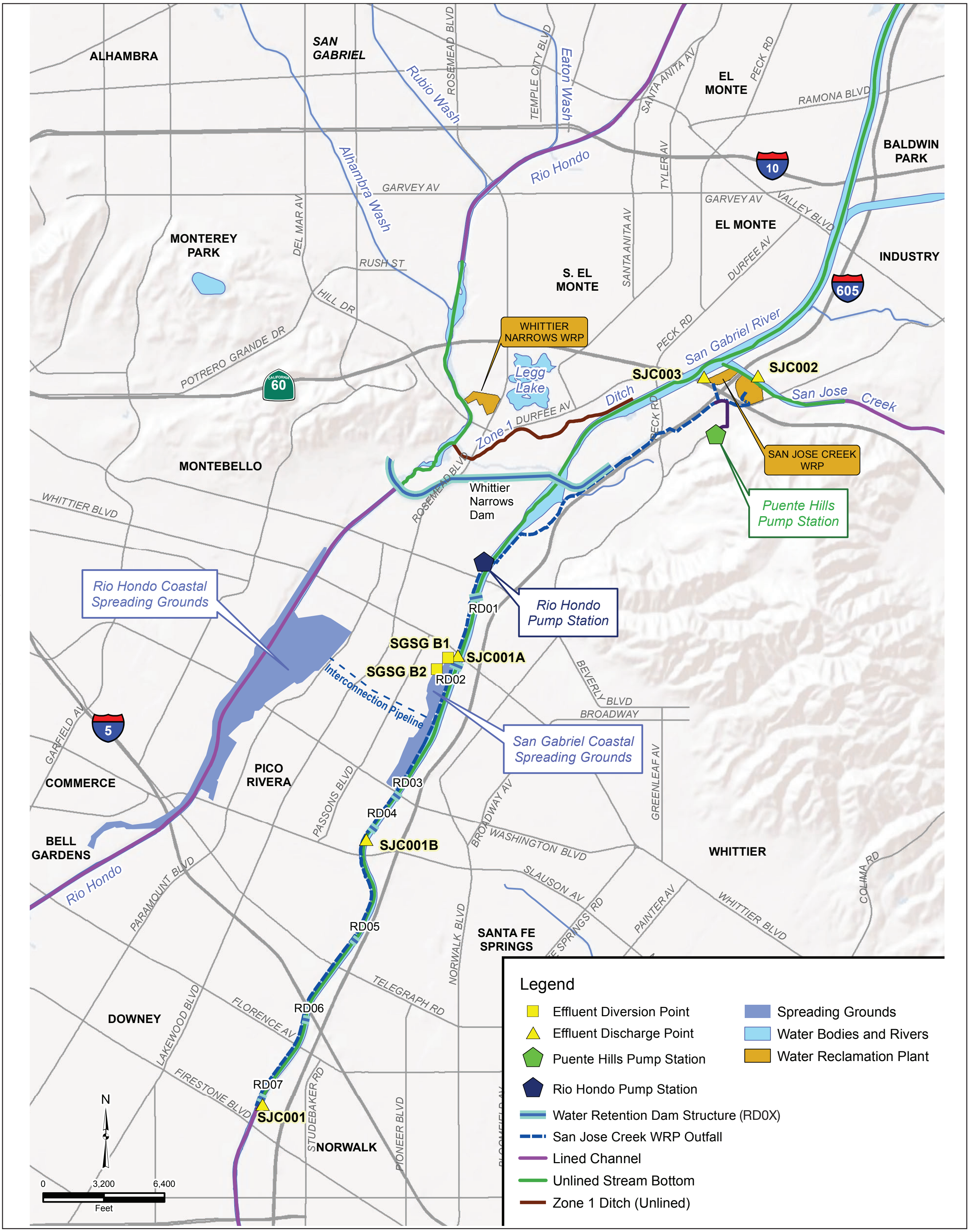
2.0 Methodology

2.1 Literature Review

ESA reviewed literature and accessed standard reference sources and databases to gather information on the natural resources and special-status species known or likely to occur in the study area.

The literature that was reviewed included the following:

- *Study of Water Flow Conditions for San Jose Creek and San Gabriel River* (Sanitation Districts of Los Angeles County, Planning Section, 2016).
- *Assessment of Potential Impacts for Sensitive Biological Resources within Select Portions of the San Gabriel River and San Jose Creek Located in Los Angeles County, California* (Chambers Group, August 24, 2016).



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SOURCE: Sanitation Districts of Los Angeles County

San Gabriel River Watershed Project to Reduce River Discharge
in Support of Increased Recycled Water Reuse

Figure 3
San Jose Creek WRP Discharge Points

ESA

- San Gabriel River Corridor Master Plan. (Moore, Iacofano, Goltsman, Inc., 2006. Prepared for the County of Los Angeles Department of Public Works).
- California Fish and Wildlife (CDFW) California Natural Diversity Database (CNDDB). Accessed February 26, 2018. Database was queried for special status species records within the nine (9) United States Geological Survey (USGS) topographic quadrants within and adjacent to the study area. These nine (9) quadrants include: Pasadena, Mt. Wilson, Azusa, Los Angeles, El Monte, Baldwin Park, South Gate, Whittier, and La Habra.
- California Native Plant Society (CNPS). Inventory of Rare and Endangered Plants (online edition, v8-01a). California Native Plant Society. Sacramento, CA. Database was queried for special status species records within the nine (9) United States Geological Survey (USGS) topographic quadrants within and adjacent to the study area. These nine (9) quadrants include: Pasadena, Mt. Wilson, Azusa, Los Angeles, El Monte, Baldwin Park, South Gate, Whittier, and La Habra.
- United States Fish and Wildlife Service (USFWS) Information for Planning and Conservation (IPac) Environmental Conservation Online System (ECOS). Accessed March 9, 2018. Database was queried for special status species records within the nine (9) United States Geological Survey (USGS) topographic quadrants within and adjacent to the study area. These nine (9) quadrants include: Pasadena, Mt. Wilson, Azusa, Los Angeles, El Monte, Baldwin Park, South Gate, Whittier, and La Habra.
- Evaluating Effects of Reduced WWTP Discharge on the Ecology of the San Gabriel River Estuary Final Study Results. (David J. Gillett, Eric D. Stein, and Liesl Tiefenthaler Southern California Coastal Water Research Project, January 12, 2018)
- San Gabriel River Riparian and Marsh Adaptive Management Plan (Wood Environment & Infrastructure Solutions, Inc. August 2019. Prepared for Los Angeles County Sanitation Districts)
- San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse Draft Initial Study / Mitigated Negative Declaration (ESA, July 2018)
- Using an Environmental Hydrology Model of the San Gabriel River to Assess Water Reclamation Plant Flow Reductions - Draft (Draft Hydrology Report) (ESA, June 2019)
- Draft Baseline Monitoring Report San Gabriel River Riparian Adaptive Management Plan. (Wood Environment & Infrastructure Solutions, Inc. October 2018)

2.2 Field Survey

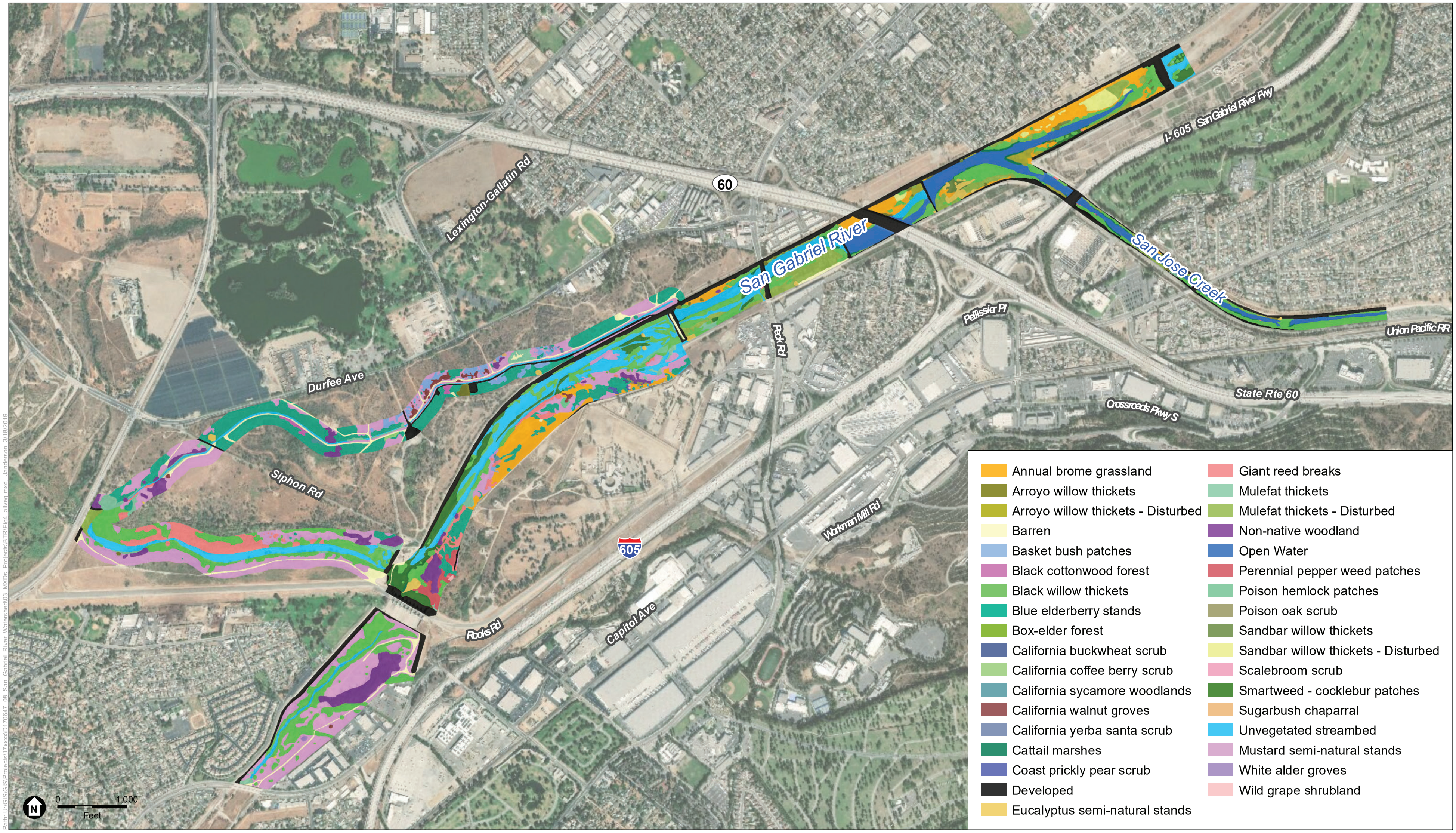
A biological resources field survey was conducted in February and July 2018 by ESA that included Segments 2 through 5 (upper portion of Segment 5 just below Whittier Narrows Dam to San Gabriel River Parkway), the Bosque Del Rio Hondo, and the adjacent portion of the WRNA where the Zone 1 Ditch passes through that area. The biological resources field survey also included the area containing the "Crossover Channel" that connects San Gabriel River to the Rio Hondo during extreme conditions, and the "backwater" area of the Rio Hondo, known as the Bosque Del Rio Hondo, just upstream from the Whittier Narrows Dam. Reconnaissance level surveys focused primarily on confirming vegetation types and habitat quality within the soft-bottom segments of San Gabriel River and San Jose Creek upstream from, and just downstream of the Whittier Narrows Dam, where significant riparian vegetation is present. No field survey was conducted in Segment 6 because these areas are periodically cleared or grubbed by the L.A. County Department of Public Works to remove most vegetation and promote water retention and percolation. Segments 1 and 7 were not surveyed because they are concrete-lined; however, these segments are included in this report to acknowledge any biological resources supported by freshwater flows. Segment 8 is the San Gabriel River estuary, which was not surveyed since the armored channel would not be affected by the project.

2.2.1 Vegetation and Habitat Mapping

Plant communities in Segments 2, 3, and 4 were mapped by Chambers Group in the summer of 2016 and provide an accurate depiction of plant communities within these segments of San Jose Creek and the San Gabriel River. Mapping from that effort was referenced during the field survey conducted by ESA in February and July 2018. Vegetation communities were classified by Chambers Group using *A Manual of California Vegetation, 2nd Ed.* (Sawyer et al. 2009). The system of attributing classifications based typically on single or dual species dominance used in the *Manual* does not always provide specific nomenclature for communities dominated by non-native or exotic species, or for ruderal (weedy) vegetation where several species are co-dominant or where dominance varies considerably in small patches. Therefore, as a practical consideration, vegetation communities may be described based on species dominance, as noted below in the descriptions of plant communities.

The plant communities that occur along the Zone 1 Ditch, Segments 2-4, and the upstream portion of Segment 5 (approximately 0.6 miles from San Gabriel River Parkway upstream to the Whittier Narrows Dam), and WRNA, were characterized and mapped by Wood Environment & Infrastructure Solutions, Inc. (Wood, Inc.) in June 2018. That mapping effort is included on **Figure 4** as the most accurate depiction of vegetation in these areas.

The limited vegetation present in Segments 5 and 6 downstream from the San Gabriel Coastal Basin Spreading Grounds was assessed from aerial imagery. In addition to referencing the Chambers Group and Wood, Inc. plant community maps, ESA biologists identified plant communities within the Bosque Del Rio Hondo, in the area west of Rosemead Avenue and upstream from the Whittier Narrows Dam, in July 2018. **Figure 5** identifies the plant communities characterized and mapped by ESA in the Bosque Del Rio Hondo.



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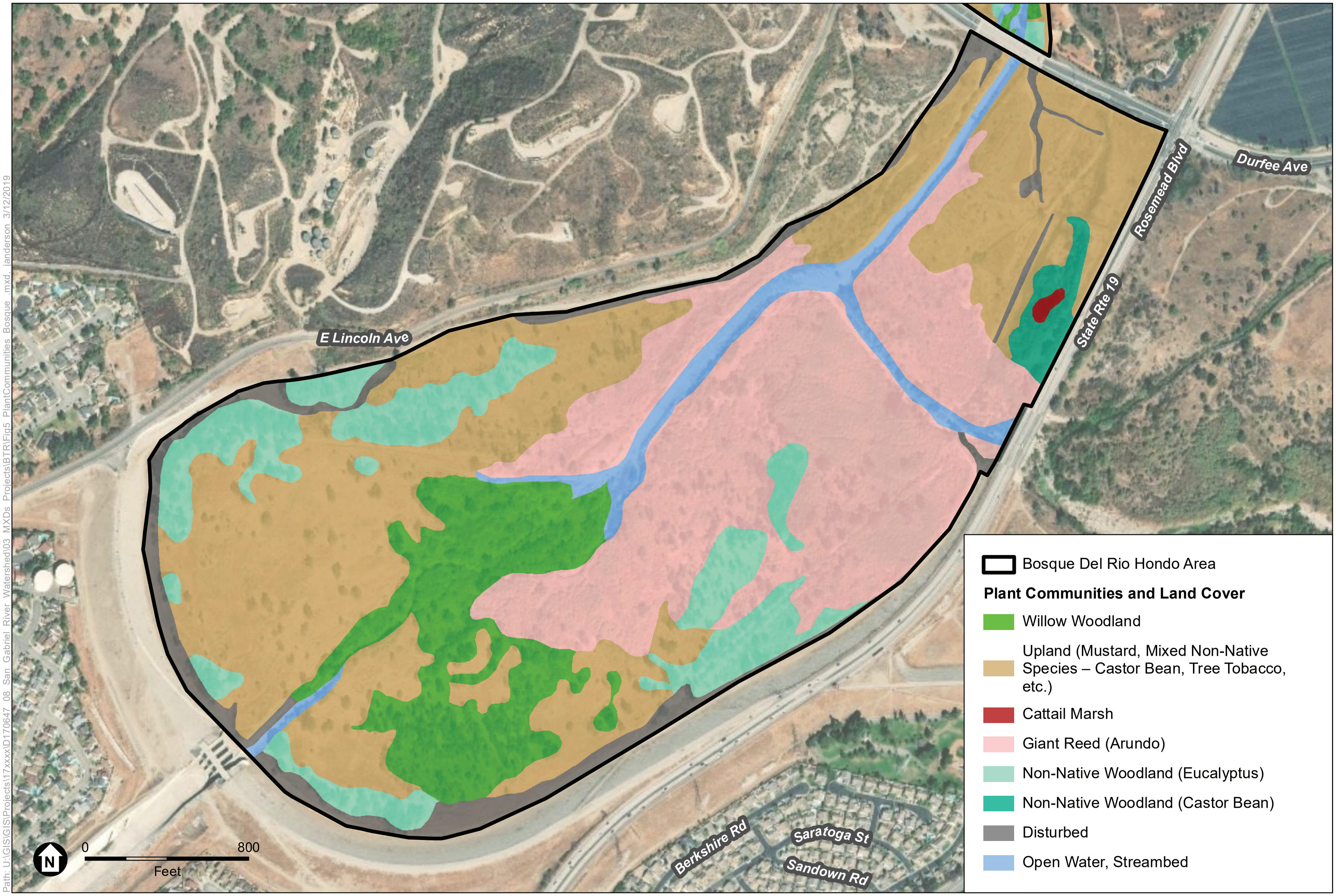
SOURCE: ESRI; Wood

San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse

Figure 4
Vegetation Communities - Overview

ESA



SOURCE: ESRI; ESA

San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse

Figure 5

Bosque Del Rio Hondo Area - Plant Communities and Land Cover

ESA

2.2.2 Habitat Assessment

The quality of habitat for native wildlife was determined based on the abundance, health, and vigor of native plant communities; abundance and diversity of invasive plant species; level of disturbance from homeless encampments, presence of substantial amounts of trash and debris, and the presence or absence of other important habitat features, such as sand bars, unobstructed flowing water, native riparian vegetation, suitable perch sites for birds of prey, etc.

2.2.3 Tri-Colored Blackbird Surveys

Three focused surveys were conducted for tri-colored blackbirds in an approximate 425-acre survey area by ESA biologists on January 22, 23, and 25, 2019. Surveys were conducted between the hours of 7:00 am and 11:00 am. During the surveys, temperatures ranged between 54-72 degrees and winds averaged three to six miles per hour (mph). Surveys focused on suitable habitat along Segments 2, 3 and 4 within the San Gabriel River and San Jose Creek including freshwater marsh habitats that contained cattails (*Typha* sp.), tules (*Schoenoplectus acutus*), and willows (*Salix* sp.). The biologists walked the perimeter of the entire survey area and stopped in areas of suitable habitat and used 10 x 42 binoculars to view and observe species and vegetation, including listening for calling blackbirds that may not have been visible. The survey area is depicted on Figure 2 and photos from the survey are provided in **Appendix A**.

2.2.4 Fish Survey

Fish surveys were conducted on February 20 and 21, 2019 to determine relative abundance of fish species within the San Gabriel River and San Jose Creek (Segments 2, 3 and 4). Eleven (11) locations within the San Gabriel River and San Jose Creek each were surveyed, including the confluence of the San Gabriel River and San Jose Creek. Sites were selected based multiple considerations, including accessibility and specific technique limitations. The survey locations can be seen on **Figure 6** and photos from the survey can be seen in Appendix A. Surveys were conducted between the hours of 7:00 am and 2:00 pm; temperatures varied between 41-57 degrees Fahrenheit with winds averaging one to five miles per hour (mph). Seine nets were used in areas that had a smooth bottom contour, composed of silt, sand, gravel, or concrete. The seine net was constructed with a panel of 1/8-inch mesh, 4 feet tall by 20 feet long, that was drawn (or hauled) through the water to capture fish. The net had floats on the top rope (float line) and weights on the bottom (lead line) and was attached to wood poles on either end. Seined areas were block-netted at the upstream and downstream ends to isolate the survey unit and essentially prevent fish from moving into or out of the blocked unit being sampled. Blocknets were also 1/8-inch mesh. The ends of each blocknet were tied to bank-side vegetation or rocks. Rocks were also placed on the lead line to keep the net on the bottom and prevent fish from entering or escaping the survey unit being sampled. At each surveyed unit, a total of three seine passes were made to establish a depletion estimate for the purpose of estimating fish abundance (Van DeVenter and Platts 1983). At the end of all seining, the downstream block net was inspected for any fish that may have become entangled in the net during the seining.

SOURCE: ESRI

San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse

Figure 6
Fish Survey Sites

ESA

2.2.5 Water Quality Sampling

At each fish survey site, water quality measurements using a YSI 556 meter were taken for temperature (Celsius and Fahrenheit), dissolved oxygen (DO), and pH.

2.2.6 Bat Surveys

Baseline bat surveys included a daytime roost assessment, emergence survey and active monitoring, and a passive acoustic survey conducted within the survey area depicted in Figure 2. These surveys were conducted to evaluate bat roosting and foraging use of the survey area.

Daytime Roost Assessment

A daytime assessment of bat roosting habitat was conducted on March 27, 2019 to identify the types of available roosting habitat within the survey area and to check for the presence of bats or other signs of bat roosting activity such as guano or staining. The daytime roost assessment was also used to determine a location to conduct the emergence survey and active monitoring.

Emergence Survey and Active Monitoring

In order to gather additional information on the number of bats roosting within the project site and to observe if bats are actively roosting, visual emergence surveys were conducted at dusk with the use of an Echo Meter Touch 2 bat detector and spot-lights on March 27, 2019. The locations and number of individual bats observed during emergence surveys, as well as any distinguishable flight patterns, was noted. In addition to noting roosting activity, active monitoring was conducted in conjunction with the emergence survey to assess bat activity patterns within the survey area.

Passive Acoustic Survey

Passive acoustic monitoring was conducted using a full-spectrum Wildlife Acoustics SM4 bat detector with an SMM-U2 microphone mounted approximately 8 feet above ground. The acoustic detector was deployed for 5 consecutive nights within the survey area (from March 27, 2019 to April 2, 2019). The detector was set to record calls from 30 minutes before to 30 minutes after solar sunrise and sunset, respectively. Acoustic data was processed offsite using SonoBat software (Version 4.2.2) to aid in identifying echolocation calls with manual vetting used to confirm the list of recorded species and automated analysis used to determine total passes.

2.2.7 Western Pond Turtle Survey

ESA biologists conducted a presence/absence survey for western pond turtle within suitable habitat in the San Gabriel River and San Jose Creek (survey area). Visual surveys were conducted following the protocol established in the *United States Geological Survey* (*USGS) Western Pond Turtle (Emys marmorata) Visual Survey Protocol for the Southcoast Ecoregion* (2006), while trapping surveys were conducted following the protocol established in *the USGS Western Pond Turtle (Emys marmorata) Trapping Survey Protocol for the Southcoast Ecoregion* (2006).

Prior to conducting the surveys, ESA reviewed CDFW's California Natural Diversity Database (CNDDB) to see if any observations have previously been recorded for the species in the vicinity of the survey area. The closest records of the western pond turtle relative to the survey area include two occurrences in the 1980's. One observation was made near the Zone 1 Ditch, west of the survey area, and the other observation was made in the San Gabriel River (CDFW, 2019).

A four-day visual and three-day trapping survey was conducted by ESA biologists within suitable habitat in the survey area from May 1, 2019 to May 4, 2019. The entire survey area was surveyed visually and assessed to determine suitable habitat for western pond turtle, including basking areas and opportunities, emergent vegetation, and pool abundance. The biologists began the visual survey in the San Gabriel River by walking along the edge of the river and surveying up to the banks. This method was repeated at San Jose Creek. Binoculars were used to scan banks and upstream areas to observe any western pond turtles. Fallen trees, large rock and boulders, and banks were also surveyed thoroughly.

After the habitat assessment was completed, ESA biologists conducted live trapping, which consisted of placing live-catch turtle traps at six trapping stations. Trap station locations were recorded using the Collector for ArcGIS and are shown on **Figure 7**.

The trapping session consisted of one trapping period lasting approximately four days and three nights (traps were set on May 1, 2019 and checked approximately 24 hours later, each of the next three days). Live-catch floating net mesh funnel traps were used. Net mesh funnel traps consist of a 20-inch by four-feet with 5/16-inch mesh and a one-way funnel entrance. PVC pipe was attached on each side of the traps and Styrofoam floats were also attached to the top of each trap to allow them to float, while the entrance of the trap was submerged underwater. The traps were firmly secured to banks, emergent trees, or other immovable objects in the pool using nylon string. Canned sardines were placed in the traps as bait and were replaced with new canned sardines each day. All aquatic species observed were documented.

3.0 Environmental Setting

3.1 Study Area

The hydrology of the San Gabriel River system has been altered, primarily for flood control and storm runoff conveyance, following a series of devastating floods in the early part of the 20th century. The portions of the San Gabriel River and San Jose Creek in the study area are confined between concrete banks or vertical concrete walls. Some of the channel sections are also concrete-lined across the channel bottom but some segments are unlined.

The area surrounding the study area is highly urbanized by residential, commercial, and industrial land uses that border San Gabriel River and San Jose Creek. The WRNA, on the west-side of San Gabriel River, above the Whittier Narrows Dam, lies directly adjacent to the San Gabriel River, some of which occurs within the study area. The WNRA is a significant natural area and constitutes the western end of the Los Angeles County Puente Hills Significant Ecological Area (SEA). The WNRA is managed by the US Army Corps of Engineers (USACE) and is within the Whittier Narrows Master Plan (USACE 2011).

SOURCE: ESRI

San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse

Figure 7
Western Pond Turtle Trap Locations

ESA

Recreation is very common along the banks of the San Gabriel River in the vicinity of the WNRA and elsewhere along the waterways where access is permitted. A substantial amount of trash and foreign debris occurs throughout the San Gabriel River. Some trash is carried into the area from upstream storm flows, dispersed by wind, and is discarded from vehicles traveling over nearby bridges and roadways. Much of the trash is cast aside in the channel by a homeless population that lives in or near the channel. In addition, invasive plant species occur in several areas, particularly in the Crossover Channel and the Bosque Del Rio Hondo on the upstream side of the Whittier Narrows Dam.

The following sections describe the habitat values and quality of each river segment in the study area.

Segment 1

Segment 1 is the concrete-lined vertical walled channel section of San Jose Creek downstream from the Pomona WRP and provides limited biological resource value to wildlife other than as a water source and for some common avian and terrestrial species that typically forage in urban areas and along concrete channels, such as ravens, rodents, and raccoons. Foraging opportunities are limited to algae, decaying vegetation, and trash. Vertical concrete walls may reduce its use by wildlife. The channel conveys nuisance runoff, stormwater, groundwater upwelling, and reclaimed water from the Pomona WRP downstream to Segment 2.

Segment 2

Segment 2 is an unlined, soft or earthen-bottomed section in San Jose Creek and extends upstream about one-mile from the confluence with San Gabriel River. This segment receives stormwater and urban runoff, as well as discharge from the Pomona WRP. This area also exhibits considerable upwelling from local groundwater as indicated by flow measurements collected in San Jose Creek when there was no discharge from the Pomona WRP upstream.

Surface water is typically present within this channel segment as a result of upstream flows, groundwater upwelling and the ponding effect of the downstream drop structure. The channel is dominated by black willow thickets and non-native invasive vegetation such as castor bean. This area provides both foraging and nesting habitat for avian species and the presence of surface water for long periods supports aquatic habitat for non-native fish species. No native fish species are known to occupy Segments 2 through 4, as suitable habitat does not exist.

Segment 3

This segment is approximately 4,000 feet in length extending from near the San Gabriel River - San Jose Creek confluence to just upstream from the SR-60 Bridge. Segment 3 also includes a small portion of the San Gabriel River upstream from the confluence with San Jose Creek. This segment receives water from nuisance flows and stormwater, San Jose Creek groundwater upwelling contributions, Pomona and San Jose Creek WRP discharges, and occasionally when water is released from the Morris and San Gabriel Dams, or from imported water sources upstream. The San Gabriel River is generally dry upstream from the first drop structure above the confluence and supports little riparian vegetation. Water in this segment is impounded by the weirs and generally covers a wide area of the channel bottom. Vegetation in this area includes black willow thicket habitats at the water's edge, sand bars, and areas where non-native weed species are established on the channel edges. The quality of the riparian habitat is generally disturbed due to the prevalence of invasive species and trash. A perennial aquatic habitat is supported by in-stream flows and groundwater upwelling, which is impounded by a series of drop structures.

Segment 4

Segment 4 extends downstream in the San Gabriel River, just north of the SR-60 Bridge, to upstream from the Whittier Narrows Dam. There are three drop structures (or weirs) in this segment. The last weir, located just downstream from the head works for the Zone 1 Ditch, divides this segment into two different hydrologic regimes.

The upstream regime of Segment 4 receives water from the same sources as Segment 3. Riparian black willow thicket habitat occurs adjacent to water ponded from behind the drop structures. The quality of the riparian habitat is somewhat poor due to the prevalence of invasive species and trash. Aquatic habitat is also supported by ponded water that occurs due to in-stream flows, WRP discharges, and groundwater upwelling.

The downstream portion of Segment 4 below the last (downstream) drop structure is usually dry, except after storm events, or during deliveries of imported water from tributaries feeding into San Gabriel River upstream. The vegetation is mostly disturbed scrub habitat dominated primarily by ruderal (weedy) vegetation, non-native grasslands, and dry river bottom. This is likely due to the reduced influence of groundwater upwelling in the lower portion of the segment, and less consistent ponded water. Typically, the water in the upstream regime of Segment 4, including WRP discharges, infiltrates into the ground due to the high permeability of the riverbed soil and does not contribute to the downstream regime. Near the dam, mature stands of riparian vegetation, including large willow and cottonwood trees, occur in the center of the channel.

Whittier Narrows Recreation Area and Zone 1 Ditch

The WNRA lies adjacent to the west-side of the San Gabriel River between Peck Road and the Whittier Narrows Dam. The WNRA in this area is comprised of natural open space used primarily for passive recreation, and also contains flood control facilities, extraction wells, and is crossed by Southern California Edison (SCE) transmission lines. Zone 1 Ditch is an artificial channel through the WNRA that conveys water drawn from the San Gabriel River to the Rio Hondo River. Zone 1 Ditch is operated and maintained by the L.A. County Department of Public Works. Periodically, water deliveries are conveyed from the San Gabriel River to the Rio Hondo. For most of its length, Zone 1 Ditch exhibits a soft bottom and earthen banks. However, some sections exhibit grouted riprap along the banks and riprap on the bottom. Some of the water that is conveyed through the channel may percolate into the ground and may support vegetation that is adjacent to the channel. Vegetation around the channel is dominated by blue elderberry stands and the backwash area nearer the dam within the WNRA, which feeds into Bosque Del Rio Hondo, exhibits patches of black willow thickets, some non-native woodland, giant reed breaks, and upland areas dominated by mustard and other disturbed scrub dominated by non-native weed species and non-native grasslands.

Bosque Del Rio Hondo appears to have some standing water for a long duration and saturated conditions may persist through much of the dry season. However, these areas exhibit predominantly non-native vegetation, including the exotic and invasive giant reed (*Arundo donax*), although some willow woodland patches occur along the stream in the southern section of this area.

Segments 5 and 6

Segment 5 is soft bottomed and continues downstream within the San Gabriel River from the Whittier Narrows Dam and past the San Gabriel Coastal Basin Spreading Grounds. Just below the dam, for a stretch of approximately two miles, the river channel appears to receive local runoff conveyed into the area via the Peck Road Channel, which enters near the upstream end of the segment from the northeast. Segment 5 does not receive surface flows from the San Gabriel River upstream of the dam except during large storm events. However, in this area just below the dam, the channel supports healthy stands of black willow.

Downstream of this portion, the San Jose Creek WRP can discharge into Segment 5 at two points: SJC001A, which is located at the head works for the San Gabriel Coastal Spreading Grounds (SGSG); and, SJC001B, located at the downstream end of Segment 5. The drop structure at the SGSG head works functions to retain flows that are then diverted into the spreading grounds.

Segment 6 is similar to Segment 5 in that it does not contain native habitat. The unlined channel areas in Segments 5 and 6 of the San Gabriel River are part of the overall Montebello Forebay recharge area, which also includes both the Rio Hondo and San Gabriel Coastal Spreading Grounds. There are a total of 7 inflatable rubber dams in Segments 5 and 6 that are used to detain flows within this area for groundwater recharge. Vegetation is periodically maintained and the channel bottom scarified with equipment to promote percolation and reduce water loss. Patches of riparian shrubs and some trees are left in place on the channel side slopes. The channel bottom is highly disturbed and exhibits predominantly ruderal herbaceous vegetation and barren areas.

Segment 7

Segment 7 consists of a concrete-lined channel from just north of Firestone Blvd. Bridge, to the San Gabriel River estuary “mixing zone” at the interface of the concrete-lined San Gabriel River channel (and Coyote Creek confluence), and the estuarine waters upstream from the power plants. Shore birds and local wildlife utilize the freshwater for loafing, but foraging habitat values are marginal due to a lack of vegetation and soils that would otherwise provide a food source.

Segment 8 “Mixing Zone”

Within the San Gabriel River estuary mixing zone, freshwater mixes with the seawater in a small apron area beyond the final concrete drop structure. The freshwater initially stays on the surface until wind and currents promote more thorough mixing. Waterfowl and shore birds are seen in this area loafing and foraging. The freshwater influence may attract aquatic species that the water fowl prey on.

3.2 Plant Communities and Land Uses

The plant communities and non-vegetated areas were characterized and mapped within the study area, specifically for the Zone 1 Ditch, Segments 2, 3, and 4; and a portion of Segment 5. Plant communities and other non-vegetated areas in the Bosque Del Rio Hondo were characterized and mapped as shown on Figure 4**.** Vegetation communities were characterized using A Manual of California Vegetation, 2nd Ed. (Sawyer et al. 2009). The system of attributing classifications based typically on single or dual species dominance used in the Manual does not always provide specific nomenclature for communities dominated by non-native or exotic species, or for ruderal (weedy) vegetation where several species are co-dominant or where dominance varies considerably in small patches. Therefore, as a practical consideration, unique vegetation communities were described based on species dominance. Plant communities and disturbed areas land use located within the project area are described in detail below.

3.2.1 Aquatic / Riverine

Open Water

Areas identified as "open water" were observed during ESA's habitat assessment in February 2018 or based on aerial photographs where access was limited, and consists of standing or flowing water. Open water was observed in Segments 2 through 4, which represents the extent of surface water in the study area. Open water generally includes areas where emergent vegetation was absent.

Cattail Marsh - Typha (angustifolia, domingensis, latifolia) Herbaceous Alliance

A small patch of cattail marsh occurs within the floodplain of the Bosque Del Rio Hondo, upstream from the dam near Route 19. This community consisted entirely of broadleaf cattail (*Typha sp.*), submerged in open water, with hydric soils. Cattail marsh is also present within the San Gabriel River and San Jose Creek.

Unvegetated Streambed

Areas characterized as unvegetated streambed include the soft-bottom channel bed where vegetation is very sparse or entirely lacking. These areas are typically result from scour or silt/sand deposition during high flows and storm events in the San Gabriel River. Unvegetated streambed areas also represent those areas where standing or flowing water was not apparent based on review of aerial imagery or during field inspections.

3.2.2 Native Riparian Communities

Arroyo Willow Thickets - Salix lasiolepis Shrubland Alliance

Arroyo willow thickets (*Salix lasiolepis*) are generally dominant or co-dominant in the tall shrub or low tree canopy with Bigleaf maple (*Acer macrophyllum*), coyote brush (*Baccharis pilularis*), mule fat (*Baccharis salicifolia*), buttonbush *(Cephalanthus occidentalis*), red osier dogwood (*Cornus sericea*), Pacific wax myrtle (*Morella californica*), western sycamore (Platanus racemose), Fremont cottonwood (*Populus fremontii*), black cottonwood (*Populus trichocarpa*), willow (*Salix* spp), and elder *(Sambucus nigra*). This community was observed throughout San

Jose Creek, the San Gabriel River, and Zone 1 Ditch. This community has a NatureServe rank of S4G4 and is designated by CDFW as a Sensitive Natural Community.

Arroyo Willow Thickets – Disturbed - Salix lasiolepis Shrubland Alliance (Disturbed)

This community was characterized and mapped along the San Gabriel River and San Jose Creek. While this community is generally very similar to the arroyo willow thickets, this community is disturbed. The disturbed areas are most likely attributed to human presence; such as, but not limited to homeless encampments, construction and installation of concrete weirs in the San Gabriel River, and the construction and installation of the asphalt bike trail along the north side of the San Gabriel River.

Black Willow Thickets - Salix gooddingii Woodland Alliance

Black willow thickets were characterized and mapped both upstream and immediately downstream of the Whittier Narrows Dam and along the Rio Hondo and San Gabriel River, respectively. This community is characterized as supporting a tree layer dominated by Goodding's black willow (*Salix gooddingii*]. In some portions of this community there are mature willow trees, such as along the San Gabriel River, whereas immature, successional trees were observed along the Rio Hondo, with many trees remaining less than three meters in height. The black willow stands are interspersed with various native and non-native grass, palm and tree species such as giant reed, mulefat, Shamel ash (*Fraxinus uhdei*), blue elderberry (*Sambucus nigra* ssp. *caerulea*), sandbar willow (*S. exigua*), arroyo willow (*S. lasiolepis*), Brazilian pepper tree (*Schinus terebinthifolia*) and Mexican fan palm (*Washingtonia filifera*).

This community supports a robust herbaceous layer dominated by various grasses and forbs, including Bermuda grass (*Cynodon dactylon*), prickly lettuce (*Lactuca serriola*), sweetclover (*Melilotus albus*), seep monkey flower (*Mimulus guttatus*), London rocket (*Sysimbrium irio*), spiny cow thistle (*Sonchus asper*) and saltmarsh aster (*Symphyotrichum subulatum* var. *parviflorum*). This community has a NatureServe rank of S3G4 and is designated by CDFW as a Sensitive Natural Community.

Sandbar Willow Thickets - Salix exigua Shrubland Alliance

A patch of sandbar willow thicket, dominated primarily by sandbar willow, occurs upstream from the San Gabriel River / San Jose Creek confluence and below the drop structure that appears to represent the upstream extent of upwelling influence from San Jose Creek.

Sandbar Willow Thickets – Disturbed - Salix exigua Shrubland Alliance (Disturbed)

Two patches of disturbed sandbar willow thickets were observed and mapped within the San Gabriel River. While this community is generally similar to the sand bar willow thickets community, more areas are disturbed. The disturbed areas are most likely attributed to human presence; such as, but not limited to homeless encampments, construction and installation of concrete weirs in the San Gabriel River, and the construction and installation of the asphalt bike trail along the north side of the San Gabriel River.

California Walnut Groves - Juglans californica Woodland Alliance

This community occurs within the Zone 1 Ditch and the San Gabriel River. California walnut (*Juglans californica*) is generally dominant or co-dominant in the tree canopy with white alder (*Alnus rhombifolia*), California ash (*Fraxinus dipetala*), toyon (*Heteromeles arbutifolia*), coast live oak (*Quercus agrifolia*), valley oak (*Quercus lobata*), red willow (*Salix laevigata*), arroyo willow (*Salix lasiolepis*), elder (*Sambucus nigra*) and California bay (*Umbellularia californica*). This community has a NatureServe rank of S3G3 and is designated by CDFW as a Sensitive Natural Community.

Mulefat Thickets - Baccharis salicifolia Shrubland Alliance

Mulefat thickets were characterized and mapped along the San Gabriel River, downstream of the Whittier Narrows Dam, and along portion of the bed and banks of the Zone 1 Ditch. This community is dominated with mulefat, interspersed with various tree species, such as arroyo willow, black willow, Shamel ash and red river gum. The mulefat and trees that comprise this community are dense and therefore does not support a formative shrub or herbaceous layer; however, various ruderal vegetation occur along the margins that includes shortpod mustard, tall cyperus (*Cyperus eragrostis*) and annual nettle (*Urtica urens*).

Mulefat Thickets – Disturbed - Baccharis salicifolia Shrubland Alliance (Disturbed)

Disturbed mulefat thickets were characterized and mapped along the San Gabriel River. While this community is generally very similar to the mulefat thickets community, more areas are disturbed. The disturbed areas are most likely attributed to human presence; such as, but not limited to homeless encampments, construction and installation of concrete weirs in the San Gabriel River, and the construction and installation of the asphalt bike trail along the north side of the San Gabriel River.

Black Cottonwood Forest - Populus trichocarpa Forest Alliance

Black cottonwood forest occurs within the Zone 1 Ditch. Black cottonwood forest is generally dominant or co-dominant in the tree canopy with black cottonwood (*Populus trichocarpa*), white fir (*Abies concolor*), bigleaf maple (*Acer macrophyllum*), box-elder maple (*Acer negundo*), grey alder (*Alnus incana*), white alder, red alder (Alnus rubra), Oregon ash (Fraxinus latifolia), western juniper (*Juniperus occidentalis*), Pacific wax myrtle (*Morella californica*), lodgepole pine (*Pinus contorta* ssp. *murrayana*), Jeffery pine (Pinus jeffreyi), western sycamore (*Platanus racemose*), Fremont cottonwood (*Populus fremontii*), quaking aspen (*Populus tremuloides*), coast live oak, sandbar willow (Salix exigua), dune willow (Salix hookeriana), red willow, arroyo willow, shining willow (*Salix lucida* ssp. *lasiandra*), yellow willow *(Salix lutea*) and Scouler's willow (*Salix scouleriana*).This community has a NatureServe rank of S3G5 and is designated by CDFW as a Sensitive Natural Community

White Alder Groves - Alnus rhombifolia Forest Alliance

White alder groves occur in a small area in the San Gabriel River below the Whittier Narrows Dam. White alder (*Alnus rhombifolia*) is generally dominant or co-dominant in the tree canopy with bigleaf maple, Port Orfors cedar (*Chamaecyparis lawsoniana*), Oregon ash, tanbark-oak

(*Notholithocarpus densiflorus*), western sycamore, Fremont cottonwood, black cottonwood (*Populus trichocarpa*), Douglas fir (*Pseudotsuga menziesii*), valley oak and willow spp. This habitat is designated by CDFW as a Sensitive Natural Community.

Poison Oak Scrub - Toxicodendron diversilobum Shrubland Alliance

Poison oak scrub was observed and mapped within the Zone 1 Ditch. Poison oak (*Toxicodendron diversilobum*) is generally dominant in the shrub canopy with California sagebrush (*Artemisia californica*), chaparral broom (*Baccharis pilularis*), sticky monkey-flower (Diplacus aurantiacus), toyon, heartleaf keckiella (*Keckiella cordifolia*), laurel sumac (*Malosma l*aurina), Lweis' mock-orange (*Philadelphus lewisii*), hollyleaf redberry (*Rhamnus ilicifolia*), thimbleberry (*Rubus parviflorus*), purple sage (*Salvia leucophylla*), black sage (*Salvia mellifera*) and black elder (*Sambucus nigra*). Emergent trees may be present at low cover, including California walnut or coast live oak.

Wild Grape Shrubland - Vitis arizonica - Vitis girdiana Shrubland Alliance

Wild grape shrubland (*Vitis arizonica*) was observed and mapped within the San Gabriel River, above the Whittier Narrows Dam. Wild grape shrublands are generally dominant or co-dominant in the shrub canopy with fourwing saltbush (Atriplex canescens), buttonbush (*Cephalanthus occidentalis*), Old-man's beard (*Clematis ligusticifolia*), common fig (*Ficus carica*), arrowweed (Pluchea sericea), Himalayan blackberry (*Rubus armeniacus*), California blackberry (*Rubus ursinus*), sandbar willow, black elder and chairmaker's bulrush (*Schoenoplectus americanus*). Emergent trees may be present at low cover including box elder (*Acer negundo*), Hind's black walnut (*Juglans hindsii*) and Fremont cottonwood. This habitat is designated by CDFW as a Sensitive Natural Community.

Box-Elder Forest - Acer negundo Forest Alliance

This community was observed and mapped within the San Gabriel River. Box-elder forest is generally dominant or co-dominant in the tree canopy with white alder (*Alnus rhombifolia*), Oregon ash, Hind's black walnut, western sycamore, Fremont cottonwood, black cottonwood, valley oak, Gooding's willow (*Salix gooddingii*) and other willow species. This community has a NatureServe rank of S2G5 and is designated by CDFW as a Sensitive Natural Community.

3.2.3 Non-native Riparian Community

Giant Reed Breaks - Arundo donax Semi-Natural Herbaceous Stands

Giant reed breaks were characterized and mapped throughout much of the floodplain surrounding the Rio Hondo, upstream of the Whittier Narrows Dam. This community supports a dense layer of giant reed, dominating both the overstory and understory, interspersed throughout with various native and non-native tree species such as black willow, bluegum (*E. globulus*), mulefat and red river gum. This community supports very few shrub or herbaceous species, except along its margins. Such species include horehound, poison hemlock and shortpod mustard.

3.2.4 Native Upland/Transitional Community

Scale broom Scrub - Lepidospartum squamatum Shrubland Alliance

This community was observed and mapped within San Gabriel River. Scale broom scrub (*Lepidospartum squamatum*) is generally dominant, co-dominant, or conspicuous in the shrub canopy with ragweed (*Ambrosia salsola*), California sagebrush, mulefat, bladderpod (*Cleome isomeris*), California cholla (*Cylindropuntia californica*), brittlebush, thickleaf yerba santa (*Eriodictyon crassifolium*), hairy yerba santa (*Eriodictyon trichocalyx*), California buckwheat, our Lorde's candle, deerweed, laurel sumac, coast prickly pear (*Opuntia littoralis*), lemonade berry (*Rhus integrifolia*), sugar sumac (*Rhus ovata*), skunkbush sumac (*Rhus trilobata*) and poison oak. This habitat is designated by CDFW as a Sensitive Natural Community.

California Yerba Santa Scrub - Eriodictyon californicum Shrubland Alliance

This community was observed and mapped in a small area in the Zone 1 Ditch. California yerba santa scrub (*Eriodictyon californicum*) is generally dominant in the shrub canopy with chamise (*Adenostoma fasciculatum*), buckbrush (*Ceanothus cuneatus*), sticky monkey-flower, our Lord's candle, deerweed, silver lupine (*Lupinus albifrons*), black elder (*Sambucus nigra*) and poison oak.

Coast Prickly Pear Scrub - Opuntia littoralis - Opuntia oricola - Cylindropuntia prolifera Shrubland Alliance

This community occurs within the San Gabriel River. Coast prickly pear scrub (*Opuntia littoralis*) and/or other cacti are generally dominant or co-dominant in the shrub canopy with California sagebrush, bladderpod (*Cleome isomeris*), bushrue (*Cneoridium dumosum*), California cholla (*Cylindropuntia californica*), Coastal cholla (*Cylindropuntia prolifera*), California brittlebush (*Encelia californica*), California buckwheat, cliff spurge (*Euphorbia misera*), our Lord's candle (*Hesperoyucca whipplei*), laurel sumac, desert wishbone-bush (Mirabilis laevis), chaparral prickly pear (*Opuntia oricola*), tulip prickly pear (*Opuntia phaeacantha*), lemonade berry, black sage and black edler. This habitat is designated by CDFW as a Sensitive Natural Community.

Basket Bush Patches - Rhus trilobata Shrubland Alliance

This community was is located within the San Gabriel River and Zone 1 Ditch. Basket bush (*Rhus trilobata*) is generally dominant or co-dominant in the shrub canopy with fourwing saltbush, willow baccharis (*Baccharis emoryi*), desert baccharis (*Baccharis sergiloides*), narrowleaf goldenbush (*Ericameria linearifolia*), broomweed (*Gutierrezia sarothrae*), wild almond (*Prunus fasciculate*), sandbar willow, black elder, and desert wild grape (*Vitis girdiana*). This habitat is designated by CDFW as a Sensitive Natural Community.

California Coffeeberry Scrub - Frangula californica Shrubland Alliance

California coffeeberry scrub (*Frangula californica*) was observed and mapped within the San Gabriel River. This community is generally dominant or co-dominant in the shrub canopy with coyote brush, sweetshrub (*Calycanthus occidentalis*), pinebush (*Ericameria pinifolia*), bastardsage (*Eriogonum wrightii*), Veatch silktassel (*Garrya veatchii*), large leather-root (*Hoita macrostachya*), chokeberry (*Prunus virginiana*), Sierra gooseberry (*Ribes roezlii*), Brewer's willow (*Salix breweri*), black elder and poison oak.

Smartweed – Cocklebur Patches - Polygonum lapathifolium - Xanthium strumarium Herbaceous Alliance

This community was observed within San Jose Creek and the San Gabriel River. This community is generally dominant or co-dominant in the herbaceous layer with devil's-pitchfork (*Bidens frondosa*), fiveangled dodder (*Cuscuta pentagona*), pale spikerush (*Eleocharis macrostachya*), western goldenrod (*Euthamia occidentalis*), common sunflower (*Helianthus annuus*), and frog fruit (*Phyla nodiflora*).

California Buckwheat Scrub - Eriogonum fasciculatum Shrubland Alliance

This community was observed and mapped within the Zone 1 Ditch. California buckwheat scrub (*Eriogonum fasciculatum*) is generally dominant or co-dominant in the shrub canopy in cismontane stands with California sagebrush, coyote brush, sticky monkey-flower, California brittlebush (*Encelia californica*), brittlebush (*Encelia farinose*), menzie's goldenbush (*Isocoma menziesii*), deerweed (*Lotus scoparius*), chaparral mallow (*Malacothamnus fasciculatus*), white sage or black sage.

Blue Elderberry Stands - Sambucus nigra Shrubland Alliance

Although characterized as native, since the main shrub and tree species are native to the area, blue elderberry stands also exhibit substantial presence of ruderal (weedy, non-native) elements. Blue elderberry stands were identified throughout upland areas adjacent to the Zone 1 Ditch. This community is characterized as having a moderately dense, small tree layer of blue elderberry, interspersed with various species of trees and shrubs including River red gum (*Eucalyptus camaldulensis*), Southern black walnut (*Juglans californica*), western sycamore (*Platanus racemosa*), golden current (*Ribes aureum*), coast live oak (*Quercus agrifolia*) and Shamel ash. This community, within the boundaries of the Whittier Narrows Nature Preserve, tend to support more native tree species as well as a dense shrub layer dominated by the native golden current (*Ribes aureum* var. *gracillimum*). It is likely that this area has been restored/maintained to preserve native species and eradicate non-natives. Portions along the Zone 1 Ditch, outside the preserve support fewer native shrub and tree species with a pronounced herbaceous layer dominated by non-native species; much of this area was heavily choked with the passion flower (*Passiflora caerulea*), an escaped cultivated vine species.

As mentioned above, the herbaceous layer is composed predominantly of non-native grasses and forbs, overwhelmingly dominated by red brome (*Bromus rubens* ssp. *madritensis*), poison hemlock (*Conium maculatum*), sweet fennel (*Foeniculum vulgare*), shortpod mustard (*Hirschfeldia incana*), horehound (*Marrubium vulgare*) and Johnson grass (*Sorghum halepense*). This community has a NatureServe rank of S3G3 and is designated by CDFW as a Sensitive Natural Community.

Annual Brome Grassland - Bromus (diandrus, hordeaceus) - Brachypodium distachyon Herbaceous Semi-Natural Alliance

This community was observed and mapped within San Jose Creek and the San Gabriel River. Brome (*Bromus hordeaceus*) is generally dominant or co-dominant with nonnatives in the herbaceous layer. Emergent trees and shrubs may be present at low cover.

3.2.5 Non-native Communities

Disturbed/Developed

Disturbed/developed areas exist throughout the study area. Developed land use consists of paved and unpaved roadways, boulder rip-rap, and various other forms of infrastructure either completely or largely devoid of vegetative cover. Disturbed areas are represented by the dominance of weedy, non-native herbaceous species in areas that appeared to have been cleared or may have been subject to scouring within the main San Gabriel River channel, which include tree tobacco (*Nicotiana glauca*), castor bean (*Ricinus communis*) and other ruderal (non-native) species.

Non-native Tree Woodland (including Eucalyptus Semi-Natural Stands [Eucalyptus spp. Woodland Semi-Natural Alliance)

Non-native tree woodland occurs throughout much of the floodplain surrounding the Rio Hondo, upstream of the Whittier Narrows Dam, intermittently within the San Gabriel River, and along the Zone 1 Ditch. This community supports a tree layer dominated by non-native species such as bluegum, edible fig, red river gum, Shamel ash and Chinese elm (*Ulmus parvifolia*) that is interspersed with native species such as black and sandbar willow. This community supports a herbaceous layer identical in character to the adjacent, disturbed, weed-dominated plant community and includes such species as castor bean, poison sumac, shortpod mustard and sweet clover.

Ruderal Forbland (including Mustard Semi-Natural Stands [Brassica nigra - Raphanus spp. Herbaceous Semi-Natural Alliance] and Poison Hemlock Patches [Conium maculatum Herbaceous Semi-Natural Alliance])

Ruderal vegetation, dominated by common non-native forbs established in historically disturbed areas, was present throughout much of the Rio Hondo floodplain, along the San Gabriel River and along the Zone 1 Ditch. This community consists almost entirely of non-native, herbaceous forbs and some shrub species such as castor bean, cheeseweed mallow (*Malva parviflora*), shortpod mustard, sweet clover, poison hemlock, and Himalayan blackberry (*Rubus armeniacus*). Native species, such as annual burrweed (*Ambrosia acanthicarpa*), ragweed (*A. psilostachya*) and annual sunflower (*Helianthus annuus*) may also occur and may be co-dominant in some areas. A few native and non-native tree species are also scattered throughout this community, such as blue gum, edible fig (*Ficus carica*), red river gum and Shamel ash.

Non-Native Grassland

This community is characterized by dominant presence of non-native grass species with forbs also present but not completely dominant. These common ruderal grasses include red brome

(*Bromus rubens* ssp. *madritensis*), ripgut brome (*Bromus diandrus*) shortpod mustard (*Hirschfeldia incana*), black mustard (*Brassica nigra*), horehound (*Marrubium vulgare*), and Johnson grass (*Sorghum halepense*). Poison hemlock (*Conium maculatum*) and sweet fennel (*Foeniculum vulgare*) are also present and may be dominant in small patch areas. This community was mapped within the upland portions of the Zone 1 Ditch.

Barren

Several areas devoid of vegetation were mapped along the San Gabriel River and Zone 1 Ditch.

Perennial Pepper weed Patches - Lepidium latifolium Herbaceous Semi-Natural Alliance

This community was observed and mapped within the San Gabriel River. Perennial pepperweed patches (*Lepidium latifolium*) are generally dominant in the herbaceous layer with pepper weed.

3.3 CDFW Sensitive Natural Communities and Habitat

"Sensitive" natural communities and habitats are those defined by the CDFW as those that have a reduced range and/or are imperiled due to various forms of impact such as residential and commercial development, agriculture, energy production and mining, and an influx of invasive and other problematic species. Vegetation communities are evaluated using NatureServe's Heritage Methodology (NatureServe, 2018) which is based on the knowledge of range and distribution of a specific vegetation type and the proportion of occurrences that are of good ecological integrity. Evaluation is done at both State (within California[S]) and Global (natural range within and outside of California[G]), each ranked from 1 (very rare and threatened) to 5 (demonstrably secure). Natural communities and habitats with state ranks of S1-S3 are considered Sensitive Natural Communities and require review when evaluating CEQA impacts.

Sensitive Natural Communities that are present within the project area include arroyo willow thickets, black cottonwood forest, black willow thickets, blue elderberry, box-elder forest, California sycamore woodlands, California walnut groves, white alder groves, wild grape shrubland, coast prickly pear scrub, scale broom scrub, and basket bush patches.

3.4 Special-Status Species

Special-status species are defined as those plants and animals that, because of their recognized rarity or vulnerability to various causes of habitat loss or population decline, are recognized by federal, state, or other agencies as under threat from human-associated actions. Some of these species receive specific protections that are defined by federal or state endangered species legislation. Others have been designated as special-status on the basis of adopted policies of state resource agencies or organizations with acknowledged expertise, or policies adopted by local governmental agencies such as counties, cities, and special districts to meet local conservation objectives. Wildlife and plants can be designated as special-status species in several ways:

- **Federal Endangered Species Act (ESA):** Species listed or proposed for listing as "threatened" or "endangered", or as a "candidate" for possible future listing as threatened or endangered; "critical habitat" can be designated for listed species; USFWS currently oversees special-status listing for species in the study and survey areas;

- **California ESA**: Species listed or proposed for listing as "threatened" or "endangered", or are a "candidate" for possible future listing as threatened or endangered;
- **California Environmental Quality Act (CEQA) Guidelines, Section 15380**: Species that meet the definitions of "rare" or "endangered", as defined in Section 15380 of the CEQA Guidelines; and/or
- **California Department of Fish and Wildlife (CDFW)**: Species designated by CDFW as "species of special concern" and species on the watch list for listing to the California ESA; and species identified as "fully protected" under the California Fish and Game Code; Sections 3511, 4700, and 5050.

3.4.1 Special-Status Plants

Special-status plants are generally not expected to occur in the study or survey due to the high level of habitat degradation that has occurred from streambed alterations (i.e., cement-lined and accelerated flows), ground disturbance, extensive populations of exotic plant species that outcompete natives, homeless encampments, and trash. CNDDB records that intersect with the River include several special-status plants. A summary of the listing status for each of these species, as well as their likelihood of occurrence in the study and survey area is presented in **Table 1**, *Special Status Plants Considered – Potential to Occur*. The "Potential for Occurrence" as described in Table 1 is defined as follows:

- **Not Expected:** The study and survey areas and/or immediate vicinity does not provide suitable habitat for a particular species.
- **Low Potential:** The study and survey areas and/or immediate vicinity only provide limited habitat for a particular species. In addition, the study area may lie outside the known range for a particular species.

3.4.2 Special-Status Wildlife

The potential for special-status wildlife species to occur in the study and survey areas was determined through the field survey, which noted observations of special-status species and the extent and quality of supporting habitat, as well as published geographic range maps, and recent or past occurrences within the study and survey areas as report to the CNDDB and the other resources that were reviewed. A summary of the listing status for each of these species, as well as their likelihood of occurrence in the Study Area is presented in **Table 2**, *Special Status Wildlife – Potential to Occur*. The "Potential for Occurrence" as described in Table 2 is defined as follows:

- **Not Expected:** The study and survey areas and/or immediate vicinity does not support suitable habitat for a particular species.
- **Low Potential:** The study and survey areas and/or immediate vicinity only provide limited habitat for a particular species. In addition, the known range for a particular species may be outside of the immediate project area.
- **Medium Potential:** The study and survey areas and/or immediate vicinity provide suitable habitat for a particular species.
- **High Potential:** The study and survey areas and/or immediate vicinity provide ideal habitat conditions for a particular species and/or known populations occur in the immediate area.
- **Present:** The species was observed on the site during a field survey conducted by ESA in 2018 or 2019.

TABLE 1
SPECIAL STATUS PLANTS CONSIDERED —POTENTIAL TO OCCUR

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
aphanisma *blitoides*	—/—/1B.2	Coastal bluff scrub, coastal dunes, coastal scrub. On bluffs and slopes near the ocean in sandy or clay soils. 3-305 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Braunton's milk-vetch *Astragalus brauntonii*	E/—/1B.1	Chaparral, coastal scrub, valley and foothill grassland. Recent burns or disturbed areas; usually on sandstone with carbonate layers. Soil specialist; requires shallow soils to defeat pocket gophers and open areas, preferably on hilltops, saddles or bowls between hills. 3-640 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Ventura Marsh milk-vetch *Astragalus pycnostachyus* var. *lanosissimus*	E/E/1B.1	Marshes and swamps, coastal dunes, coastal scrub. Within reach of high tide or protected by barrier beaches, more rarely near seeps on sandy bluffs. 1-35 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Coulter's saltbush *Atriplex coulteri*	—/—/1B.2	Coastal bluff scrub, coastal dunes, coastal scrub, valley and foothill grassland. Ocean bluffs, ridgetops, as well as alkaline low places. Alkaline or clay soils. 2-460 m.	**Not Expected:** No suitable habitat for the species present in the study area.
south coast saltscale *Atriplex pacifica*	—/—/1B.2	Coastal scrub, coastal bluff scrub, playas, coastal dunes. Alkali soils. 1-400 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Parish's brittlescale *Atriplex parishii*	—/—/1B.1	Vernal pools, chenopod scrub, playas. Usually on drying alkali flats with fine soils. 5-1420 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Davidson's saltscale *Atriplex serenana* var. *davidsonii*	—/—/1B.2	Coastal bluff scrub, coastal scrub. Alkaline soil. 0-460 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Nevin's barberry *Berberis nevinii*	E/E/1B.1	Chaparral, cismontane woodland, coastal scrub, riparian scrub. On steep, N-facing slopes or in low grade sandy washes. 290-1575 m.	**Not Expected:** The one specimen from near the study area is believed to planted by the Whittier Narrows Nature Center; otherwise, the study area is outside of the current range of the species.
slender mariposa-lily *Calochortus* clavatus var. *gracilis*	—/—/1B.2	Chaparral, coastal scrub, valley and foothill grassland. Shaded foothill canyons; often on grassy slopes within other habitat. 210-1815 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Plummer's mariposa-lily *Calochortus plummerae*	—/—/4.2	Coastal scrub, chaparral, valley and foothill grassland, cismontane woodland, lower montane coniferous forest. Occurs on rocky and sandy sites, usually of granitic or alluvial material. Can be very common after fire. 60-2500 m.	**Not Expected:** No suitable habitat for the species present in the study area.
intermediate mariposa-lily *Calochortus weedii* var. *intermedius*	—/—/1B.2	Coastal scrub, chaparral, valley and foothill grassland. Dry, rocky open slopes and rock outcrops. 60-1575 m.	**Not Expected:** No suitable habitat for the species present in the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
lucky morning-glory *Calystegia felix*	—/—/1B.1	Meadows and seeps, riparian scrub. Sometimes alkaline, alluvial. 30-215 m.	**Not Expected:** No suitable habitat for the species present in the study area.
southern tarplant *Centromadia parryi* ssp. *australis*	—/—/1B.1	Marshes and swamps (margins), valley and foothill grassland, vernal pools. Often in disturbed sites near the coast at marsh edges; also in alkaline soils sometimes with saltgrass. Sometimes on vernal pool margins. 0-975 m.	**Not Expected:** No suitable habitat for the species present in the study area.
smooth tarplant *Centromadia pungens* ssp. *laevis*	—/—/1B.1	Valley and foothill grassland, chenopod scrub, meadows and seeps, playas, riparian woodland. Alkali meadow, alkali scrub; also in disturbed places. 5-1170 m.	**Low Potential:** There is marginal habitat for the species present in the study area; however, most records for the species are from San Bernardino, Riverside and San Diego counties.
salt marsh bird's-beak *Chloropyron maritimum* ssp. *maritimum*	E/E/1B.2	Marshes and swamps, coastal dunes. Limited to the higher zones of salt marsh habitat. 0-10 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Parry's spineflower *Chorizanthe parryi* var. *parryi*	—/—/1B.1	Coastal scrub, chaparral, cismontane woodland, valley and foothill grassland. Dry slopes and flats; sometimes at interface of 2 vegetation types, such as chaparral and oak woodland. Dry, sandy soils. 90-1220 m.	**Not Expected:** No suitable habitat for the species present in the study area.
California saw-grass *Cladium californicum*	—/—/2B.2	Meadows and seeps, marshes and swamps (alkaline or freshwater). Freshwater or alkaline moist habitats. -20-2135 m.	**Not Expected:** No suitable habitat for the species present in the study area. There is only one historic (1861) record from Los Angeles County.
Peruvian dodder *Cuscuta obtusiflora* var. *glandulosa*	—/—/2B.2	Marshes and swamps (freshwater). Freshwater marsh. 15-280 m.	**Not Expected:** No suitable habitat for the species present in the study area. There are no herbarium records from Los Angeles County.
slender-horned spineflower *Dodecahema leptoceras*	E/E/1B.1	Chaparral, cismontane woodland, coastal scrub (alluvial fan sage scrub). Flood deposited terraces and washes; associates include *Encelia*, *Dalea*, *Lepidospartum*, etc. *Sandy* soils. 200-765 m.	**Not Expected:** There is marginal habitat for the species present in the study area; however, most of the herbarium records in Los Angeles County are located near the foothills of the San Gabriel Mountains.
many-stemmed dudleya *Dudleya multicaulis*	—/—/1B.2	Chaparral, coastal scrub, valley and foothill grassland. In heavy, often clayey soils or grassy slopes. 15-790 m.	**Not Expected:** No suitable habitat for the species present in the study area.
San Diego button-celery *Eryngium aristulatum* var. *parishii*	E/E/1B.1	Vernal pools, coastal scrub, valley and foothill grassland. San Diego mesa hardpan & claypan vernal pools & southern interior basalt flow vernal pools; usually surrounded by scrub. 15-880 m.	**Not Expected:** No suitable habitat for the species present in the study area.
San Gabriel bedstraw *Galium grande*	—/—/1B.2	Cismontane woodland, chaparral, broadleafed upland forest, lower montane coniferous forest. Open chaparral and low, open oak forest; on rocky slopes; probably undercollected due to inaccessible habitat. 425-1450 m.	**Not Expected:** No suitable habitat for the species present in the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
Los Angeles sunflower *Helianthus nuttallii* ssp. *parishii*	—/—/1A	Marshes and swamps (coastal salt and freshwater). 35-1525 m.	**Not Expected:** The species is believed to be extinct.
mesa horkelia *Horkelia cuneata* var. *puberula*	—/—/1B.1	Chaparral, cismontane woodland, coastal scrub. Sandy or gravelly sites. 15-1645 m.	**Low Potential:** There is marginal habitat for the species present in the study area.
decumbent goldenbush *Isocoma menziesii* var. *decumbens*	—/—/1B.2	Coastal scrub, chaparral. Sandy soils; often in disturbed sites. 1-915 m.	**Not Expected:** There is marginal habitat for the species present in the study area; however, the study area is at the northern limits of the range of the species, with most of the herbarium records for the species being from San Diego County.
Coulter's goldfields *Lasthenia glabrata* ssp. *coulteri*	—/—/1B.1	Coastal salt marshes, playas, vernal pools. Usually found on alkaline soils in playas, sinks, and grasslands. 1-1375 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Robinson's pepper-grass *Lepidium virginicum* var. *robinsonii*	—/—/4.3	Chaparral, coastal scrub. Dry soils, shrubland. 4-1435 m.	**Low Potential:** There is marginal habitat for the species present in the study area and records of the species upstream.
California muhly *Muhlenbergia californica*	—/—/4.3	Coastal scrub, chaparral, lower montane coniferous forest, meadows and seeps. Usually found near streams or seeps. 100-2000 m.	**Not Expected:** There is marginal habitat for the species present in the study area; however, most of the herbarium records in Los Angeles County are in the San Gabriel Mountains.
mud nama *Nama stenocarpa*	—/—/2B.2	Marshes and swamps. Lake shores, river banks, intermittently wet areas. 5-500 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Gambel's water cress *Nasturtium gambelii*	E/T/1B.1	Marshes and swamps. Freshwater and brackish marshes at the margins of lakes and along streams, in or just above the water level. 5-330 m.	**Not Expected:** No suitable habitat for the species present in the study area.
prostrate vernal pool navarretia *Navarretia prostrata*	—/—/1B.1	Coastal scrub, valley and foothill grassland, vernal pools, meadows and seeps. Alkaline soils in grassland, or in vernal pools. Mesic, alkaline sites. 3-1235 m.	**Not Expected:** No suitable habitat for the species present in the study area.
coast woolly-heads *Nemacaulis denudata* var. *denudata*	—/—/1B.2	Coastal dunes. 0-100 m.	**Not Expected:** No suitable habitat for the species present in the study area.
California Orcutt grass *Orcuttia californica*	E/E/1B.1	Vernal pools. 10-660 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Lyon's pentachaeta *Pentachaeta lyonii*	E/E/1B.1	Chaparral, valley and foothill grassland, coastal scrub. Edges of clearings in chaparral, usually at the ecotone between grassland and chaparral or edges of firebreaks. 30-630 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Brand's star phacelia *Phacelia stellaris*	—/—/1B.1	Coastal scrub, coastal dunes. Open areas. 3-370 m.	**Not Expected:** There is marginal habitat for the species present in the study area; however, the study area is at the northern limits of the

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
			range of the species, with most of the herbarium records for the species being from San Diego County.
white rabbit-tobacco *Pseudognaphalium leucocephalum*	—/—/2B.2	Riparian woodland, cismontane woodland, coastal scrub, chaparral. Sandy, gravelly sites. 35-515 m.	**Low Potential:** There is marginal habitat for the species present in the study area.
Parish's gooseberry *Ribes divaricatum* var. *parishii*	—/—/1A	Riparian woodland. *Salix* swales in riparian habitats. 65-300 m.	**Not Expected:** The species is believed to be extinct.
salt spring checkerbloom *Sidalcea neomexicana*	—/—/2B.2	Playas, chaparral, coastal scrub, lower montane coniferous forest, Mojavean desert scrub. Alkali springs and marshes. 3-2380 m.	**Not Expected:** No suitable habitat for the species present in the study area.
estuary seablite *Suaeda esteroa*	—/—/1B.2	Marshes and swamps. Coastal salt marshes in clay, silt, and sand substrates. 0-80 m.	**Not Expected:** No suitable habitat for the species present in the study area.
San Bernardino aster *Symphyotrichum defoliatum*	—/—/1B.2	Meadows and seeps, cismontane woodland, coastal scrub, lower montane coniferous forest, marshes and swamps, valley and foothill grassland. Vernally mesic grassland or near ditches, streams and springs; disturbed areas. 2-2040 m.	**Low Potential:** There is marginal habitat for the species present in the study area.

TABLE 2
SPECIAL STATUS WILDLIFE – POTENTIAL TO OCCUR

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
Invertebrates			
Crotch bumblebee *Bombus crotchii*	—/—/SA	Coastal California east to the Sierra-Cascade crest and south into Mexico. Food plant genera include *Antirrhinum*, *Phacelia*, *Clarkia*, *Dendromecon*, *Eschscholzia*, and *Eriogonum*.	**High Potential:** Food plants are present in the study area and there are nearby records.
western tidal-flat tiger beetle *Cicindela gabbii*	—/—/SA	Inhabits estuaries and mudflats along the coast of Southern California. Generally found on dark-colored mud in the lower zone; occasionally found on dry saline flats of estuaries.	**Not Expected:** No suitable habitat for the species present in the study area.
sandy beach tiger beetle *Cicindela hirticollis gravida*	—/—/SA	Inhabits areas adjacent to non-brackish water along the coast of California from San Francisco Bay to northern Mexico. Clean, dry, light-colored sand in the upper zone. Subterranean larvae prefer moist sand not affected by wave action.	**Not Expected:** No suitable habitat for the species present in the study area.
western beach tiger beetle *Cicindela latesignata latesignata*	—/—/SA	Mudflats and beaches in coastal Southern California.	**Not Expected:** No suitable habitat for the species present in the study area.
senile tiger beetle *Cicindela senilis frosti*	—/—/SA	Inhabits marine shoreline, from Central California coast south to salt marshes of San Diego. Also found at Lake Elsinore Inhabits dark-colored mud in the lower zone and dried salt pans in the upper zone.	**Not Expected:** No suitable habitat for the species present in the study area.
globose dune beetle *Coelus globosus*	—/—/SA	Inhabitant of coastal sand dune habitat; erratically distributed from Ten Mile Creek in Mendocino County south to Ensenada, Mexico. Inhabits foredunes and sand hummocks; it burrows beneath the sand surface and is most common beneath dune vegetation.	**Not Expected:** No suitable habitat for the species present in the study area.
monarch - California overwintering population *Danaus plexippus* pop. 1	—/—/SA	Winter roost sites extend along the coast from northern Mendocino to Baja California, Mexico. Roosts located in wind-protected tree groves (eucalyptus, Monterey pine, cypress), with nectar and water sources nearby.	**Not Expected:** No suitable habitat for the species present in the study area.
wandering (=saltmarsh) skipper *Panoquina errans*	—/—/SA	Southern California coastal salt marshes. Requires moist saltgrass for larval development.	**Not Expected:** No suitable habitat for the species present in the study area.
Dorothy's El Segundo Dune weevil	—/—/SA	Coastal sand dunes in Los Angeles County.	**Not Expected:** No suitable habitat for the species present in the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
Trigonoscuta dorothea dorothea			
San Diego fairy shrimp *Branchinecta sandiegonensis*	E/—/—	Endemic to San Diego and Orange County mesas. Vernal pools.	**Not Expected:** No suitable habitat for the species present in the study area.
Fish			
Santa Ana sucker *Catostomus santaanae*	T/—/—	Endemic to Los Angeles Basin south coastal streams. Habitat generalists, but prefer sand-rubble-boulder bottoms, cool, clear water, and algae.	**Not Expected:** No suitable habitat for the species present in the study area. The species is known to occur upstream, but numerous barriers are present between the study area and these populations. This species was not observed during 2019 fish surveys conducted in Segments 2 through 4.
arroyo chub *Gila orcuttii*	—/—/SSC	Native to streams from Malibu Creek to San Luis Rey River basin. Introduced into streams in Santa Clara, Ventura, Santa Ynez, Mojave and San Diego river basins. Slow water stream sections with mud or sand bottoms. Feeds heavily on aquatic vegetation and associated invertebrates.	**Not Expected:** No suitable habitat for the species present in the study area. The species is known to occur upstream, but numerous barriers are present between the study area and these populations. This species was not observed during 2019 fish surveys conducted in Segments 2 through 4.
Santa Ana speckled dace *Rhinichthys osculus* ssp. 3	—/—/SSC	Headwaters of the Santa Ana and San Gabriel rivers. May be extirpated from the Los Angeles River system. Requires permanent flowing streams with summer water temps of 17-20° Celsius. Usually inhabits shallow cobble and gravel riffles.	**Not Expected:** No suitable habitat for the species present in the study area. The species is known to occur upstream, but numerous barriers are present between the study area and these populations. This species was not observed during 2019 fish surveys conducted in Segments 2 through 4.
		Amphibians	
arroyo toad *Anaxyrus californicus*	E/—/SSC	Semi-arid regions near washes or intermittent streams, including valley-foothill and desert riparian, desert wash, etc. Rivers with sandy banks, willows, cottonwoods, and sycamores; loose, gravelly areas of streams in drier parts of range.	**Not Expected:** No suitable habitat for the species present in the study area. The species has been extirpated from most of Los Angeles County.
southern mountain yellow-legged frog *Rana muscosa*	E/E/WL	Always encountered within a few feet of water. Tadpoles may require 2 - 4 years to complete their aquatic development.	**Not Expected:** No suitable habitat for the species present in the study area.
western spadefoot *Spea hammondii*	—/—/SSC	Occurs primarily in grassland habitats but can be found in valley-foothill hardwood woodlands. Vernal pools are essential for breeding and egg-laying.	**Not Expected:** No suitable habitat for the species present in the study area.
Coast Range newt *Taricha torosa*	—/—/SSC	Coastal drainages from Mendocino County to San Diego County. Lives in terrestrial habitats and will migrate over 1 kilometer to breed in ponds, reservoirs and slow-moving streams.	**Not Expected:** No suitable habitat for the species present in the study area. The species is known to occur upstream, but numerous barriers are present between the study area and these populations.
Reptiles			
California glossy snake	—/—/SSC	Patchily distributed from the eastern portion of San Francisco Bay, southern San Joaquin Valley, and the Coast, Transverse, and Peninsular	**Low Potential:** Marginal habitat for the species occurs in the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
Arizona elegans occidentalis		ranges, south to Baja California. Generalist reported from a range of scrub and grassland habitats, often with loose or sandy soils.	
orange-throated whiptail *Aspidoscelis hyperythra*	—/—/WL	Inhabits low-elevation coastal scrub, chaparral, and valley-foothill hardwood habitats. Prefers washes and other sandy areas with patches of brush and rocks. Perennial plants necessary for its major food: termites.	**Not Expected:** The study area is outside of the range of the species.
coastal whiptail *Aspidoscelis tigris stejnegeri*	—/—/SSC	Found in deserts and semi-arid areas with sparse vegetation and open areas. Also found in woodland and riparian areas. Ground may be firm soil, sandy, or rocky.	**Medium Potential.** Marginal habitat for the species is found in the study area
green sea turtle *Chelonia mydas*	T/—/—	Marine. Completely herbivorous; needs adequate supply of seagrasses and algae.	**Present:** This species has been observed in the San Gabriel River estuary area in Segment 8 in recent years. It is possible individual may occur anywhere in this segment subject to tidal influence and could occasionally occur in or near the “mixing zone” where Segment 7 meets Segment 8. This species is Not Expected in any other part of the Study Area because no suitable habitat is present and numerous barriers separate Segment 8 from upstream areas.
western pond turtle *Emys marmorata*	—/—/SSC	A thoroughly aquatic turtle of ponds, marshes, rivers, streams and irrigation ditches, usually with aquatic vegetation, below 6000 feet elevation. Needs basking sites and suitable (sandy banks or grassy open fields) upland habitat up to 0.5 km from water for egg-laying.	**Low Potential:** The CNDDB includes two records in the near vicinity from the 1980’s, one near the Zone 1 Ditch and one in the San Gabriel River. It is possible but not likely that native pond turtle could have persisted in Segment 2 and Segment 3, since suitable habitat is present. These segments contain a relatively limited amount of potentially suitable egg-laying habitat near areas where surface water occurs. Also, introduced predators (e.g., bullfrog, African clawed frog, carp, bass) are prevalent and storm events occasionally result in extremely high flows in these segments that would put estivating turtles at risk. These factors reduce the chances that a viable breeding population could persist and make it likely that this species has been extirpated in the study area. The species occurs in upstream area in the San Gabriel River, but numerous barriers are present between the study area and these populations. Western pond turtles were not observed or captured during the May 2019 surveys.
coast horned lizard *Phrynosoma blainvillii*	—/—/SSC	Frequents a wide variety of habitats, most common in lowlands along sandy washes with scattered low bushes. Open areas for sunning, bushes for cover, patches of loose soil for burial, and abundant supply of ants and other insects.	**Low Potential:** Marginal habitat for the species occurs in the study area.
two-striped garter snake *Thamnophis hammondii*	—/—/SSC	Coastal California from vicinity of Salinas to northwest Baja California. From sea to about 7,000 feet elevation. Highly aquatic, found in or near permanent fresh water.	**Low Potential:** Marginal habitat for the species occurs in the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
Birds			
Cooper's hawk *Accipiter cooperii*	—/—/WL	Habitat includes mature forest, open woodlands, wood edges, river groves. Typically nests in woodlands with tall trees and openings or edge habitat nearby. Increasingly found in cities where some tall trees exist.	**Present:** The species has been observed year-round in the study area and is expected to nest and forage there.
tricolored blackbird *Agelaius tricolor*	—/CE/SSC	Highly colonial species, most numerous in Central Valley and vicinity. Largely endemic to California. Requires open water, protected nesting substrate, and foraging area with insect prey within a few km of the colony.	**Not Expected:** No suitable nesting habitat for the species present in the study area. May pass through the area during migration. Species was not observed during 2019 surveys.
southern California rufous-crowned sparrow *Aimophila ruficeps canescens*	—/—/WL	Resident in Southern California coastal sage scrub and sparse mixed chaparral. Frequents relatively steep, often rocky hillsides with grass and forb patches.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
grasshopper sparrow *Ammodramus savannarum*	—/—/SSC	Dense grasslands on rolling hills, lowland plains, in valleys and on hillsides on lower mountain slopes. Favors native grasslands with a mix of grasses, forbs and scattered shrubs. Loosely colonial when nesting.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
burrowing owl *Athene cunicularia*	—/—/SSC	Open, dry annual or perennial grasslands, deserts, and scrublands characterized by low-growing vegetation. Subterranean nester, dependent upon burrowing mammals, most notably, the California ground squirrel.	**Low Potential.** The species is not expected to breed in the study area, but individuals could occur during winter and migration.
ferruginous hawk *Buteo regalis*	—/—/WL	Open grasslands, sagebrush flats, desert scrub, low foothills and fringes of pinyon and juniper habitats. Eats mostly lagomorphs, ground squirrels, and mice. Population trends may follow lagomorph population cycles.	**Not Expected:** Outside of the breeding range of the species. May pass through the study area during migration.
Swainson's hawk *Buteo swainsoni*	—/T/—	Breeds in grasslands with scattered trees, juniper-sage flats, riparian areas, savannahs, and agricultural or ranch lands with groves or lines of trees. Requires adjacent suitable foraging areas such as grasslands, or alfalfa or grain fields supporting rodent populations.	**Not Expected:** Outside of the breeding range of the species. May pass through the study area during migration.
coastal cactus wren *Campylorhynchus brunneicapillus sandiegensis*	—/—/SSC	Southern California coastal sage scrub. Wrens require tall *Opuntia* cactus for nesting and roosting.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
western snowy plover *Charadrius alexandrinus nivosus*	T/—/SSC	Sandy beaches, salt pond levees and shores of large alkali lakes. Needs sandy, gravelly or friable soils for nesting.	**Not Expected:** Outside of the breeding range of the species. May pass through the area during migration.
western yellow-billed cuckoo *Coccyzus*	FT/SE/—	Riparian forest nester, along the broad, lower flood-bottoms of larger river systems. Nests in riparian jungles of willow, often mixed with cottonwoods, with lower story of blackberry, nettles, or wild grape.	**Not Expected:** No suitable nesting habitat for the species present in the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
americanus occidentalis			
yellow rail *Coturnicops noveboracensis*	—/—/SSC	Summer resident in eastern Sierra Nevada in Mono County. Freshwater marshlands.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
black swift *Cypseloides niger*	—/—/SSC	Coastal belt of Santa Cruz and Monterey counties; central and southern Sierra Nevada; San Bernardino and San Jacinto mountains. Breeds in small colonies on cliffs behind or adjacent to waterfalls in deep canyons and sea-bluffs above the surf; forages widely.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
white-tailed kite *Elanus leucurus*	—/—/FP	Rolling foothills and valley margins with scattered oaks and river bottomlands or marshes next to deciduous woodland. Open grasslands, meadows, or marshes for foraging close to isolated, dense-topped trees for nesting and perching.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
southwestern willow flycatcher *Empidonax traillii extimus*	E/E/—	Prefers dense vegetation throughout all vegetation layers present in riparian areas. Prefers nesting over or in the immediate vicinity of standing water.	**Low Potential:** Marginal habitat for the species occurs in the study area.
American peregrine falcon *Falco peregrinus anatum*	D/D/FP	Near wetlands, lakes, rivers, or other water; on cliffs, banks, dunes, mounds; also, human-made structures. Nest consists of a scrape or a depression or ledge in an open site.	**Not Expected:** No suitable nesting habitat for the species present in the study area. May forage in the study area.
yellow-breasted chat *Icteria virens*	—/—/SSC	Summer resident; inhabits riparian thickets of willow and other brushy tangles near watercourses. Nests in low, dense riparian, consisting of willow, blackberry, wild grape; forages and nests within 10 feet of ground.	**Present:** The species has been observed and is expected to use the study area for nesting and foraging.
California black rail *Laterallus jamaicensis coturniculus*	—/T/FP	Inhabits freshwater marshes, wet meadows and shallow margins of saltwater marshes bordering larger bays. Needs water depths of about 1 inch that do not fluctuate during the year and dense vegetation for nesting habitat.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
osprey *Pandion haliaetus*	—/—/WL	Ocean shore, bays, freshwater lakes, and larger streams. Large nests built in tree-tops within 15 miles of a good fish-producing body of water.	**Not Expected:** No suitable nesting or foraging habitat for the species present in the study area.
Belding's savannah sparrow *Passerculus sandwichensis beldingi*	—/E/—	Inhabits coastal salt marshes, from Santa Barbara south through San Diego County. Nests in Salicornia on and about margins of tidal flats.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
California brown pelican *Pelecanus*	D/D/FP	Colonial nester on coastal islands just outside the surf line. Nests on coastal islands of small to moderate size which afford immunity from attack by ground-dwelling predators. Roosts communally.	**Not Expected:** No suitable nesting habitat for the species present in the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
occidentalis californicus			
coastal California gnatcatcher *Polioptila californica californica*	T/—/SSC	Obligate, permanent resident of coastal sage scrub below 2500 feet in Southern California. Low, coastal sage scrub in arid washes, on mesas and slopes. Not all areas classified as coastal sage scrub are occupied.	**High Potential:** No suitable nesting habitat for the species present in the study area. However, the study area is within designated critical habitat for the species. The species is known to occur adjacent to the study area in the Montebello Hills and may occur in the study area as a transient. The species is not expected to occur within the river channel since suitable habitat for this species is not present in the river channel.
light-footed Ridgway's rail *Rallus obsoletus levipes*	E/E/FP	Found in salt marshes traversed by tidal sloughs, where cordgrass and pickleweed are the dominant vegetation. Requires dense growth of either pickleweed or cordgrass for nesting or escape cover; feeds on mollusks and crustaceans.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
bank swallow *Riparia riparia*	—/T/—	Colonial nester; nests primarily in riparian and other lowland habitats west of the desert. Requires vertical banks/cliffs with fine-textured/sandy soils near streams, rivers, lakes, ocean to dig nesting hole.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
black skimmer *Rynchops niger*	—/—/SSC	Nests on gravel bars, low islets, and sandy beaches, in unvegetated sites. Nesting colonies usually less than 200 pairs.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
yellow warbler *Setophaga petechia*	—/—/SSC	Riparian plant associations in close proximity to water. Also nests in montane shrubbery in open conifer forests in Cascades and Sierra Nevada. Frequently found nesting and foraging in willow shrubs and thickets, and in other riparian plants including cottonwoods, sycamores, ash, and alders.	**Present:** The species has been observed and is expected to use the study area for nesting and foraging.
California least tern *Sternula antillarum browni*	E/E/FP	Nests along the coast from San Francisco Bay south to northern Baja California. Colonial breeder on bare or sparsely vegetated, flat substrates: sand beaches, alkali flats, landfills, or paved areas.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
least Bell's vireo *Vireo bellii pusillus*	E/E/—	Summer resident of Southern California in low riparian in vicinity of water or in dry river bottoms; below 2000 feet. Nests placed along margins of bushes or on twigs studying into pathways, usually willow, Baccharis, mesquite.	**Present:** The species has been observed and is expected to use the study area for nesting and foraging.
Mammals			
pallid bat *Antrozous pallidus*	—/—/SSC	Deserts, grasslands, shrublands, woodlands and forests. Most common in open, dry habitats with rocky areas for roosting. Roosts must protect bats from high temperatures. Very sensitive to disturbance of roosting sites.	**Not Expected:** No suitable roosting habitat for the species present in the study area. May forage in the study area.
Townsend's big-eared bat *Corynorhinus townsendii*	—/—/SSC	Throughout California in a wide variety of habitats. Most common in mesic sites. Roosts in the open, hanging from walls and ceilings. Roosting sites limiting. Extremely sensitive to human disturbance.	**Not Expected:** No suitable roosting habitat for the species present in the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
western mastiff bat *Eumops perotis californicus*	—/—/SSC	Many open, semi-arid to arid habitats, including conifer and deciduous woodlands, coastal scrub, grasslands, chaparral, etc. Roosts in crevices in cliff faces, high buildings, trees and tunnels.	**Low Potential:** Species was not observed or detected during bat emergence survey and acoustic monitoring conducted in 2019; however, species could potentially forage within the project area.
silver-haired bat *Lasionycteris noctivagans*	—/—/ WBWG	Primarily a coastal and montane forest dweller, feeding over streams, ponds and open brushy areas. Roosts in hollow trees, beneath exfoliating bark, abandoned woodpecker holes, and rarely under rocks. Needs drinking water.	**Low Potential:** Species was not observed or detected during bat emergence survey and acoustic monitoring conducted in 2019; however, species could potentially forage within the project area.
western red bat *Lasiurus blossevillii*	—/—/SSC	Roosts primarily in trees, 2-40 feet above ground, from sea level up through mixed conifer forests. Roosts in the foliage of trees and shrubs in forests. Prefers habitat edges and mosaics with trees that are protected from above and open below with open areas for foraging.	**Present:** This species was detected during bat emergence surveys and acoustic monitoring conducted in 2019.
hoary bat *Lasiurus cinereus*	—/—/ WBWG	Prefers open habitats or habitat mosaics, with access to trees for cover and open areas or habitat edges for feeding. Roosts in dense foliage of medium to large trees. Feeds primarily on moths. Requires water.	**Low Potential:** Species was not observed or detected during bat emergence survey and acoustic monitoring conducted in 2019; however, species could roost and forage seasonally during the winter, spring, and fall migration.
western yellow bat *Lasiurus xanthinus*	—/—/SSC	Found in valley foothill riparian, desert riparian, desert wash, and palm oasis habitats. Roosts in trees, particularly palms. Forages over water and among trees.	**Low Potential:** Species was not observed or detected during bat emergence survey and acoustic monitoring conducted in 2019; however, species could potentially roost and forage year-round within the project area.
San Diego black-tailed jackrabbit *Lepus californicus bennettii*	—/—/SSC	Intermediate canopy stages of shrub habitats and open shrub / herbaceous and tree / herbaceous edges. Coastal sage scrub habitats in Southern California.	**Low Potential:** The species may be extirpated from the study area due to the loss of suitable habitat.
south coast marsh vole *Microtus californicus stephensi*	—/—/SSC	Tidal marshes in Los Angeles, Orange and southern Ventura counties.	**Not Expected:** No suitable habitat for the species present in the study area.
pocketed free-tailed bat *Nyctinomops femorosaccus*	—/—/SSC	Variety of arid areas in Southern California; pine-juniper woodlands, desert scrub, palm oasis, desert wash, desert riparian, etc. Rocky areas with high cliffs.	**Not Expected:** No suitable roosting habitat for the species present in the study area. May forage in the study area.
big free-tailed bat *Nyctinomops macrotis*	—/—/SSC	A migratory species that forms maternity colonies in rock crevices and caves that are typically used long term. Roost mainly in crevices and rocks in cliff situations, with occasional roosts occurring in buildings, caves, and tree cavities.	**Not Expected:** No suitable roosting habitat for the species present in the study area. May forage in the study area.
southern grasshopper mouse	—/—/SSC	Desert areas, especially scrub habitats with friable soils for digging. Prefers low to moderate shrub cover. Feeds almost exclusively on arthropods, especially scorpions and orthopteran insects.	**Not Expected:** No suitable habitat for the species present in the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
Onychomys torridus ramona			
Pacific pocket mouse *Perognathus longimembris pacificus*	E/—/SSC	Inhabits the narrow coastal plains from the Mexican border north to El Segundo, Los Angeles County. Seems to prefer soils of fine alluvial sands near the ocean, but much remains to be learned.	**Not Expected:** No suitable habitat for the species present in the study area.
southern California saltmarsh shrew *Sorex ornatus salicornicus*	—/—/SSC	Coastal marshes in Los Angeles, Orange and Ventura counties. Requires dense vegetation and woody debris for cover.	**Not Expected:** No suitable habitat for the species present in the study area.
American badger *Taxidea taxus*	—/—/SSC	Most abundant in drier open stages of most shrub, forest, and herbaceous habitats, with friable soils. Needs sufficient food, friable soils and open, uncultivated ground. Preys on burrowing rodents. Digs burrows.	**Not Expected:** The species is extirpated within the study area.

Definitions:
1. Federal status: USFWS Listing, other non-CA specific listing
BC – Bird of Conservation Concern
FE = Listed as endangered under the federal Endangered Species Act (ESA)
FT = Listed as threatened under ESA

2. State status: CDFW Listing
SE = Listed as endangered under the California Endangered Species Act (CESA)
ST = Listed as threatened under the CESA
SSC = Species of Special Concern as identified by the CDFW
FP = Listed as fully protected under CDFG code
WL = Listed as a Watchlist species by CDFW

3. Other status:
WBWG = Listing by the Western Bat Working Group

3.4.3 Listed Species Present or Expected to Occur

California Gnatcatcher (*Polioptila californica californica*)

The coastal California gnatcatcher was federally listed as threatened on March 30, 1993 (58 FR 16742) and is noted as a State Species of Special Concern for CDFW. Critical habitat was designated by USFWS in 2000. Critical habitat in the study area overlays the WRNA, the Crossover Channel and the adjacent section of the San Gabriel River upstream from Whittier Narrows Dam up to the inlet to the Zone 1 Ditch. Despite being designated as Critical Habitat, potentially suitable nesting habitat is lacking from the San Gabriel River but does occur within patches of upland vegetation within the blue elderberry plant community where patches of California buckwheat, sagebrush and other sage scrub representative shrubs provide adequate cover and patch size. This species has been reported in the WNRA (Aspen 2009) and is considered potentially present and may breed within that part of the study area. The breeding season of the coastal California gnatcatcher extends from about February 15 through August 30, with the peak of nesting activity occurring from mid-March through mid-May.

Least Bell's Vireo (*Vireo bellii pusillus*)

A range-wide decline of least Bell's vireo resulted in its being federally listed as endangered on May 2, 1986 (51 FR 16474). Critical habitat for the species was designated on February 2, 1994. The State of California listed the least Bell's vireo as Endangered on June 27, 1980. The decline was attributed to extensive historic habitat loss and degradation and brood parasitism by brown-headed cowbirds (*Molothrus ater*).

The least Bell's vireo is a summer resident of cottonwood-willow forest, oak woodland, shrubby thickets, and dry washes with willow thickets at the edges. The cottonwood-willow habitat is the more commonly used habitat. The physical and biological habitat features that support feeding, nesting, roosting, and sheltering essential to the conservation of the vireo are described by USFWS as "riparian woodland vegetation that generally contains both canopy and shrub layers, and includes some associated upland habitats."

The closest area of designated Critical Habitat for this species is at least 20 miles to the east of the study area in the Prado Basin located north of SR-91 and east of SR-71 in the Chino area, upstream from Prado Dam on the Santa Ana River. However, this species is known from multiple reports to occur along the reach of the San Gabriel River in Segments 2, 3, 4, and the upstream part of 5 (USACE 2016). It has also been observed in the WNRA although very recent data is not available. Most of the native riparian woodland and riparian scrub (e.g., black willow, mule fat), except very small (e.g., < 0.1 acre), isolated and disturbed patches, are considered to provide suitable breeding habitat in the study area. Blue elderberry stands in the WNRA provide additional foraging habitat and may offer suitable nesting opportunities.

4.0 Results

4.1 Tri-Colored Blackbird Surveys

No tri-colored blackbirds were observed or heard vocalizing during the surveys. At the time of the surveys, approximately 50% of cattails and tules were matted or removed (i.e., scoured) from a recent heavy rain event.

Several red-wing blackbirds (*Agelaius phoeniceus*), a similar and closely related species to tri-colored blackbird, were observed within the survey area along the San Gabriel River. A total of 48 avian species were observed; including, but not limited to: American coot (*Fulica Americana*), great blue heron (Ardea herodias), great egret (*Ardea alba*), green heron (*Butorides virescens*), killdeer (*Charadrius vociferous*), least sandpiper (*Calidris minutilla*), mallard (*Anas platyrhynchos*), ring-billed gull (*Larus delawarensis*), snowy egret (*Egretta thula*), and spotted sandpiper (*Actitis macularius*).

4.2 Fish Surveys

Eleven sites within Segments 2, 3, and 4 were sampled for fish using the seining method, capturing or observing a total of 30 fish. **Table 3** lists the survey sites, coordinates and method; species observed, and the total amount of fish captured (or observed).

TABLE 3
SURVEY LOCATION, METHOD, SPECIES, AND TOTAL CAUGHT

Site	Site Coordinates	Method	Western mosquitofish	Mozambique tilapia	Common carp	Total fish
Site #1	34.036866, -118.022998	Seine	0	0	0	0
Site #2	34.036083, -118.021615	Seine	0	2	0	2
Site #3	34.037812, -118.024696	Seine	0	0	0	0
Site #4	34.031982, -118.042252	Seine	0	0	0	0
Site #5	34.031838, -118.043517	Seine	0	0	0	0
Site #6	34.031606, -118.044268	Seine	0	0	0	0
Site #7	34.031285, -118.044790	Seine	0	0	1	1
Site #8	34.036541, -118.030416	Seine	0	2	0	2
Site #9	34.036035, -118.030967	Seine	0	0	0	0
Site #10	34.038893, -118.027153	Seine	5	0	0	5
Site #11	34.041783, -118.019516	Seine	20	0	0	20
Total			**25**	**4**	**1**	**30**

Species observed or captured during the survey included western mosquitofish (*Gambusia affinis,* non-native), Mozambique tilapia (*Oreochromis mossambicus,* non-native), and common carp (*Cyprinus carpio,* non-native). No fish were observed or captured at Sites #1, 3, 4, 5, 6, and 9, while Sites #2, 7, 8, 10, and 11 produced a minimal amount of fish. Approximately 25 red-eared sliders (*Trachemys scripta elegans*) were observed or captured in the survey area as well. No native fish species were observed or captured.

4.3 Water Quality Sampling

The water quality sampling results are included in **Table 4**.

TABLE 4
WATER QUALITY SAMPLING DATA

Site	Date and Time	pH	Temp. (°C)/ (°F)	Dissolved Oxygen (mg/l)
Site #1	2/19/19 7:03 am	7.98	10.99/51.78	10.93
Site #2	2/19/19 8:11 am	7.77	11.30/52.34	11.30
Site #3	2/19/19 10:03 am	7.82	11.34/52.41	11.65
Site #4	2/19/19 12:12 pm	8.01	13.32/55.98	11.68
Site #5	2/19/19 1:03 pm	8.06	13.87/56.98	10.52
Site #6	2/20/19 7:05 am	7.98	11.31/52.36	10.32
Site #7	2/20/19 7:43 am	8.09	11.86/53.35	10.05
Site #8	2/20/19 9:39 am	7.99	12.01/53.62	10.64
Site #9	2/20/19 10:31 am	7.86	12.07/53.73	10.74
Site #10	2/20/19 12:07 pm	8.11	12.43/54.37	10.84
Site #11	2/20/19 1:33 pm	8.06	13.65/56.57	10.61

Temperature, pH, and dissolved oxygen remained consistent at each location, including during different times of the day. Water temperatures remained cold throughout the survey, ranging from 10.99°C (51.78°F) to 13.87°C (56.98°F). With such consistent water quality parameters at each of the sampling locations, this only benefits the functionality of the San Gabriel River and San Jose Creek for aquatic species.

4.4 Bat Surveys

The river corridor within the survey area includes naturalized habitats within a bermed flood control channel. Habitats include open water, riparian forest, riparian scrub, non-native herbaceous grassland. The river corridor is traversed by two major bridge crossings at Peck road and State Route (SR) 60.

Roost Assessment

The survey area contains features that may support roosting of bat species that typically roost in bridges or trees. Features identified within the survey area that may support day-roosting bats include bridge expansion gaps, box-girder bridge cavities, and mature riparian trees and snags with sloughing bark, crevices, and/or foliage roosting habitat. (e.g. cottonwoods and eucalyptus). The survey area does not contain cliffs, caves, or mines. Old industrial and residential buildings, including livestock stables, adjacent to the river corridor may also provide adjacent roosting habitat for species that roost in buildings.

Bridge-roosting habitat included expansion gaps at the SR-60 overpass and box-girder cavities at the Peck Road, SR-60, and I-605 overpasses. All of the large box culverts along the floodway were occupied by homeless camps, therefore these culverts were not surveyed for additional bat roosting habitat.

No guano was noted during the roost assessment; however, accumulated guano may have been washed away during recent flooding. Potential staining was noted along the expansion gap under the SR-60 overpass.

Emergence Survey and Active Monitoring

The emergence survey and active monitoring were conducted at the SR-60 overpass area because this area was determined to have the highest potential for roosting bats due to the presence of expansion gaps and staining along the underside of the bridge. During the emergence survey, the first bat detections occurred at 19:38 and 19:50 of Mexican free-tailed bat and Yuma myotis, respectively. Based on the time of detection, it was estimated that these individuals emerged from roosting in the SR-60 bridge. Five Yuma myotis individuals were subsequently identified by spotlighting within a gap under the bridge, adjacent to a colony of white-throated swifts that were roosting within the same gap.

Passive Acoustic Monitoring

A total of five bat species were detected during passive acoustic monitoring, as listed in **Table 5**. The most commonly detected species was the Mexican free-tailed bat with 960 passes[1], followed by the Yuma myotis with 122 passes.

TABLE 5
BAT SPECIES DETECTED IN THE SURVEY AREA

Common Name (Scientific Name)	Status[1]	Detection Type	Total Passes Detected
Western red bat (*Lasiurus blossevillii*)	CDFW-SSC; WBWG-H	Acoustic	4
Hoary bat (*Lasiurus cinereus*)	WBWG-M	Acoustic	2
California myotis (*Myotis californicus*)	None	Acoustic	16
Yuma myotis (*Myotis yumanensis*)	WBWG-L	Visual, Acoustic	122
Mexican free-tailed bat (*Tadarida brasiliensis*)	None	Acoustic	960

[1]Status Definitions:
CDFW-SSC = California Department of Fish and Wildlife Species of Special Concern
WBWG = Western Bat Working Group
WBWG-H = High Priority Species. These species are imperiled or are at high risk of imperilment.
WBWG-M = Medium Priority Species. A lack of meaningful information is a major obstacle in adequately assessing these species' status.
WBWG-L = Low Priority Species. Most of the existing data support stable populations of the species, and that the potential for major changes in status in the near future is considered unlikely.
None = No CDFW, U.S. Fish and Wildlife, or WBWG designation. Protection of maternity roosts is still applicable.

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[1] A "pass", for purposes of this analysis, is defined as a recorded sequence of bat echolocation calls with a duration of up to 3 seconds.

Table 6 describes the expected use of the survey area by bat species that were detected or are expected to occur, based on the bat roost assessment, emergence survey, and acoustic monitoring.

TABLE 6
EXPECTED BAT USE OF THE SURVEY AREA

Scientific Name	Typical Habitat	Expected Use of the Survey Area
Big brown bat (*Eptesicus fuscus*)	Foraging: Various habitats. Roosting: Caves, crevices, structures, tree hollows, palm skirts.	Potential year-round roosting and foraging.
California myotis (*Myotis californicus*)	Foraging: Various habitats, particularly riparian forest. Roosting: Crevices in caves, buildings, structures, and trees.	Year-round roosting and foraging .
Hoary bat (*Lasiurus cinereus*)	Foraging: Forested habitats. Roosting: Tree foliage.	Seasonal roosting and foraging (winter and spring/fall migration).
Mexican free-tailed bat (*Tadarida brasiliensis*)	Foraging: Various habitats. Roosting: Caves, crevices, buildings, and structures.	Year-round roosting and foraging.
Western red bat (*Lasiurus blossevillii*)	Foraging: Riparian habitats. Roosting: Tree foliage.	Year-round roosting and foraging.
Yuma myotis (*Myotis yumanensis*)	Foraging: Permanent water. Roosting: Caves, crevices, buildings, and structures.	Year-round roosting and foraging.
Western mastiff bat (*Eumops perotis californicus*)	Foraging: Various semi-arid to arid habitats. Roosting: Crevices in cliff faces, high buildings, trees and tunnels.	Potential occasional foraging.
Silver-haired bat (*Lasionycteris noctivagans*)	Foraging: Coniferous or mixed forests. Roosting: Hollow trees, under bark, and woodpecker holes.	Potential seasonal (spring/fall migration) roosting and foraging.
Western yellow bat (*Lasiurus xanthinus*)	Foraging: Riparian and palm oasis habitats. Roosting: Trees, particularly palms.	Potential year-round roosting and foraging.
Pocketed free-tailed bat (*Nyctinomops femorosaccus*)	Foraging: Variety of arid habitats. Roosting: Rocky areas with high cliffs.	Potential occasional foraging.
Big free-tailed bat (*Nyctinomops macrotis*)	Foraging: Diverse habitats. Roosting: Crevices and rocks in cliff situations.	Potential transient or migrant foraging.

4.5 Western Pond Turtle Survey

No western pond turtles were observed or captured during the surveys conducted in May 2019. Nineteen (19) red-eared sliders (RES) were observed or captured during the surveys. Other aquatic species observed during the survey included western mosquitofish, Mozambique tilapia, and common carp. Additionally, as previously described in Section 4.2, approximately 25 red-eared sliders were observed during the fish survey in February 2019. **Table 7** lists the survey date, start/end time, air/water temperature, wind speed, and species observed or captured. Complete survey data sheets can be observed in **Appendix B**.

TABLE 7
SUMMARY OF WESTERN POND TURTLE VISUAL AND TRAPPING SURVEY RESULTS

Survey Date	Start/End Time	Air/Water Temp (°F)	Wind Speed (mph)	Visual Survey	Trapping Survey
5/1/19	8:00 am – 2:00 pm	65-75/68-72	0-5	No western pond turtle; four (4) red-eared sliders observed.	N/A – traps were originally set on this day
5/2/19	8:00am – 2:00 pm	63-76/70-72	0-5	No western pond turtle observed.	Trap 1 – Three (3) RES Trap 2 – Zero (0) Trap 3 – Zero (0) Trap 4 – Six (6) RES Trap 5 – Zero (0) Trap 6 – Zero (0)
5/3/19	8:00 am – 2:00 pm	63-73/70	0-5	No western pond turtle observed.	Trap 1 – Two (2) RES Trap 2 – Zero (0) Trap 3 – Zero (0) Trap 4 – Zero (0) Trap 5 – Zero (0) Trap 6 – One (1) RES
5/4/19	8:00 am – 2:00 pm	66-78/70-71	0-5	No western pond turtle observed.	Trap 1 – One (1) RES Trap 2 – Zero (0) Trap 3 – Two (2) RES Trap 4 – Zero (0) Trap 5 – Zero (0) Trap 6 – Zero (0)

5.0 Project Impacts

The only special-status species known to occupy the study and survey areas are the California coastal gnatcatcher, least Bell's vireo, and western red bat. Reduced discharge to the stream channels would have no effect on the upland gnatcatcher habitat, but could affect riparian habitats supporting least Bell's vireo and western red bat. The current inconsistent discharges to the San Gabriel River above the Whittier Narrows Dam supports riparian habitat suitable for least Bell's vireo and western red bat, as well as small amounts of wetland habitat. These habitats types are reliant on consistent access to water.

Elimination of discharges from Pomona WRP would reduce freshwater within the concrete channels. However, this is not considered a significant impact, since no special-status species utilize this water due to the lack of suitable habitat (i.e., riparian vegetation).

Reducing annual discharges to the San Gabriel River could reduce moisture availability to riparian or wetland habitat. If the proposed project resulted in a reduction of riparian or wetland habitat, it would be a significant impact. However, it is likely that more water is currently discharged to the river than is required to maintain the existing riparian habitat as evidenced by bypass flows that are diverted at Zone 1 Ditch to other areas within the WNRA. In addition, the proposed project would improve the consistency of flow that would reduce prolonged droughts that occur under current conditions. Implementation of an Adaptive Management Plan would enable the Sanitation Districts to monitor the habitat within the WRNA and implement corrective management actions should impacts to riparian habitat be observed.

Below Whittier Narrows Dam, reduced flows from Pomona WRP and San Jose Creek WRP would have no impact on habitat, since existing discharge flows do not reach these river segments. Lastly, the discharge reductions from Los Coyotes WRP and Long Beach WRP would reduce freshwater within concrete channels; however, similar to the San Jose Creek WRP, this is not considered a significant impact since no special-status species utilize this water, and flows would not be entirely eliminated.

No impacts are expected on tri-colored blackbird or special-status fish species. Though suitable habitat (cattail marsh) is present within Segments 2, 3, and 4, no tri-colored blackbirds were observed during the three-day surveys conducted in February 2019. Moreover, cattail marsh comprises 2.31 acres of the 425-acre study area, which is an insignificant amount (<1%) of suitable habitat that is available for tri-colored blackbird. No impacts would occur to native or special-status fish from implementation of the project, because the habitat is considered poor due to manmade alterations of the waterways that have either eliminated or substantially degraded the habitat needed for supporting native fish populations. Moreover, no native or special-status fish were observed or captured during surveys conducted by ESA in February 2019 and no native pond turtles were identified during surveys conducted in May 2019.

TABLE 8
SUMMARY OF PROJECT EFFECTS

Segment	Habitat	Effects of Project	Impact Conclusion
Segment 1	Fresh water on concrete	Eliminated Pomona WRP discharge would reduce freshwater flow that could dry the channel periodically. Algae in channel may be reduced. Wildlife would find foraging elsewhere.	Less than significant due to lack of sensitive species utilizing concrete freshwater.
Segment 2	Black Willow Thicket with invasives	Eliminated Pomona WRP and reduced San Jose Creek WRP discharges would reduce in-stream flow, but groundwater upwelling would remain, supporting existing habitat.	Less than significant with adaptive management due to habitat sustaining groundwater upwelling and ponding water providing sufficient water to sustain existing riparian habitat.
Segment 3	Ruderal Forbland, Black Willow Thicket, Sand Bar Willow	Eliminated Pomona WRP and reduced San Jose Creek WRP discharges would reduce in-stream flow, but groundwater upwelling would remain, supporting existing habitat, including least Bell's vireo habitat.	Less than significant with adaptive management due to habitat sustaining groundwater upwelling and ponding water providing sufficient water to sustain existing riparian habitat.
Segment 4	Ruderal Forbland, Non-native Grassland, dry river bottom, Sand Bar Willow, Black Willow Thicket	Eliminated Pomona WRP and reduced San Jose Creek WRP would reduce in-stream flow, but remaining discharges would support existing habitat, including least Bell's vireo habitat.	Less than significant with adaptive management due to limited riparian habitat and remaining discharges sufficient to sustain existing riparian habitat.

Segment	Habitat	Effects of Project	Impact Conclusion
Zone 1 Ditch and WNRA	Blue Elderberry Stands, Ruderal Forbland, Non-native Grassland	Eliminated Pomona WRP and reduced San Jose Creek WRP would reduce periodic water deliveries, but remaining discharges would support existing habitat.	Less than significant with adaptive management due to limited riparian habitat and remaining discharges sufficient to sustain existing habitat.
Segment 5	Non-native Grassland and invasives	No Impact from discharge reductions.	No Impact due to lack of sensitive habitat and lack of flow impacts from project.
Segment 6	Non-native grass and invasives	No Impact from discharge reductions.	No Impact due to lack of sensitive habitat and lack of flow impacts from project.
Segment 7	Freshwater on concrete	Reduced discharges from Los Coyotes WRP and Long Beach WRP would reduce freshwater flow. Algae in channel may be reduced. Wildlife would find foraging elsewhere.	Less than significant due to lack of sensitive species utilizing concrete freshwater and availability of freshwater in other locations.
Segment 8	San Gabriel River Estuary Mixing Zone	Reduced discharges from Los Coyotes WRP and Long Beach WRP would reduce freshwater in mixing zone.	Less than significant due to limited values of freshwater mixing zone within rip-rap channel and remaining discharges sustaining habitat values.

6.0 References

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Appendix A
Photographic Log

Appendix A - Photographs

Photo 1: Tricolored Blackbird Surveys. Facing west from a rip-rap levee within the San Gabriel River. Photo depicts San Gabriel River and associated vegetation.

Photo 2: Tricolored Blackbird Surveys. Facing southeast from a rip-rap levee within the San Gabriel River. Photo depicts recent cattail marsh growth.

Appendix A - Photographs

Photo 3: Tricolored Blackbird Surveys. Facing west within the San Gabriel River. Photo depicts open water habitat and associated vegetation.

Photo 4: Tricolored Blackbird Surveys. Facing southwest from a levee adjacent to the San Gabriel River. Emergent cattail marsh habitat can be observed at the water's edge.

Photo 5: Fish Surveys. Facing northeast. Photo depicts the installation of a block net at Site #1.

Photo 6: Fish Surveys. Facing north from the southern side of the San Gabriel River. Photo depicts a red-eared slider captured in the seine net during the fish survey.

Photo 7: Fish Surveys. Facing southeast from the north bank of the San Gabriel River. Photo depicts the confluence of the San Gabriel River and San Jose Creek.

Photo 8: Fish Surveys. Facing southwest. Photo depicts a Mozambique tilapia in a shallow area of the San Gabriel River.

Appendix B
WEPT Survey Data Sheets

Turtle: Trapping Survey Form

Date 5/1/19
Survey Name Whittier Narrows WPT Survey
Survey Completed Y [✓ N]
Project Code
Observer1 TM
Obsv1 Task [✓ observer]/[✓ recorder]/processor
Block
Survey Type visual/[✓ trapping]
Observer2 RS
Obsv2 Task [✓ observer]/[✓ recorder]/processor
Site Day #1
Start Time 0800 am
Observer3
Obsv3 Task observer/recorder/processor
Site Photo Y N
End Time 0200 pm
Observer4
Obsv4 Task observer/recorder/processor
photos

Start Lat
End Lat
Start Long
End Long
Site
Start Elev
End Elev
Length
Datum
Drainage

Weather:

Air Temp (ºC) 65-75
Water Temp (ºC) 62-75
Condition: clear or few clouds, [✓ partly cloudy or variable], cloudy or overcast, fog, mist or drizzle, showers or light rain, heavy rain, sleet or hail, snow, no data
Wind Speed: [✓ <1 calm], 2-3 light air movement, 4-7 light breeze, 8-12 gentle breeze, 13-18 moderate breeze, 19-24 fresh breeze, 25-31 strong breeze, 32-38 near gale, >39 gale and above, no data

All Animals:

	Observ Method	Trap Name (if applicable)	Trap Type (if applicable)	Trap Number (if applicable)	Lat/Long	Date/Time Trap Set	Date/Time Trap Pulled	Elapsed Hours
1	audio/hand/trap/[✓ vis]	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	audio/hand/trap/[✓ vis]	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	audio/hand/trap/[✓ vis]	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	audio/hand/trap/[✓ vis]	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	audio/hand/trap/vis							
6	audio/hand/trap/vis							
7	audio/hand/trap/vis							
8	audio/hand/trap/vis							
9	audio/hand/trap/vis							
10	audio/hand/trap/vis							
11	audio/hand/trap/vis							
12	audio/hand/trap/vis							

All Animals (continued):

	Type	Species	Age Category	Disposition				Sex				Length (mm)	Notched		Tissue			Photo	# Photo
1	Turtle	Slider	[✓ A],J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	[✓ X]	N/A	Y	[✓ N]	Y	[✓ N]	U	Y/[✓ N]	
2	Turtle	Slider	[✓ A],J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	[✓ X]	N/A	Y	[✓ N]	Y	[✓ N]	U	Y/[✓ N]	
3	Turtle	Slider	[✓ A],J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	[✓ X]	N/A	Y	[✓ N]	Y	[✓ N]	U	Y/[✓ N]	
4	Turtle	Slider	[✓ A],J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	[✓ X]	N/A	Y	[✓ N]	Y	[✓ N]	U	Y/[✓ N]	
5			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
6			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
7			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
8			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
9			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
10			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
11			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
12			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	

Additional Fields for Pond Turtles:

	Carapace Width (mm)	Carapace Height (mm)	Plastron Length (mm)	Weight (g)	Shell Damag		Type of Shell Damage	Other ID Markings		
1					Y	N		Y	N	
2					Y	N		Y	N	
3					Y	N		Y	N	
4					Y	N		Y	N	
5					Y	N		Y	N	
6					Y	N		Y	N	
7					Y	N		Y	N	
8					Y	N		Y	N	
9					Y	N		Y	N	
10					Y	N		Y	N	
11					Y	N		Y	N	
12					Y	N		Y	N	

NO WEPT

	Recapture	ID #	Location Within Habitat	Animal Behavior
1	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
2	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
3	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
4	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
5	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
6	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
7	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
8	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
9	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
10	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
11	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
12	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other

Pond Turtle Trap Information:

NO WEPT

Trap Name	Trap Type	Trap Number	Lat/Long	Date/Time Trap Set	Date/Time Trap Pulled	Elapsed Hours

Temperature Loggers Form:

Logger ID	Lat/Long

Notes: No western pond turtle observed or captured.

Wind Speed

ID	mph & Indicator
0	<1 calm, smoke rises vertically
1	2-3 light air movement
2	4-7 light breeze
3	8-12 gentle breeze
4	13-18 moderate breeze
5	19-24 fresh breeze
6	25-31 strong breeze
7	32-38 near gale
8	>39 gale and above
9	No data

Sky Code

ID	Description
0	Clear or few clouds
1	Partly cloudy or variable
2	Cloudy or overcast
3	Fog
4	Mist or drizzle
5	Showers or light rain
6	Heavy rain
7	Sleet or hail
8	Snow
9	No data

Animal Age Category

A	Adult
J	Juvenile
Mm	Metamorph
L	Larvae
H	Hatchling
Em	Egg/Egg Mass

Disposition

R	Release
D	Dead
E	Escape
C	Collected

General

Y	Yes
N	No
U	Unknown
X	Not Checked

Turtle: Trapping Survey Form

Date 5/2/19
Survey Name Whittier Narrows WPT Survey
Survey Completed Y [✓ N]
Project Code
Observer1 TM
Obsv1 Task [✓ observer/recorder]/processor
Block
Survey Type [✓ visual/trapping]
Observer2 DS
Obsv2 Task [✓ observer/recorder]/processor
Site Day # 2
Start Time 0900 am
Observer3
Obsv3 Task observer/recorder/processor
Site Photo Y N
End Time 0200 pm
Observer4
Obsv4 Task observer/recorder/processor
\# photos

Start Lat
End Lat
Start Long
End Long
Site Length
Start Elev
End Elev
Datum
Drainage

Weather:

Air Temp (°C) 63 - 76
Water Temp (°C) 70 - 72
Condition: clear or few clouds, [✓ partly cloudy or variable], cloudy or overcast, fog, mist or drizzle, showers or light rain, heavy rain, sleet or hail, snow, no data
Wind Speed: [✓ <1 calm], 2-3 light air movement, 4-7 light breeze, 8-12 gentle breeze, 13-18 moderate breeze, 19-24 fresh breeze, 25-31 strong breeze, 32-38 near gale, >39 gale and above, no data

All Animals:

	Observ Method	Trap Name (if applicable)	Trap Type (if applicable)	Trap Number (if applicable)	Lat/Long	Date/Time Trap Set	Date/Time Trap Pulled	Elapsed Hours
1	audio/hand/[✓ trap]/vis	4	Funnel	4	34 0390, -118.0264	5/1 1015	5/2 1008	23 +
2	audio/hand/[✓ trap]/vis	4	Funnel	4	34.0390, -118.0264	5/1 1015	5/2 1008	23 +
3	audio/hand/[✓ trap]/vis	4	Funnel	4	34.0390, -118.0264	5/1 1015	5/2 1008	23 +
4	audio/hand/[✓ trap]/vis	4	Funnel	4	34.0390, -118.0264	5/1 1015	5/2 1008	23 +
5	audio/hand/[✓ trap]/vis	4	Funnel	4	34.0390, -118.0264	5/1 1015	5/2 1008	23 +
6	audio/hand/[✓ trap]/vis	4	Funnel	4	34.0390, -119.0264	5/1 1015	5/2 1008	23 +
7	audio/hand/[✓ trap]/vis	1	Funnel	1	34.0324, -118.0414	5/1 0935	5/2 0830	23 +
8	audio/hand/[✓ trap]/vis	1	Funnel	1	34.0324 -118.0414	5/1 0935	5/2 0830	23 +
9	audio/hand/[✓ trap]/vis	1	Funnel	1	34.0324, -118.0419	5/1 0635	5/2 0830	23 +
10	audio/hand/trap/vis							
11	audio/hand/trap/vis							
12	audio/hand/trap/vis							

All Animals (continued):

	Type	Species	Age Category	Disposition				Sex				Length (mm)	Notched		Tissue			Photo	# Photo
1	Turtle	Slider	[✓ A],J,Mm,L1,L2,H,Em,U	[✓ R]	D	E	C	[✓ M]	F	U	X	242	Y	[✓ N]	Y	[✓ N]	U	Y/N	
2	Turtle	Slider	[✓ A],J,Mm,L1,L2,H,Em,U	[✓ R]	D	E	C	[✓ M]	F	U	X	210	Y	[✓ N]	Y	[✓ N]	U	Y/N	
3	Turtle	Slider	[✓ A],J,Mm,L1,L2,H,Em,U	[✓ R]	D	E	C	[✓ M]	F	U	X	221	Y	[✓ N]	Y	[✓ N]	U	Y/N	
4	Turtle	Slider	A,[✓ J],Mm,L1,L2,H,Em,U	[✓ R]	D	E	C	M	[✓ F]	U	X	65	Y	[✓ N]	Y	[✓ N]	U	Y/N	
5	Turtle	Slider	A,[✓ J],Mm,L1,L2,H,Em,U	[✓ R]	D	E	C	M	[✓ F]	U	X	89	Y	[✓ N]	Y	[✓ N]	U	Y/N	
6	Turtle	Slider	[✓ A],J,Mm,L1,L2,H,Em,U	[✓ R]	D	E	C	[✓ M]	F	U	X	191	Y	[✓ N]	Y	[✓ N]	U	Y/N	
7	Turtle	Slider	A,[✓ J],Mm,L1,L2,H,Em,U	[✓ R]	D	E	C	M	[✓ F]	U	X	82	Y	[✓ N]	Y	[✓ N]	U	Y/N	
8	Turtle	Slider	[✓ A],J,Mm,L1,L2,H,Em,U	[✓ R]	D	E	C	M	[✓ F]	U	X	191	Y	[✓ N]	Y	[✓ N]	U	Y/N	
9	Turtle	Slider	[✓ A],J,Mm,L1,L2,H,Em,U	[✓ R]	D	E	C	M	[✓ F]	U	X	172	Y	[✓ N]	Y	[✓ N]	U	Y/N	
10			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
11			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
12			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	

Additional Fields for Pond Turtles:

	Carapace Width (mm)	Carapace Height (mm)	Plastron Length (mm)	Weight (g)	Shell Damag		Type of Shell Damage	Other ID Markings		
1					Y	N		Y	N	
2					Y	N		Y	N	
3					Y	N		Y	N	
4					Y	N		Y	N	
5					Y	N		Y	N	
6					Y	N		Y	N	
7					Y	N		Y	N	
8					Y	N		Y	N	
9					Y	N		Y	N	
10					Y	N		Y	N	
11					Y	N		Y	N	
12					Y	N		Y	N	

NO WEPT

	Recapture		ID #	Location Within Habitat	Animal Behavior
1	Y	N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
2	Y	N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
3	Y	N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
4	Y	N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
5	Y	N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
6	Y	N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
7	Y	N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
8	Y	N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
9	Y	N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
10	Y	N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
11	Y	N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
12	Y	N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other

NO WEPT

Pond Turtle Trap Information:

Trap Name	Trap Type	Trap Number	Lat/Long	Date/Time Trap Set	Date/Time Trap Pulled	Elapsed Hours

Temperature Loggers Form:

Logger ID	Lat/Long

Notes: No western pond turtle captured or observed.

Wind Speed

ID	mph & indicator
0	<1 calm, smoke rises vertically
1	2-3 light air movement
2	4-7 light breeze
3	8-12 gentle breeze
4	13-18 moderate breeze
5	19-24 fresh breeze
6	25-31 strong breeze
7	32-38 near gale
8	>39 gale and above
9	No data

Sky Code

ID	Description
0	Clear or few clouds
1	Partly cloudy or variable
2	Cloudy or overcast
3	Fog
4	Mist or drizzle
5	Showers or light rain
6	Heavy rain
7	Sleet or hail
8	Snow
9	No data

Animal Age Category

A	Adult
J	Juvenile
Mm	Metamorph
L	Larvae
H	Hatchling
Em	Egg/Egg Mass

Disposition

R	Release
D	Dead
E	Escape
C	Collected

General

Y	Yes
N	No
U	Unknown
X	Not Checked

Turtle: Trapping Survey Form

Date 5/3/19
Project Code
Survey Type [✓ visual/trapping]
Start Time 0900am
End Time 0200 pm

Survey Name Whittier Narrows WPT survey
Observer1 TM
Observer2 RS
Observer3
Observer4

Obsv1 Task [✓ observer/recorder]/processor
Obsv2 Task [✓ observer/recorder]/processor
Obsv3 Task observer/recorder/processor
Obsv4 Task observer/recorder/processor

Survey Completed Y [✓ N]
Block
Site Day #3
Site Photo Y N
photos

Start Lat
Start Long
Start Elev
Datum
End Lat
End Long
End Elev
Drainage
Site
Length

Weather:

Air Temp (°C) 63-73°F
Water Temp (°C) 70°F
Condition: clear or few clouds, [✓ partly cloudy or variable], cloudy or overcast, fog, mist or drizzle, showers or light rain, heavy rain, sleet or hail, snow, no data
Wind Speed: [✓ <1 calm], 2-3 light air movement, 4-7 light breeze, 8-12 gentle breeze, 13-18 moderate breeze, 19-24 fresh breeze, 25-31 strong breeze, 32-38 near gale, >39 gale and above, no data

All Animals:

	Observ Method	Trap Name (if applicable)	Trap Type (if applicable)	Trap Number (if applicable)	Lat/Long	Date/Time Trap Set	Date/Time Trap Pulled	Elapsed Hours
1	audio/hand/[✓ trap]/vis	6	Funnel	6	34.0366, -118.0229	5/2 1000	5/3 0944	23 +
2	audio/hand/[✓ trap]/vis	1	Funnel	1	34.0366, -118 0229	5/2 1208	5/3 1157	23 +
3	audio/hand/[✓ trap]/vis	1	Funnel	1	34.0324, -118.0417	5/2 1202	5/3 1157	23 +
4	audio/hand/trap/vis							
5	audio/hand/trap/vis							
6	audio/hand/trap/vis							
7	audio/hand/trap/vis							
8	audio/hand/trap/vis							
9	audio/hand/trap/vis							
10	audio/hand/trap/vis							
11	audio/hand/trap/vis							
12	audio/hand/trap/vis							

All Animals (continued):

	Type	Species	Age Category	Disposition				Sex				Length (mm)	Notched		Tissue			Photo	# Photo
1	Turtle	slider	[✓ A],J,Mm,L1,L2,H,Em,U	[✓ R]	D	E	C	[✓ M]	F	U	X	193	Y	[✓ N]	Y	[✓ N]	U	Y/N	
2	Turtle	Slider	[✓ A],J,Mm,L1,L2,H,Em,U	[✓ R]	D	E	C	M	[✓ F]	U	X	241	Y	[✓ N]	Y	[✓ N]	U	Y/N	
3	Turtle	Slider	A,[✓ J],Mm,L1,L2,H,Em,U	[✓ R]	D	E	C	M	[✓ F]	U	X	85	Y	[✓ N]	Y	[✓ N]	U	Y/N	
4			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
5			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
6			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
7			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
8			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
9			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
10			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
11			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
12			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	

Additional Fields for Pond Turtles:

	Carapace Width (mm)	Carapace Height (mm)	Plastron Length (mm)	Weight (g)	Shell Damag		Type of Shell Damage	Other ID Markings		
1					Y	N		Y	N	
2					Y	N		Y	N	
3					Y	N		Y	N	
4					Y	N		Y	N	
5					Y	N		Y	N	
6					Y	N		Y	N	
7					Y	N		Y	N	
8					Y	N		Y	N	
9					Y	N		Y	N	
10					Y	N		Y	N	
11					Y	N		Y	N	
12					Y	N		Y	N	

No WEPT

	Recapture	ID #	Location Within Habitat	Animal Behavior
1	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
2	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
3	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
4	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
5	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
6	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
7	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
8	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
9	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
10	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
11	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
12	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other

NO WEPT

Pond Turtle Trap Information:

Trap Name	Trap Type	Trap Number	Lat/Long	Date/Time Trap Set	Date/Time Trap Pulled	Elapsed Hours

Temperature Loggers Form:

Logger ID	Lat/Long

Notes: No western pond turtle observed or captured.

Wind Speed

ID	mph & indicator
0	<1 calm, smoke rises vertically
1	2-3 light air movement
2	4-7 light breeze
3	8-12 gentle breeze
4	13-18 moderate breeze
5	19-24 fresh breeze
6	25-31 strong breeze
7	32-38 near gale
8	>39 gale and above
9	No data

Sky Code

ID	Description
0	Clear or few clouds
1	Partly cloudy or variable
2	Cloudy or overcast
3	Fog
4	Mist or drizzle
5	Showers or light rain
6	Heavy rain
7	Sleet or hail
8	Snow
9	No data

Animal Age Category

A	Adult
J	Juvenile
Mm	Metamorph
L	Larvae
H	Hatchling
Em	Egg/Egg Mass

Disposition

R	Release
D	Dead
E	Escape
C	Collected

General

Y	Yes
N	No
U	Unknown
X	Not Checked

Turtle: Trapping Survey Form

Date	5/4/19	Survey Name	Whittier Narrows WPT survey			Survey Completed	[✓ Y] N
Project Code		Observer1	JM	Obsv1 Task	[✓ observer]/[✓ recorder]/processor	Block	
Survey Type	[✓ visual/trapping]	Observer2	RS	Obsv2 Task	[✓ observer]/[✓ recorder]/processor	Site	Day #4
Start Time	0800 am	Observer3		Obsv3 Task	observer/recorder/processor	Site Photo	Y N
End Time	0200 pm	Observer4		Obsv4 Task	observer/recorder/processor	# photos	

Start Lat		End Lat			
Start Long		End Long		Site	
Start Elev		End Elev		Length	
Datum		Drainage			

Weather:

Air Temp (°C)	66-78
Water Temp (°C)	70-72°F
Condition	clear or few clouds, [✓ partly cloudy or variable], cloudy or overcast, fog, mist or drizzle, showers or light rain, heavy rain, sleet or hail, snow, no data
Wind Speed	[✓ <1 calm], 2-3 light air movement, 4-7 light breeze, 8-12 gentle breeze, 13-18 moderate breeze, 19-24 fresh breeze, 25-31 strong breeze, 32-38 near gale, >39 gale and above, no data

All Animals:

	Observ Method	Trap Name (if applicable)	Trap Type (if applicable)	Trap Number (if applicable)	Lat/Long	Date/Time Trap Set	Date/Time Trap Pulled	Elapsed Hours
1	audio/hand/[✓ trap]/vis	5	Funnel	5	34.0354,-118.0344	5/3 1010	5/4 1001	22 +
2	audio/hand/[✓ trap]/vis	3	Funnel	3	34.0354,-118.0344	5/3 1010	5/4 1001	23 +
3	audio/hand/[✓ trap]/vis	1	Funnel	1	34.0324,-118.0414	5/3 1215	5/4 1207	23 +
4	audio/hand/trap/vis							
5	audio/hand/trap/vis							
6	audio/hand/trap/vis							
7	audio/hand/trap/vis							
8	audio/hand/trap/vis							
9	audio/hand/trap/vis							
10	audio/hand/trap/vis							
11	audio/hand/trap/vis							
12	audio/hand/trap/vis							

All Animals (continued):

	Type	Species	Age Category	Disposition				Sex				Length (mm)	Notched		Tissue			Photo	# Photo
1	Turtle	slider	[✓ A],J,Mm,L1,L2,H,Em,U	[✓ R]	D	E	C	M	F	[✓ U]	X	7C0T	Y	[✓ N]	Y	[✓ N]	U	Y/N	
2	Turtle	slider	[✓ A],J,Mm,L1,L2,H,Em,U	[✓ R]	D	E	C	M	[✓ F]	U	X	160	Y	[✓ N]	Y	[✓ N]	U	Y/N	
3	Turtle	slider	[✓ A],J,Mm,L1,L2,H,Em,U	[✓ R]	D	E	C	M	[✓ F]	U	X	170	Y	[✓ N]	Y	[✓ N]	U	Y/N	
4			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
5			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
6			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
7			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
8			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
9			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
10			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
11			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	
12			A,J,Mm,L1,L2,H,Em,U	R	D	E	C	M	F	U	X		Y	N	Y	N	U	Y/N	

Additional Fields for Pond Turtles:

	Carapace Width (mm)	Carapace Height (mm)	Plastron Length (mm)	Weight (g)	Shell Damag		Type of Shell Damage	Other ID Markings		
1					Y	N		Y	N	
2					Y	N		Y	N	
3					Y	N		Y	N	
4					Y	N		Y	N	
5					Y	N		Y	N	
6					Y	N		Y	N	
7					Y	N		Y	N	
8					Y	N		Y	N	
9					Y	N		Y	N	
10					Y	N		Y	N	
11					Y	N		Y	N	
12					Y	N		Y	N	

No WEPT

	Recapture	ID #	Location Within Habitat	Animal Behavior
1	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
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3	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
4	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
5	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
6	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
7	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
8	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
9	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
10	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
11	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other
12	Y N		pool, run, riffle, bank, upland, splashzone, other	calling, basking, foraging, mating, hiding, other

NO WEPT

Pond Turtle Trap Information:

Trap Name	Trap Type	Trap Number	Lat/Long	Date/Time Trap Set	Date/Time Trap Pulled	Elapsed Hours

Temperature Loggers Form:

Logger ID	Lat/Long

Notes: No western pond turtle observed or captured.

Wind Speed

ID	mph & Indicator
0	<1 calm, smoke rises vertically
1	2-3 light air movement
2	4-7 light breeze
3	8-12 gentle breeze
4	13-18 moderate breeze
5	19-24 fresh breeze
6	25-31 strong breeze
7	32-38 near gale
8	>39 gale and above
9	No data

Sky Code

ID	Description
0	Clear or few clouds
1	Partly cloudy or variable
2	Cloudy or overcast
3	Fog
4	Mist or drizzle
5	Showers or light rain
6	Heavy rain
7	Sleet or hail
8	Snow
9	No data

Animal Age Category

A	Adult
J	Juvenile
Mm	Metamorph
L	Larvae
H	Hatchling
Em	Egg/Egg Mass

Disposition

R	Release
D	Dead
E	Escape
C	Collected

General

Y	Yes
N	No
U	Unknown
X	Not Checked

Appendix B2

Biological Resources Technical Memorandum, San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse, July 2018

ESA

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Los Angeles, CA 90017
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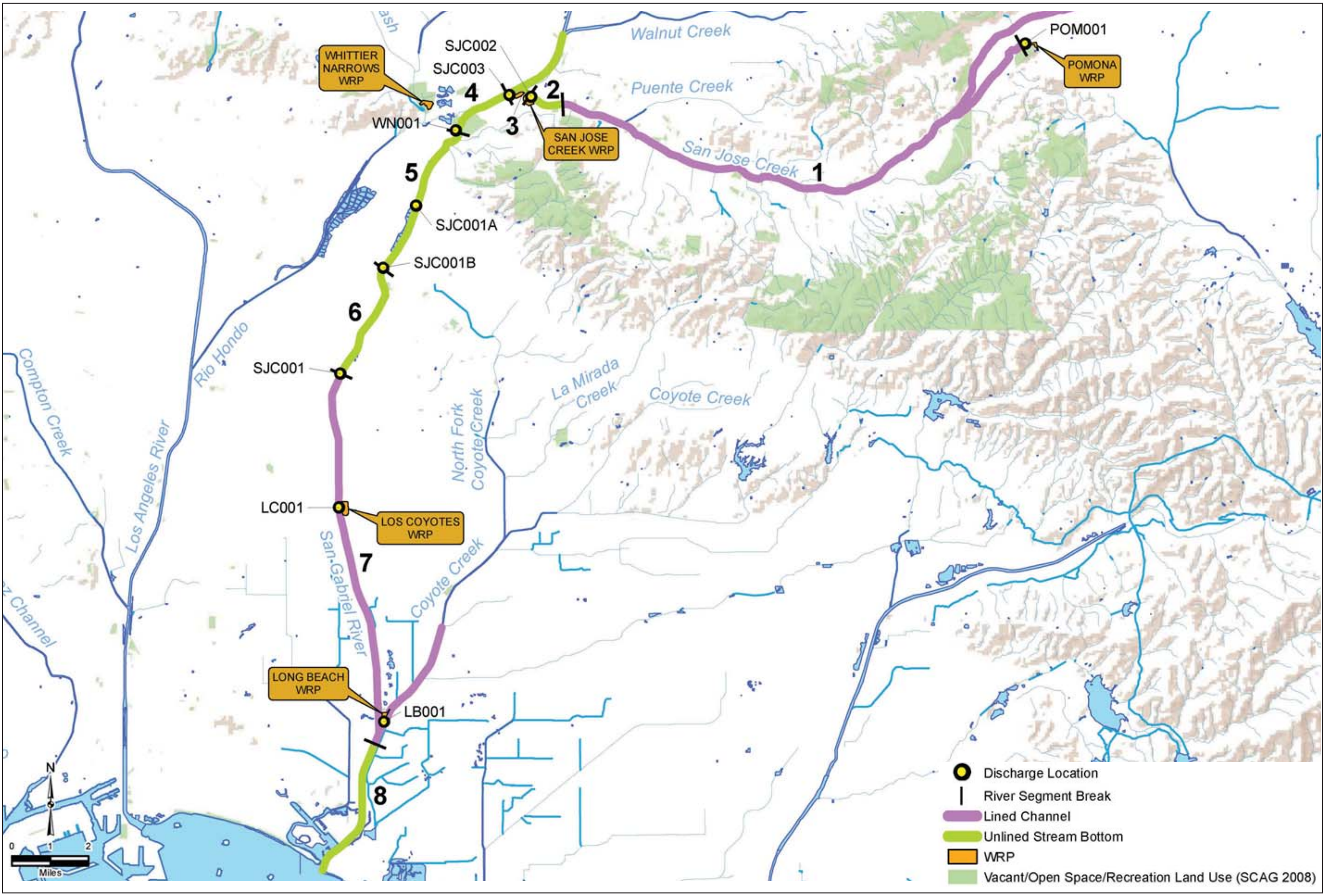
Biological Resources Technical Memorandum

date	July 2018
to	Sanitation Districts of Los Angeles County
cc	
from	Tom Barnes, ESA
subject	San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse

The Sanitation Districts of Los Angeles County (Sanitation Districts) serves the regional wastewater and solid waste management needs of Los Angeles County. The Sanitation Districts operate 10 water reclamation plants (WRPs) and the Joint Water Pollution Control Plant. Seventeen special districts that provide sewerage services in the metropolitan Los Angeles area are signatory to a Joint Outfall Agreement that provides for the regional, interconnected systems of facilities known as the Joint Outfall System (JOS). Under the Joint Outfall Agreement, Sanitation District No. 2 of the Los Angeles County (District) has been appointed managing authority over the JOS. Several of these WRPs discharge into rivers and creeks within the San Gabriel River watershed (See Figure 1).

This technical memorandum identifies biological resources within the river segments where several water reclamation plants currently discharge treated effluent. ESA conducted reconnaissance-level surveys and vegetation mapping in the Whittier Narrows area and performed a review of available literature pertaining to the overall study area to inform this study. The report provides an overview of the existing conditions and biological resources within the study areas, divided into 8 segments, as shown on Figure 1, and then discusses potential project effects in various segments of the San Gabriel River and the San Jose Creek and particular connected areas located downstream from effluent discharge points. Segment 1 is the concrete-lined portion of the San Jose Creek channel from the Pomona WRP to just upstream of the San Jose Creek WRP. Segments 2 through 6 are soft-bottomed, and Segment 7 is the concrete-lined San Gabriel River that discharges to the estuary. Segment 8 is the soft-bottomed segment of the San Gabriel River that is subject to tidal influence over the 3.75-mile length of the segment, from the ocean outlet up to the end of Segment 7. For the purpose of this study, only the “mixing zone” is considered. This zone occurs immediately downstream from the end of Segment 7, where freshwater flows into and mixes with the estuarine waters in Segment 8.



D170647.00 - LACSD On-call\D170647.04 - San Jose Creek WRP Change Petition ISMND\05 Graphics-GIS-Modeling\Bio Tech Report

SOURCE: Clearwater EIR Segment Map

San Gabriel River Watershed Project to Reduce River Discharge
in Support of Increased Recycled Water Reuse

Figure 1
Regional Location & River Segments Map

Proposed Project Description

The District is proposing to incrementally reduce discharges of recycled water from the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP. The District is not proposing to construct any new facilities. The proposed use of the recycled water would be implemented by water agencies and other uses over time. The District will continue to maintain the ability to discharge treated water at the same points but anticipates lesser quantities. A separate Hydrology Study has been prepared that identifies the existing and proposed river flow regimes. Figure 2 identifies the location of WRPs and discharge points mentioned in this analysis.

Methodology

Literature Review

ESA reviewed recent documents and accessed standard reference sources and databases to gather information on the natural resources and special status species known or likely to occur in the Study Area for the relevant segments of San Jose Creek and the San Gabriel River.

The literature that was reviewed included the following:

- Study of Water Flow Conditions for San Jose Creek and San Gabriel River. (Sanitation Districts of Los Angeles County, Planning Section, 2016).
- Assessment of Potential Impacts for Sensitive Biological Resources within Select Portions of the San Gabriel River and San Jose Creek Located in Los Angeles County, California (Chambers Group). Letter Report dated August 24, 2016.
- San Gabriel River Corridor Master Plan. (Moore, Iacofano, Goltsman, Inc., 2006) Prepared for the County of Los Angeles Department of Public Works.
- California Fish and Wildlife (CDFW) California Natural Diversity Database (CNDDB). Accessed February 26, 2018.
- United States Fish and Wildlife Service (USFWS) Information for Planning and Conservation (IPac) Environmental Conservation Online System (ECOS). Accessed March 9, 2018.
- Evaluating Effects of Reduced WWTP Discharge on the Ecology of the San Gabriel River Estuary Final Study Results. January 12, 2018. David J. Gillett, Eric D. Stein, and Liesl Tiefenthaler Southern California Coastal Water Research Project.
- Adaptive Management Plan for Least Bell's Vireo Los Angeles County Sanitation Districts San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse (Amec Foster Wheeler Environment & Infrastructure, Inc., Rev. April 2018). Prepared for Los Angeles County Sanitation Districts

Field Survey

The biological resources field survey included Segments 2 through 5 and the adjacent portion of the Whittier Narrows Recreation Area where the Zone 1 Ditch passes through that area, including the area containing the "Crossover Channel" that connects San Gabriel River to the Rio Hondo during extreme conditions, and the "backwater" area of the Rio Hondo, known as the Bosque Del Rio Hondo, just upstream from the Whittier Narrows Dam. Reconnaissance level surveys focused primarily on confirming vegetation types and habitat quality within the soft-bottom segments of San Gabriel River and San Jose Creek upstream from, and just downstream of the Whittier Narrows Dam, where significant riparian vegetation is present. No field survey was conducted in Segment 6 because these areas are periodically cleared or grubbed to remove most vegetation and promote water

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SOURCE: Amec, Foster, Wheeler, 2017

San Gabriel River Watershed Project to Reduce River Discharge
in Support of Increased Recycled Water Reuse

Figure 2
SJC Discharge and Diversion Points

retention and percolation. Segments 1 and 7 are concrete-lined and were observed during field visits, but were not characterized as containing native habitat. Nonetheless, these segments are included in this assessment to acknowledge any biological resources supported by freshwater flows. Segment 8 is the San Gabriel River estuary, which was not surveyed since the armored channel would not be affected by the project.

Vegetation and Habitat Mapping

Plant communities in Segments 2, 3, and 4 were mapped by Chambers Group in the summer of 2016 and provide an accurate depiction of plant communities within these segments of San Jose Creek and the San Gabriel River. Mapping from that effort was referenced during the field survey. Vegetation communities were classified by Chambers Group using *A Manual of California Vegetation, 2nd Ed.* (Sawyer et al. 2009). The results of that mapping effort are presented in Attachment A to this technical memorandum. The system of attributing classifications based typically on single or dual species dominance used in the *Manual* does not always provide specific nomenclature for communities dominated by non-native or exotic species, or for ruderal (weedy) vegetation where several species are co-dominant or where dominance varies considerably in small patches. Therefore, as a practical consideration, this study may sometimes identify non-native woodland, ruderal forbland, and non-native grassland communities which exhibit dominance by multiple species, as noted below in the descriptions of plant communities.

The plant communities found along the Zone 1 Ditch and in the upstream section of Segment 5 of the San Gabriel River, just below the Whittier Narrows Dam, were recently mapped by AMEC Foster Wheeler. That mapping effort is included here in Figure 3 as the most accurate depiction of vegetation in that area. The limited vegetation present in Segments 5 and 6, downstream from the San Gabriel Coastal Basin Spreading Grounds, was noted from aerial imagery and confirmed from field observations at certain vantage points. In addition to referencing the Chambers Group and AMEC Foster Wheeler plant community maps, ESA biologists also identified plant communities within the Bosque Del Rio Hondo, in the area west of Rosemead Avenue and upstream from the Whittier Narrows Dam. Figure 4 identifies the plant communities mapped for this study in the Bosque Del Rio Hondo.

Habitat Assessment

The quality of habitat for native wildlife was determined based on the abundance, health, and vigor of native plant communities; abundance and diversity of invasive plant species; level of disturbance from homeless encampments, presence of substantial amounts of trash and debris, and the presence or absence of other important habitat features, such as sand bars, unobstructed flowing water, native riparian vegetation, suitable perch sites for birds of prey, etc.

Environmental Setting

Existing Conditions in the Study Area

The hydrology of the San Gabriel River system has been completely altered, primarily for flood control and storm runoff conveyance, following a series of devastating floods in the early part of the 20th century. The San Gabriel River and San Jose Creek in the study area are completely confined between concrete banks or vertical concrete walls. Some of the channel sections are also concrete-lined across the channel bottom but some segments are unlined.

The area surrounding the study area is highly urbanized by residential, commercial, and industrial land uses that border both San Gabriel River and San Jose Creek along most of the study area segments. The Whittier Narrows Recreation Area (WNRA), on the west side of San Gabriel River above the Whittier Narrows Dam, lies directly adjacent to the San Gabriel River and part of the WNRA is included in this study. The WNRA is a significant natural area and constitutes the western end of the Puente Hills Significant Ecological Area (SEA) as recognized by the County of Los Angeles. The WNRA is managed by the US Army Corps of Engineers (USACE). The USACE prepared a Whittier Narrows Master Plan in 2011.

Recreation is very common along the banks of the San Gabriel River in the vicinity of the WNRA and elsewhere along the waterways where access is permitted. A substantial amount of trash and foreign debris occurs in all areas of the San Gabriel River. Some trash is carried into the area from upstream by storm flows and some blows in or is thrown from bridges and adjacent roads. Much of the trash is cast aside in the channel by the significant homeless population that travels along and lives in or near the channel in many areas. In addition, invasive plant species occur in several areas, particularly in the Crossover Channel and the Bosque Del Rio Hondo on the upstream side of the Whittier Narrows Dam.

The following sections describe the habitat values and quality of each river segment included in the study area, as indicated in Figures 3 and 4. Figures 5 through 9 provide photos of each segment.

Segment 1

Segment 1 is the concrete-lined vertical walled channel section of San Jose Creek downstream from the Pomona WRP and provides limited biological resource value to wildlife other than as a water source and for some common avian and terrestrial species that typically forage in urban areas and along concrete channels such as ravens, rodents, and raccoons. Foraging opportunities are limited to algae, decaying vegetation, and trash. Vertical concrete walls may reduce its use by wildlife. The channel conveys nuisance runoff, stormwater, groundwater upwelling, and reclaimed water from the Pomona WRP downstream to Segment 2.

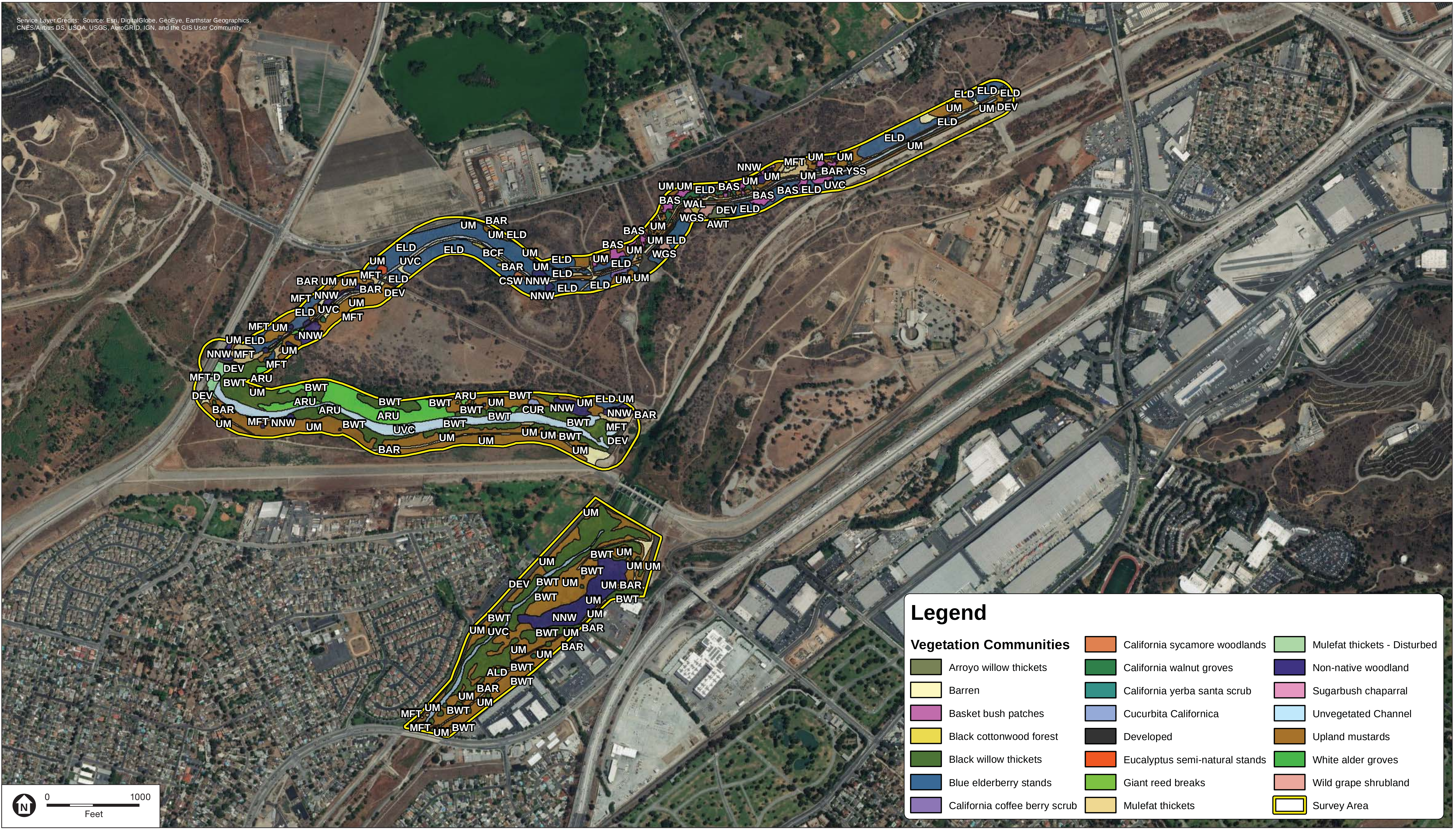
Segment 2

Segment 2 is an unlined, soft or earthen-bottomed section completely in San Jose Creek and extends upstream about 1 mile from the confluence with San Gabriel River. This segment receives stormwater and urban runoff, as well as any discharge from the Pomona WRP. This area also exhibits considerable upwelling from local groundwater as indicated by flow measurements collected in San Jose Creek on 9 dates when there was no discharge from the Pomona WRP upstream.

Surface water is typically present within this channel segment as a result of upstream flows, groundwater upwelling and the ponding effect of the downstream drop structure. The channel is dominated by black willow thickets and non-native invasive vegetation such as castor bean. This area provides both foraging and nesting habitat for avian species and the presence of surface water for long periods supports aquatic habitat. Non-native fish species are found in this segment, but no native species are known to occupy the ponded areas.

Segment 3

This segment is approximately 4,000 feet in length extending from near the San Gabriel River / San Jose Creek confluence to just upstream from the SR-60 Bridge. Segment 3 also includes a short segment in San Gabriel River upstream from the confluence with San Jose Creek. This segment receives flow from nuisance flows and stormwater, San Jose Creek groundwater upwelling contributions, Pomona and San Jose Creek WRP discharges, and occasionally when water volumes are released from the Morris and San Gabriel dams or from imported water sources upstream. The San Gabriel River is generally dry upstream from the first drop structure above the confluence and supports little riparian vegetation. Thus, most of the water in Segment 3 is received from San Jose Creek, particularly during the dry season. Water in this segment is impounded by the weirs and generally covers a wide area of the channel bottom. Vegetation in this area includes black willow thicket habitats at the water’s edge,



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SOURCE: AMEC Foster Wheeler , 2018

San Gabriel River Watershed Project to Reduce River Discharge
in Support of Increased Recycled Water Reuse

Figure 3

Zone 1 Ditch & San Gabriel River below Whittier Narrows Dam - Plant Communities and Land Cover

ESA

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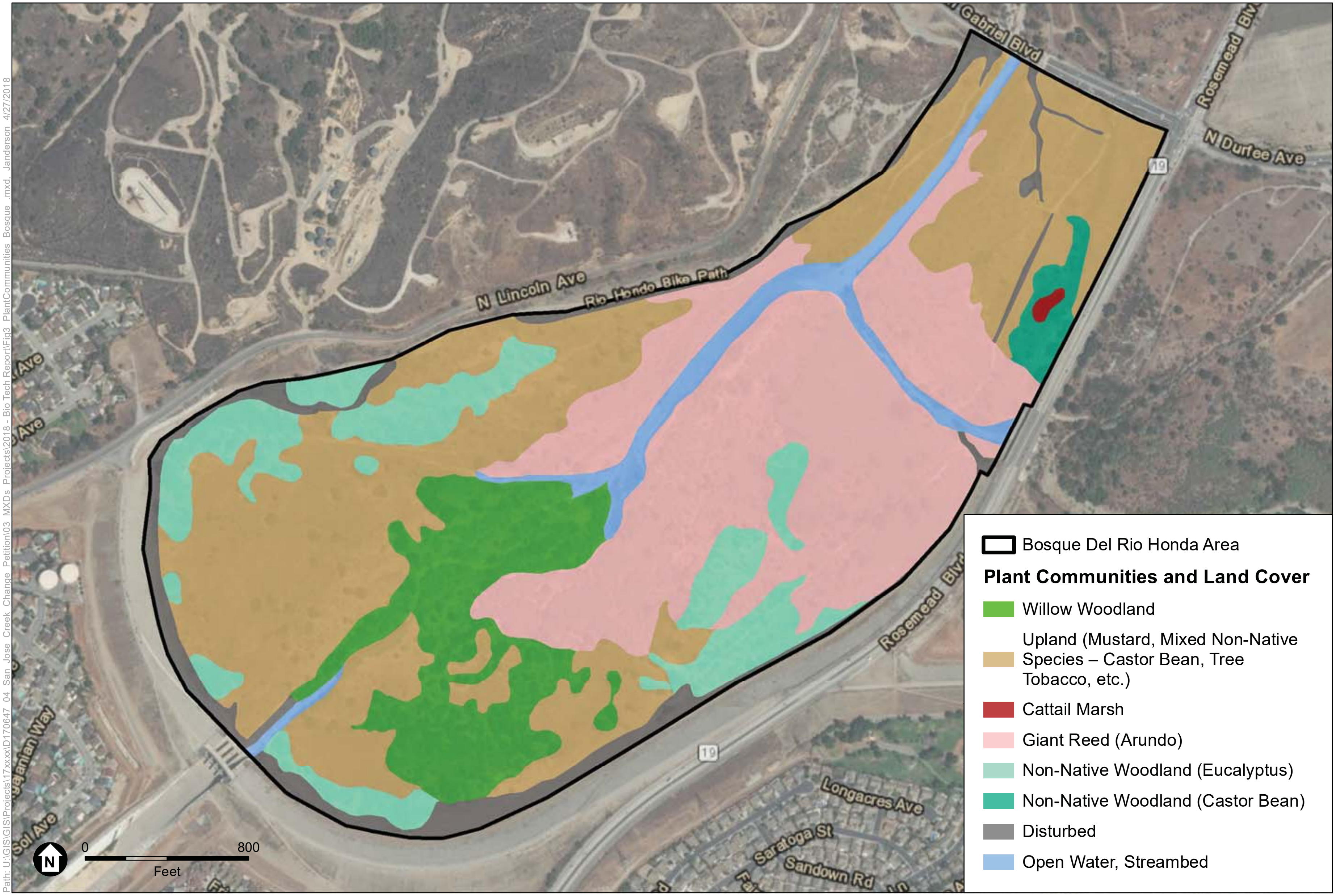

SOURCE: ESRI; ESA

San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse

Figure 4

Bosque Del Rio Hondo Area - Plant Communities and Land Cover

ESA

Segment 1: Concrete lined section of SJC, near transition to Segment 2 (facing upstream)

Segment 2: Earthen bottomed section of SJC, near transition from Segment 1 (facing downstream)

SOURCE: ESA, 2018; Amec Foster Wheeler, 2017

San Gabriel River Watershed Project to Reduce River Discharge
in Support of Increased Recycled Water Reuse

Figure 5
Segments 1 and 2

Segment 3: Near SGR / SJC confluence at SJC WRP outfall SJC0003 (facing west)

Segment 4: Typical view of weir in SGR, just downstream from Peck Road Bridge (facing southeast)

SOURCE: Amec Foster Wheeler, 2017

San Gabriel River Watershed Project to Reduce River Discharge
in Support of Increased Recycled Water Reuse

Figure 6
Segments 3 and 4

Zone 1 Ditch (A): Near upstream end, WNRA to the right, SGR levee on left (facing southwest)

Zone 1 Ditch (B): From Siphon Road crossing (facing upstream)

SOURCE: ESA, 2018

San Gabriel River Watershed Project to Reduce River Discharge
in Support of Increased Recycled Water Reuse

Figure 7
Zone 1 Ditch

Segment 5: Downstream from Whittier Narrows Dam, some vegetation maintained to promote recharge

Segment 6: Upstream from Firestone Blvd. Bridge and transition to concrete lined (Segment 7), note deflated rubber dam being inspected

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SOURCE: Amec Foster Wheeler, 2017

San Gabriel River Watershed Project to Reduce River Discharge
in Support of Increased Recycled Water Reuse

Figure 8
Segments 5 and 6

ESA

Segment 7: Broad concrete lined section with low flow in center (facing upstream)

Segment 8: Transition from Segment 7 at the “mixing zone”, freshwater flows into estuarine (Segment 8)

SOURCE: ESA, 2018

Figure 9
Segments 7 and 8

sand bars, and areas where non-native weed species are established on the channel edges. The quality of the riparian habitat is generally disturbed due to the prevalence of invasive species and trash. A perennial aquatic habitat is supported by in stream flows and groundwater upwelling which is impounded by the series of drop structures.

Segment 4

Segment 4 extends downstream in the San Gabriel River from just north of the SR-60 Bridge, to just upstream from the Whittier Narrows Dam. There are three drop structures (or weirs) in this segment. The last weir, located just downstream from the head works for the Zone 1 Ditch, divides this segment into two different hydrologic regimes.

The upstream regime of Segment 4 receives water flow from the same sources as Segment 3. Riparian black willow thicket habitat occurs adjacent to water ponded behind the drop structures. The quality of the riparian habitat is generally disturbed due to the prevalence of invasive species and trash. Aquatic habitat is also supported by ponded water that occurs due to in-stream flows, WRP discharges, and groundwater upwelling.

The downstream portion of Segment 4 below the last drop structure is usually dry, except after storm events, or during deliveries of imported water from tributaries feeding into San Gabriel River upstream. The vegetation is mostly disturbed scrub habitat dominated primarily by ruderal (weedy) vegetation, non-native grasslands, and dry river bottom. This is likely due to the reduced influence of groundwater upwelling in the lower portion of the segment, and less consistent ponded water. Typically, all the water in the upstream regime of Segment 4, including WRP discharges, infiltrates into the ground due to the high permeability of the riverbed soil and does not contribute to the downstream regime. Near the dam, mature stands of riparian vegetation including large willow and cottonwood trees occur in the center of the wide channel.

Whittier Narrows Recreation Area and Zone 1 Ditch

The study area includes the WNRA which lies adjacent to the west side of the San Gabriel River between Peck Road and the Whittier Narrows Dam. The WNRA in this area is comprised of natural open space utilized primarily for passive recreation, and also contains flood control facilities, extraction wells, and is crossed by Southern California Edison (SCE) transmission lines. The Zone 1 Ditch is an artificial channel through the WNRA that conveys water drawn from the San Gabriel River to the Rio Hondo River. The Zone 1 Ditch is operated and maintained by the L.A. County Department of Public Works. Periodically, water deliveries are conveyed from the San Gabriel River to the Rio Hondo. For most of its length, the Zone 1 Ditch exhibits a soft bottom and earthen banks. However, some sections exhibit grouted riprap along the banks and riprap on the bottom. Some of the water conveyed through the channel may percolate into the ground and may support some of the vegetation adjacent to the channel. Vegetation around the channel is dominated by blue elderberry stands and the backwash area nearer the dam within the WNRA which feeds into the Bosque Del Rio Hondo exhibits patches of black willow thickets, some non-native woodland, giant reed breaks, and upland areas dominated by mustard and other disturbed scrub dominated by non-native weed species and non-native grasslands.

The Bosque Del Rio Hondo area appears to have some standing water for long duration and saturated conditions may persist through much of the dry season. However, these areas exhibit predominantly non-native woodland and exotic invasive giant reed, although some willow woodland patches occur along the stream in the southern section of this area.

Segments 5 and 6

Segment 5 is soft bottomed and continues downstream within the San Gabriel River from the Whittier Narrows Dam past the San Gabriel Coastal Basin Spreading Grounds. Just below the dam for a stretch of approximately two miles the river channel appears to receive local runoff conveyed into the area via the Peck Road Channel, which enters near the upstream end of the segment from northeast. Segment 5 does not receive surface flows from the San Gabriel River upstream of the dam except during large storm events. However, in this area just below the dam, the channel supports healthy stands of black willow.

Downstream of this portion, the San Jose Creek WRP can discharge into Segment 5 at two points, SJC001A, located at the head works for the San Gabriel Coastal Spreading Grounds (SGSG), and SJC001B at the downstream end of Segment 5. The drop structure at the SGSG head works functions to retain flows that are then diverted into the spreading grounds.

Segment 6 is similar to Segment 5 containing no native habitat. The unlined channel areas in Segments 5 and 6 of the San Gabriel River are part of the overall Montebello Forebay recharge area, which also includes both the Rio Hondo and San Gabriel Coastal Spreading Grounds. There are a total of 7 inflatable rubber dams in Segments 5 and 6 that are used to detain flows within this area for groundwater recharge. Vegetation is periodically grubbed and the channel bottom scarified with equipment to promote percolation and reduce water loss. Patches of riparian shrubs and some trees are left in place on the channel side slopes. The channel bottom is highly disturbed and exhibits predominantly ruderal herbaceous vegetation and barren areas.

Segment 7

Segment 7 includes the concrete-lined channel from just north of the Firestone Blvd. Bridge to the San Gabriel River estuary “mixing zone” at the interface of the concrete-lined San Gabriel River channel (and Coyote Creek confluence) and the estuarine waters upstream from the power plants. Shore birds and local wildlife utilize the freshwater for loafing, but foraging habitat values are marginal.

Segment 8 “Mixing Zone”

Within the San Gabriel River estuary mixing zone, freshwater mixes with the seawater in a small apron area beyond the final concrete drop structure. The freshwater initially stays on the surface until wind and currents promote more thorough mixing. Water fowl and shore birds are seen in this area loafing and foraging. The freshwater influence may attract aquatic species that the water fowl prey on.

Plant Communities and Land Uses

The plant communities and non-vegetated areas were characterized and mapped within the study area for Segments 2, 3, and 4, and extending into Segment 5, and are described below. Plant communities and other non-vegetated areas in the Bosque Del Rio Hondo were delineated in the field and the digitized using ArcGIS as depicted on Figure 4**.** Each community and land use have been organized based on native or non-native dominance and are described in detail below.

Aquatic / Riverine

Open Water

Areas identified as “open water” were observed to contain standing or flowing water and represent the extent of surface water present where emergent vegetation was absent as indicated on aerial photographs and from field inspection.

Cattail Marsh

A small patch of cat-tail marsh was noted within a fully inundated portion of the mulefat plant community, mapped within the floodplain of the Rio Hondo upstream from the dam near Route 19. This community consisted entirely of broadleaf cat-tail (likely *Typha latifolia*), submerged in open water, with hydric soils.

Unvegetated Streambed

Areas classified as unvegetated streambed include the soft-bottom channel bed where vegetation is very sparse or entirely lacking. These areas are typically result from scour or silt/sand deposition during high flows and storm events in the San Gabriel River. Unvegetated streambed areas also represent those areas where standing or flowing water was not apparent in most aerial photos or during field inspection.

Native Riparian Communities

Black Willow Thickets

Black willow thickets were characterized and mapped both upstream and immediately downstream of the Whittier Narrows Dam; along the Rio Hondo and San Gabriel River, respectively. This community is characterized as supporting a tree layer dominated by Goodding's black willow (*Salix gooddingii*]; a much more mature form of this tree layer was observed along the San Gabriel River, while mainly successional tree growth was observed along the Rio Hondo, with many trees remaining less than three meters in height. The black willow is interspersed with various other native and non-native grass, palm and tree species such as arundo (*Arundo donax*), mulefat (*Baccharis salicifolia*), Shamel ash (*Fraxinus uhdei*), blue elderberry (*Sambucus nigra* ssp. *caerulea*), sandbar willow (*S. exigua*), arroyo willow (*S. lasiolepis*), Brazilian pepper tree (*Schinus terebinthifolia*) and Mexican fan palm (*Washingtonia filifera*).

This community supports a robust herbaceous layer dominated by various grasses and forbs, including Bermuda grass (*Cynodon dactylon*), prickly lettuce (*Lactuca serriola*), sweetclover (*Melilotus albus*), seep monkey flower (*Mimulus guttatus*), London rocket (*Sysimbrium irio*), spiny cow thistle (*Sonchus asper*) and saltmarsh aster (*Symphyotrichum subulatum* var. *parviflorum*). This community has a NatureServe rank of S3G4 and is designated by CDFW as 'sensitive'.

Sandbar Willow Thickets

A patch of willow scrub, dominated primarily by sandbar willow, occurs upstream from the San Gabriel River / San Jose Creek confluence and below the drop structure that appears to represent the upstream extent of upwelling influence from San Jose Creek.

Mulefat Thickets

Mulefat thickets were characterized and mapped along the San Gabriel River, downstream of the Whittier Narrows Dam, and along portion of the Zone 1 Ditch bed and banks. This community supports a dense, small tree layer of mulefat interspersed with various other tree species such as arroyo willow, black willow, Shamel ash and red river gum. Due to the dense tree layer, this community does not support a formative shrub or herbaceous layer; however, various species observed within the adjacent ruderal vegetation occur along the margins of this community and include shortpod mustard, tall cyperus (*Cyperus eragrostis*) and annual stinging nettle (*Urtica urens*).

Non-native Riparian Community

Giant Reed Breaks

Giant reed breaks were characterized and mapped throughout much of the floodplain surrounding the Rio Hondo, upstream of the Whittier Narrows Dam. This community supports a dense layer of giant reed, dominating both the overstory and understory, interspersed throughout with various native and non-native tree species such as black willow, bluegum (*E. globulus*), mulefat and red river gum. This community supports very few shrub or herbaceous species, except along its margins. Such species include horehound, poison hemlock and shortpod mustard.

Native Upland/Transitional Community

Blue Elderberry Stands

Although characterized as native, since the main shrub and tree species are native to the area, blue elderberry stands also exhibit substantial presence of ruderal (weedy, non-native) elements. Blue elderberry stands were identified throughout upland areas adjacent to the Zone 1 Ditch. This community is characterized as having a moderately dense, small tree layer of blue elderberry, interspersed with various species of trees and shrubs including River red gum (*Eucalyptus camaldulensis*), Southern black walnut (*Juglans californica*), western sycamore (*Platanus racemosa*), golden current (*Ribes aureum*), coast live oak (*Quercus agrifolia*) and Shamel ash. This community, within the boundaries of the Whittier Narrows Nature Preserve, tend to support more native tree species as well as a dense shrub layer dominated by the native golden current (*Ribes aureum* var. *gracillimum*). It is likely that this area has been restored/maintained to preserve native species and eradicate non-natives. Portions along the Zone 1 Ditch, outside the preserve support fewer native shrub and tree species with a pronounced herbaceous layer dominated by non-native species; much of this area was heavily choked with the passion flower (*Passiflora caerulea*), an escaped cultivated vine species.

As mentioned above, the herbaceous layer is composed predominantly of non-native grasses and forbs, overwhelmingly dominated by red brome (*Bromus rubens* ssp. *madritensis*), poison hemlock (*Conium maculatum*), sweet fennel (*Foeniculum vulgare*), shortpod mustard (*Hirschfeldia incana*), horehound (*Marrubium vulgare*) and Johnson grass (*Sorghum halepense*). This community has a NatureServe rank of S3G3 and is designated by CDFW as ‘sensitive’.

Non-native Communities

Disturbed/Developed

Disturbed/developed land use was noted and mapped throughout the survey area. Developed land use consisted of paved and unpaved roadways, boulder rip-rap, and various other forms of infrastructure either completely or largely devoid of vegetative cover. Disturbed areas are represented by only weedy, herbaceous species in areas that appeared to have been cleared or may have been subject to scouring within the main San Gabriel River channel (Chambers Group mapping, Attachment A) which include tree tobacco (*Nicotiana glauca*), castor bean (*Ricinus communis*) and other ruderal (non-native) species.

Non-native Tree Woodland (e.g., Eucalyptus, Ash, Elm, Fig)

Non-native tree woodland was characterized and mapped throughout much of the floodplain surrounding the Rio Hondo, upstream of the Whittier Narrows Dam and various other locations within the San Gabriel River and along the Zone 1 Ditch. This community supports a tree layer dominated by non-native species such as bluegum, edible fig, red river gum, Shamel ash and Chinese elm (*Ulmus parvifolia*) that is interspersed with native species such as black and sandbar willow. This community supports an herbaceous layer identical in character to the adjacent, disturbed, weed-dominated plant community and includes such species as castor bean, poison sumac, shortpod mustard and sweet clover.

Ruderal Forbland (e.g., Castor Bean, Mustard, Cheeseweed, Poison Hemlock, Sweetclover)

Ruderal vegetation, dominated by common non-native forbs established in historically disturbed areas, was present throughout much of the Rio Hondo floodplain, along the San Gabriel River and along the Zone 1 Ditch. This community consists almost entirely of non-native, herbaceous forbs and some shrub species such as castor bean, cheeseweed mallow (*Malva parviflora*), shortpod mustard, sweet clover, poison hemlock, and Himalayan blackberry (*Rubus armeniacus*). Native species, such as annual burrweed (*Ambrosia acanthicarpa*), ragweed (*A. psilostachya*) and annual sunflower (*Helianthus annuus*) may also occur and may be co-dominant in some areas. A few native and non-native tree species are also scattered throughout this community, such as blue gum, edible fig (*Ficus carica*), red river gum and Shamel ash.

Non-Native Grassland (e.g., Red Brome, Ripgut Brome, Mustard, Johnson Grass)

This community is characterized by dominant presence of non-native grass species with forbs also present but not completely dominant. These common ruderal grasses include red brome (*Bromus rubens* ssp. *madritensis*), ripgut brome (*Bromus diandrus*) shortpod mustard (*Hirschfeldia incana*), black mustard (*Brassica nigra*), horehound (*Marrubium vulgare*), and Johnson grass (*Sorghum halepense*). Poison hemlock (*Conium maculatum*) and sweet fennel (*Foeniculum vulgare*) are also present and may be dominant in small patch areas.

CDFW Sensitive Natural Communities and Habitat

“Sensitive” natural communities and habitats are those defined by the CDFW as those that have a reduced range and/or are imperiled due to various forms of impact such as residential and commercial development, agriculture, energy production and mining, and an influx of invasive and other problematic species. Vegetation communities are evaluated using NatureServe’s Heritage Methodology (NatureServe, 2018) which is based on the knowledge of range and distribution of a specific vegetation type and the proportion of occurrences that are of good ecological integrity. Evaluation is done at both State (within California[S]) and Global (natural range within and outside of California[G]), each ranked from 1 (very rare and threatened) to 5 (demonstrably secure). Natural communities and habitats with state ranks of S1-S3 are considered Sensitive Natural Communities and require review when evaluating CEQA impacts (CDFW, 2018b).

As described above black willow thickets and blue elderberry stands each have a NatureServe rank of S3G4; therefore, these communities are designated by the CDFW as “sensitive” and may be afforded protection under CEQA.

Special-Status Species

Special-status species are defined as those plants and animals that, because of their recognized rarity or vulnerability to various causes of habitat loss or population decline, are recognized by federal, state, or other agencies as under threat from human-associated actions. Some of these species receive specific protections that are defined by federal or state endangered species legislation. Others have been designated as special-status on the basis of adopted policies of state resource agencies or organizations with acknowledged expertise, or policies adopted by local governmental agencies such as counties, cities, and special districts to meet local conservation objectives. Wildlife and plants can be designated as special-status species in several ways:

- **Federal Endangered Species Act (ESA):** Species listed or proposed for listing as “threatened” or “endangered”, or as a “candidate” for possible future listing as threatened or endangered; “critical habitat” can be designated for listed species; USFWS currently oversees special-status listing for species in the Study Area;

- **California ESA**: Species listed or proposed for listing as “threatened” or “endangered”, or are a “candidate” for possible future listing as threatened or endangered;
- **California Environmental Quality Act (CEQA) Guidelines, Section 15380**: Species that meet the definitions of “rare” or “endangered”, as defined in Section 15380 of the CEQA Guidelines; and/or
- **California Department of Fish and Wildlife (CDFW)**: Species designated by CDFW as “species of special concern” and species on the watch list for listing to the California ESA; and species identified as "fully protected" under the California Fish and Game Code; Sections 3511, 4700, and 5050.

Special-Status Plants

Special-status plants are generally not expected to occur in the Study Area due to the high level of habitat degradation that has occurred from streambed alterations (i.e., cement-lined and accelerated flows), ground disturbance, extensive populations of exotic plant species that outcompete natives, homeless encampments, and trash. CNDDB records that intersect with the River include several special-status plants, but only Nevin’s barberry (*Berberis nevinii*), is considered potentially present in the Whittier Narrows Recreation Area, and that record is known to have been intentionally planted there rather than occurring naturally. A summary of the listing status for each of these species, as well as their likelihood of occurrence in the Study Area is presented in **Table 1**, *Special Status Plants Considered – Potential to Occur*. The “Potential for Occurrence” as described in Table 1 is defined as follows:

- **Not Expected:** The Study Area and/or immediate vicinity does not provide suitable habitat for a particular species.
- **Low Potential:** The Study Area and/or immediate vicinity only provide limited habitat for a particular species. In addition, the study area may lie outside the known range for a particular species.

Special-Status Wildlife

The potential for special-status wildlife species to occur in the Study Area was determined through the field survey, which noted observations of special-status species and the extent and quality of supporting habitat, as well as published geographic range maps, and recent or past occurrences within the Study Area as report to the CNDDB and the other resources that were reviewed. A summary of the listing status for each of these species, as well as their likelihood of occurrence in the Study Area is presented in **Table 2**, *Special Status Wildlife – Potential to Occur*. The “Potential for Occurrence” as described in Table 2 is defined as follows:

- **Not Expected:** The Study Area and/or immediate vicinity does not support suitable habitat for a particular species.
- **Low Potential:** The Study Area and/or immediate vicinity only provide limited habitat for a particular species. In addition, the known range for a particular species may be outside of the immediate project area.
- **Medium Potential:** The Study Area and/or immediate vicinity provide suitable habitat for a particular species.
- **High Potential:** The Study Area and/or immediate vicinity provide ideal habitat conditions for a particular species and/or known populations occur in the immediate area.
- **Present:** The species was observed on the site during a field survey conducted by ESA in 2018.

Listed Species Present or Expected to Occur

California Gnatcatcher *(Polioptila californica californica)*

The coastal California gnatcatcher was federally listed as threatened on March 30, 1993 (58 FR 16742) and is noted as a State Species of Special Concern for CDFW. Critical habitat was designated by USFWS in 2000. Critical habitat in the study area overlays the Whittier Narrows Recreation Area, the Crossover Channel and the adjacent section of the San Gabriel River upstream from Whittier Narrows Dam up to the inlet to the Zone 1 Ditch. Despite being designated as Critical Habitat, potentially suitable nesting habitat is lacking from the San Gabriel River but does occur within patches of upland vegetation within the blue elderberry plant community where patches of California buckwheat, sagebrush and other sage scrub representative shrubs provide adequate cover and patch size. This species has been reported in the WNRA and is considered potentially present and may breed within that part of the study area. The breeding season of the coastal California gnatcatcher extends from about February 15 through August 30, with the peak of nesting activity occurring from mid-March through mid-May.

TABLE 1
SPECIAL STATUS PLANTS CONSIDERED —POTENTIAL TO OCCUR

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
aphanisma *blitoides*	—/—/1B.2	Coastal bluff scrub, coastal dunes, coastal scrub. On bluffs and slopes near the ocean in sandy or clay soils. 3-305 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Braunton's milk-vetch *Astragalus brauntonii*	E/—/1B.1	Chaparral, coastal scrub, valley and foothill grassland. Recent burns or disturbed areas; usually on sandstone with carbonate layers. Soil specialist; requires shallow soils to defeat pocket gophers and open areas, preferably on hilltops, saddles or bowls between hills. 3-640 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Ventura Marsh milk-vetch *Astragalus pycnostachyus* var. *lanosissimus*	E/E/1B.1	Marshes and swamps, coastal dunes, coastal scrub. Within reach of high tide or protected by barrier beaches, more rarely near seeps on sandy bluffs. 1-35 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Coulter's saltbush *Atriplex coulteri*	—/—/1B.2	Coastal bluff scrub, coastal dunes, coastal scrub, valley and foothill grassland. Ocean bluffs, ridgetops, as well as alkaline low places. Alkaline or clay soils. 2-460 m.	**Not Expected:** No suitable habitat for the species present in the study area.
south coast saltscale *Atriplex pacifica*	—/—/1B.2	Coastal scrub, coastal bluff scrub, playas, coastal dunes. Alkali soils. 1-400 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Parish's brittlescale *Atriplex parishii*	—/—/1B.1	Vernal pools, chenopod scrub, playas. Usually on drying alkali flats with fine soils. 5-1420 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Davidson's saltscale *Atriplex serenana* var. *davidsonii*	—/—/1B.2	Coastal bluff scrub, coastal scrub. Alkaline soil. 0-460 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Nevin's barberry *Berberis nevinii*	E/E/1B.1	Chaparral, cismontane woodland, coastal scrub, riparian scrub. On steep, N-facing slopes or in low grade sandy washes. 290-1575 m.	**Not Expected:** The one specimen from near the study area is believed to planted by the Whittier Narrows Nature Center; otherwise, the study area is outside of the current range of the species.
slender mariposa-lily *Calochortus* clavatus var. *gracilis*	—/—/1B.2	Chaparral, coastal scrub, valley and foothill grassland. Shaded foothill canyons; often on grassy slopes within other habitat. 210-1815 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Plummer's mariposa-lily *Calochortus plummerae*	—/—/4.2	Coastal scrub, chaparral, valley and foothill grassland, cismontane woodland, lower montane coniferous forest. Occurs on rocky and sandy sites, usually of granitic or alluvial material. Can be very common after fire. 60-2500 m.	**Not Expected:** No suitable habitat for the species present in the study area.
intermediate mariposa-lily *Calochortus weedii* var. *intermedius*	—/—/1B.2	Coastal scrub, chaparral, valley and foothill grassland. Dry, rocky open slopes and rock outcrops. 60-1575 m.	**Not Expected:** No suitable habitat for the species present in the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
lucky morning-glory *Calystegia felix*	—/—/1B.1	Meadows and seeps, riparian scrub. Sometimes alkaline, alluvial. 30-215 m.	**Not Expected:** No suitable habitat for the species present in the study area.
southern tarplant *Centromadia parryi* ssp. *australis*	—/—/1B.1	Marshes and swamps (margins), valley and foothill grassland, vernal pools. Often in disturbed sites near the coast at marsh edges; also in alkaline soils sometimes with saltgrass. Sometimes on vernal pool margins. 0-975 m.	**Not Expected:** No suitable habitat for the species present in the study area.
smooth tarplant *Centromadia pungens* ssp. *laevis*	—/—/1B.1	Valley and foothill grassland, chenopod scrub, meadows and seeps, playas, riparian woodland. Alkali meadow, alkali scrub; also in disturbed places. 5-1170 m.	**Low Potential:** There is marginal habitat for the species present in the study area; however, most records for the species are from San Bernardino, Riverside and San Diego counties.
salt marsh bird's-beak *Chloropyron maritimum* ssp. *maritimum*	E/E/1B.2	Marshes and swamps, coastal dunes. Limited to the higher zones of salt marsh habitat. 0-10 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Parry's spineflower *Chorizanthe parryi* var. *parryi*	—/—/1B.1	Coastal scrub, chaparral, cismontane woodland, valley and foothill grassland. Dry slopes and flats; sometimes at interface of 2 vegetation types, such as chaparral and oak woodland. Dry, sandy soils. 90-1220 m.	**Not Expected:** No suitable habitat for the species present in the study area.
California saw-grass *Cladium californicum*	—/—/2B.2	Meadows and seeps, marshes and swamps (alkaline or freshwater). Freshwater or alkaline moist habitats. -20-2135 m.	**Not Expected:** No suitable habitat for the species present in the study area. There is only one historic (1861) record from Los Angeles County.
Peruvian dodder *Cuscuta obtusiflora* var. *glandulosa*	—/—/2B.2	Marshes and swamps (freshwater). Freshwater marsh. 15-280 m.	**Not Expected:** No suitable habitat for the species present in the study area. There are no herbarium records from Los Angeles County.
slender-horned spineflower *Dodecahema leptoceras*	E/E/1B.1	Chaparral, cismontane woodland, coastal scrub (alluvial fan sage scrub). Flood deposited terraces and washes; associates include *Encelia*, *Dalea*, *Lepidospartum*, etc. *Sandy* soils. 200-765 m.	**Not Expected:** There is marginal habitat for the species present in the study area; however, most of the herbarium records in Los Angeles County are located near the foothills of the San Gabriel Mountains.
many-stemmed dudleya *Dudleya multicaulis*	—/—/1B.2	Chaparral, coastal scrub, valley and foothill grassland. In heavy, often clayey soils or grassy slopes. 15-790 m.	**Not Expected:** No suitable habitat for the species present in the study area.
San Diego button-celery *Eryngium aristulatum* var. *parishii*	E/E/1B.1	Vernal pools, coastal scrub, valley and foothill grassland. San Diego mesa hardpan & claypan vernal pools & southern interior basalt flow vernal pools; usually surrounded by scrub. 15-880 m.	**Not Expected:** No suitable habitat for the species present in the study area.
San Gabriel bedstraw *Galium grande*	—/—/1B.2	Cismontane woodland, chaparral, broadleafed upland forest, lower montane coniferous forest. Open chaparral and low, open oak forest; on rocky slopes; probably undercollected due to inaccessible habitat. 425-1450 m.	**Not Expected:** No suitable habitat for the species present in the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
Los Angeles sunflower *Helianthus nuttallii* ssp. *parishii*	—/—/1A	Marshes and swamps (coastal salt and freshwater). 35-1525 m.	**Not Expected:** The species is believed to be extinct.
mesa horkelia *Horkelia cuneata* var. *puberula*	—/—/1B.1	Chaparral, cismontane woodland, coastal scrub. Sandy or gravelly sites. 15-1645 m.	**Low Potential:** There is marginal habitat for the species present in the study area.
decumbent goldenbush *Isocoma menziesii* var. *decumbens*	—/—/1B.2	Coastal scrub, chaparral. Sandy soils; often in disturbed sites. 1-915 m.	**Not Expected:** There is marginal habitat for the species present in the study area; however, the study area is at the northern limits of the range of the species, with most of the herbarium records for the species being from San Diego County.
Coulter's goldfields *Lasthenia glabrata* ssp. *coulteri*	—/—/1B.1	Coastal salt marshes, playas, vernal pools. Usually found on alkaline soils in playas, sinks, and grasslands. 1-1375 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Robinson's pepper-grass *Lepidium virginicum* var. *robinsonii*	—/—/4.3	Chaparral, coastal scrub. Dry soils, shrubland. 4-1435 m.	**Low Potential:** There is marginal habitat for the species present in the study area and records of the species upstream.
California muhly *Muhlenbergia californica*	—/—/4.3	Coastal scrub, chaparral, lower montane coniferous forest, meadows and seeps. Usually found near streams or seeps. 100-2000 m.	**Not Expected:** There is marginal habitat for the species present in the study area; however, most of the herbarium records in Los Angeles County are in the San Gabriel Mountains.
mud nama *Nama stenocarpa*	—/—/2B.2	Marshes and swamps. Lake shores, river banks, intermittently wet areas. 5-500 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Gambel's water cress *Nasturtium gambelii*	E/T/1B.1	Marshes and swamps. Freshwater and brackish marshes at the margins of lakes and along streams, in or just above the water level. 5-330 m.	**Not Expected:** No suitable habitat for the species present in the study area.
prostrate vernal pool navarretia *Navarretia prostrata*	—/—/1B.1	Coastal scrub, valley and foothill grassland, vernal pools, meadows and seeps. Alkaline soils in grassland, or in vernal pools. Mesic, alkaline sites. 3-1235 m.	**Not Expected:** No suitable habitat for the species present in the study area.
coast woolly-heads *Nemacaulis denudata* var. *denudata*	—/—/1B.2	Coastal dunes. 0-100 m.	**Not Expected:** No suitable habitat for the species present in the study area.
California Orcutt grass *Orcuttia californica*	E/E/1B.1	Vernal pools. 10-660 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Lyon's pentachaeta *Pentachaeta lyonii*	E/E/1B.1	Chaparral, valley and foothill grassland, coastal scrub. Edges of clearings in chaparral, usually at the ecotone between grassland and chaparral or edges of firebreaks. 30-630 m.	**Not Expected:** No suitable habitat for the species present in the study area.
Brand's star phacelia *Phacelia stellaris*	—/—/1B.1	Coastal scrub, coastal dunes. Open areas. 3-370 m.	**Not Expected:** There is marginal habitat for the species present in the study area; however, the study area is at the northern limits of the

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
			range of the species, with most of the herbarium records for the species being from San Diego County.
white rabbit-tobacco *Pseudognaphalium leucocephalum*	—/—/2B.2	Riparian woodland, cismontane woodland, coastal scrub, chaparral. Sandy, gravelly sites. 35-515 m.	**Low Potential:** There is marginal habitat for the species present in the study area.
Parish's gooseberry *Ribes divaricatum* var. *parishii*	—/—/1A	Riparian woodland. *Salix* swales in riparian habitats. 65-300 m.	**Not Expected:** The species is believed to be extinct.
salt spring checkerbloom *Sidalcea neomexicana*	—/—/2B.2	Playas, chaparral, coastal scrub, lower montane coniferous forest, Mojavean desert scrub. Alkali springs and marshes. 3-2380 m.	**Not Expected:** No suitable habitat for the species present in the study area.
estuary seablite *Suaeda esteroa*	—/—/1B.2	Marshes and swamps. Coastal salt marshes in clay, silt, and sand substrates. 0-80 m.	**Not Expected:** No suitable habitat for the species present in the study area.
San Bernardino aster *Symphyotrichum defoliatum*	—/—/1B.2	Meadows and seeps, cismontane woodland, coastal scrub, lower montane coniferous forest, marshes and swamps, valley and foothill grassland. Vernally mesic grassland or near ditches, streams and springs; disturbed areas. 2-2040 m.	**Low Potential:** There is marginal habitat for the species present in the study area.

TABLE 2
SPECIAL STATUS WILDLIFE – POTENTIAL TO OCCUR

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
Invertebrates			
Crotch bumblebee *Bombus crotchii*	—/—/SA	Coastal California east to the Sierra-Cascade crest and south into Mexico. Food plant genera include *Antirrhinum*, *Phacelia*, *Clarkia*, *Dendromecon*, *Eschscholzia*, and *Eriogonum*.	**High Potential:** Food plants are present in the study area and there are nearby records.
western tidal-flat tiger beetle *Cicindela gabbii*	—/—/SA	Inhabits estuaries and mudflats along the coast of Southern California. Generally found on dark-colored mud in the lower zone; occasionally found on dry saline flats of estuaries.	**Not Expected:** No suitable habitat for the species present in the study area.
sandy beach tiger beetle *Cicindela hirticollis gravida*	—/—/SA	Inhabits areas adjacent to non-brackish water along the coast of California from San Francisco Bay to northern Mexico. Clean, dry, light-colored sand in the upper zone. Subterranean larvae prefer moist sand not affected by wave action.	**Not Expected:** No suitable habitat for the species present in the study area.
western beach tiger beetle *Cicindela latesignata latesignata*	—/—/SA	Mudflats and beaches in coastal Southern California.	**Not Expected:** No suitable habitat for the species present in the study area.
senile tiger beetle *Cicindela senilis frosti*	—/—/SA	Inhabits marine shoreline, from Central California coast south to salt marshes of San Diego. Also found at Lake Elsinore Inhabits dark-colored mud in the lower zone and dried salt pans in the upper zone.	**Not Expected:** No suitable habitat for the species present in the study area.
globose dune beetle *Coelus globosus*	—/—/SA	Inhabitant of coastal sand dune habitat; erratically distributed from Ten Mile Creek in Mendocino County south to Ensenada, Mexico. Inhabits foredunes and sand hummocks; it burrows beneath the sand surface and is most common beneath dune vegetation.	**Not Expected:** No suitable habitat for the species present in the study area.
monarch - California overwintering population *Danaus plexippus* pop. 1	—/—/SA	Winter roost sites extend along the coast from northern Mendocino to Baja California, Mexico. Roosts located in wind-protected tree groves (eucalyptus, Monterey pine, cypress), with nectar and water sources nearby.	**Not Expected:** No suitable habitat for the species present in the study area.
wandering (=saltmarsh) skipper *Panoquina errans*	—/—/SA	Southern California coastal salt marshes. Requires moist saltgrass for larval development.	**Not Expected:** No suitable habitat for the species present in the study area.
Dorothy's El Segundo Dune weevil	—/—/SA	Coastal sand dunes in Los Angeles County.	**Not Expected:** No suitable habitat for the species present in the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
Trigonoscuta dorothea dorothea			
San Diego fairy shrimp *Branchinecta sandiegonensis*	E/—/—	Endemic to San Diego and Orange County mesas. Vernal pools.	**Not Expected:** No suitable habitat for the species present in the study area.
Fish			
Santa Ana sucker *Catostomus santaanae*	T/—/—	Endemic to Los Angeles Basin south coastal streams. Habitat generalists, but prefer sand-rubble-boulder bottoms, cool, clear water, and algae.	**Not Expected:** No suitable habitat for the species present in the study area. The species is known to occur upstream, but numerous barriers are present between the study area and these populations.
arroyo chub *Gila orcuttii*	—/—/SSC	Native to streams from Malibu Creek to San Luis Rey River basin. Introduced into streams in Santa Clara, Ventura, Santa Ynez, Mojave and San Diego river basins. Slow water stream sections with mud or sand bottoms. Feeds heavily on aquatic vegetation and associated invertebrates.	**Not Expected:** No suitable habitat for the species present in the study area. The species is known to occur upstream, but numerous barriers are present between the study area and these populations.
Santa Ana speckled dace *Rhinichthys osculus* ssp. 3	—/—/SSC	Headwaters of the Santa Ana and San Gabriel rivers. May be extirpated from the Los Angeles River system. Requires permanent flowing streams with summer water temps of 17-20° Celsius. Usually inhabits shallow cobble and gravel riffles.	**Not Expected:** No suitable habitat for the species present in the study area. The species is known to occur upstream, but numerous barriers are present between the study area and these populations.
		Amphibians	
arroyo toad *Anaxyrus californicus*	E/—/SSC	Semi-arid regions near washes or intermittent streams, including valley-foothill and desert riparian, desert wash, etc. Rivers with sandy banks, willows, cottonwoods, and sycamores; loose, gravelly areas of streams in drier parts of range.	**Not Expected:** No suitable habitat for the species present in the study area. The species has been extirpated from most of Los Angeles County.
southern mountain yellow-legged frog *Rana muscosa*	E/E/WL	Always encountered within a few feet of water. Tadpoles may require 2 - 4 years to complete their aquatic development.	**Not Expected:** No suitable habitat for the species present in the study area.
western spadefoot *Spea hammondii*	—/—/SSC	Occurs primarily in grassland habitats but can be found in valley-foothill hardwood woodlands. Vernal pools are essential for breeding and egg-laying.	**Not Expected:** No suitable habitat for the species present in the study area.
Coast Range newt *Taricha torosa*	—/—/SSC	Coastal drainages from Mendocino County to San Diego County. Lives in terrestrial habitats and will migrate over 1 kilometer to breed in ponds, reservoirs and slow-moving streams.	**Not Expected:** No suitable habitat for the species present in the study area. The species is known to occur upstream, but numerous barriers are present between the study area and these populations.
Reptiles			
California glossy snake *Arizona elegans occidentalis*	—/—/SSC	Patchily distributed from the eastern portion of San Francisco Bay, southern San Joaquin Valley, and the Coast, Transverse, and Peninsular ranges, south to Baja California. Generalist reported from a range of scrub and grassland habitats, often with loose or sandy soils.	**Low Potential:** Marginal habitat for the species occurs in the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
orange-throated whiptail *Aspidoscelis hyperythra*	—/—/WL	Inhabits low-elevation coastal scrub, chaparral, and valley-foothill hardwood habitats. Prefers washes and other sandy areas with patches of brush and rocks. Perennial plants necessary for its major food: termites.	**Not Expected:** The study area is outside of the range of the species.
coastal whiptail *Aspidoscelis tigris stejnegeri*	—/—/SSC	Found in deserts and semi-arid areas with sparse vegetation and open areas. Also found in woodland and riparian areas. Ground may be firm soil, sandy, or rocky.	**Medium Potential.** Marginal habitat for the species is found in the study area
green sea turtle *Chelonia mydas*	T/—/—	Marine. Completely herbivorous; needs adequate supply of seagrasses and algae.	**Present:** This species has been observed in the San Gabriel River estuary area in Segment 8 in recent years. It is possible individual may occur anywhere in this segment subject to tidal influence and could occasionally occur in or near the "mixing zone" where Segment 7 meets Segment 8. This species is Not Expected in any other part of the Study Area because no suitable habitat is present and numerous barriers separate Segment 8 from upstream areas.
western pond turtle *Emys marmorata*	—/—/SSC	A thoroughly aquatic turtle of ponds, marshes, rivers, streams and irrigation ditches, usually with aquatic vegetation, below 6000 feet elevation. Needs basking sites and suitable (sandy banks or grassy open fields) upland habitat up to 0.5 km from water for egg-laying.	**Low Potential:** The CNDDB includes two records in the near vicinity from the 1980's, one near the Zone 1 Ditch and one in the San Gabriel River. It is possible but not likely that native pond turtle could have persisted in Segment 2 and Segment 3, since suitable habitat is present. These segments contain a relatively limited amount of potentially suitable egg-laying habitat near areas where surface water occurs. Also, introduced predators (e.g., bullfrog, African clawed frog, carp, bass) are prevalent and storm events occasionally result in extremely high flows in these segments that would put estivating turtles at risk. These factors reduce the chances that a viable breeding population could persist and make it likely that this species has been extirpated in the study area. The species occurs in upstream area in the San Gabriel River, but numerous barriers are present between the study area and these populations.
coast horned lizard *Phrynosoma blainvillii*	—/—/SSC	Frequents a wide variety of habitats, most common in lowlands along sandy washes with scattered low bushes. Open areas for sunning, bushes for cover, patches of loose soil for burial, and abundant supply of ants and other insects.	**Low Potential:** Marginal habitat for the species occurs in the study area.
two-striped garter snake *Thamnophis hammondii*	—/—/SSC	Coastal California from vicinity of Salinas to northwest Baja California. From sea to about 7,000 feet elevation. Highly aquatic, found in or near permanent fresh water.	**Low Potential:** Marginal habitat for the species occurs in the study area.
Birds			
Cooper's hawk *Accipiter cooperii*	—/—/WL	Habitat includes mature forest, open woodlands, wood edges, river groves. Typically nests in woodlands with tall trees and openings or edge habitat nearby. Increasingly found in cities where some tall trees exist.	**Present:** The species has been observed year-round in the study area and is expected to nest and forage there.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
tricolored blackbird *Agelaius tricolor*	—/CE/SSC	Highly colonial species, most numerous in Central Valley and vicinity. Largely endemic to California. Requires open water, protected nesting substrate, and foraging area with insect prey within a few km of the colony.	**Not Expected:** No suitable nesting habitat for the species present in the study area. May pass through the area during migration.
southern California rufous-crowned sparrow *Aimophila ruficeps canescens*	—/—/WL	Resident in Southern California coastal sage scrub and sparse mixed chaparral. Frequents relatively steep, often rocky hillsides with grass and forb patches.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
grasshopper sparrow *Ammodramus savannarum*	—/—/SSC	Dense grasslands on rolling hills, lowland plains, in valleys and on hillsides on lower mountain slopes. Favors native grasslands with a mix of grasses, forbs and scattered shrubs. Loosely colonial when nesting.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
burrowing owl *Athene cunicularia*	—/—/SSC	Open, dry annual or perennial grasslands, deserts, and scrublands characterized by low-growing vegetation. Subterranean nester, dependent upon burrowing mammals, most notably, the California ground squirrel.	**Low Potential.** The species is not expected to breed in the study area, but individuals could occur during winter and migration.
ferruginous hawk *Buteo regalis*	—/—/WL	Open grasslands, sagebrush flats, desert scrub, low foothills and fringes of pinyon and juniper habitats. Eats mostly lagomorphs, ground squirrels, and mice. Population trends may follow lagomorph population cycles.	**Not Expected:** Outside of the breeding range of the species. May pass through the study area during migration.
Swainson's hawk *Buteo swainsoni*	—/T/—	Breeds in grasslands with scattered trees, juniper-sage flats, riparian areas, savannahs, and agricultural or ranch lands with groves or lines of trees. Requires adjacent suitable foraging areas such as grasslands, or alfalfa or grain fields supporting rodent populations.	**Not Expected:** Outside of the breeding range of the species. May pass through the study area during migration.
coastal cactus wren *Campylorhynchus brunneicapillus sandiegensis*	—/—/SSC	Southern California coastal sage scrub. Wrens require tall *Opuntia* cactus for nesting and roosting.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
western snowy plover *Charadrius alexandrinus nivosus*	T/—/SSC	Sandy beaches, salt pond levees and shores of large alkali lakes. Needs sandy, gravelly or friable soils for nesting.	**Not Expected:** Outside of the breeding range of the species. May pass through the area during migration.
western yellow-billed cuckoo *Coccyzus americanus occidentalis*	FT/SE/—	Riparian forest nester, along the broad, lower flood-bottoms of larger river systems. Nests in riparian jungles of willow, often mixed with cottonwoods, with lower story of blackberry, nettles, or wild grape.	**Not Expected:** No suitable nesting habitat for the species present in the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
yellow rail *Coturnicops noveboracensis*	—/—/SSC	Summer resident in eastern Sierra Nevada in Mono County. Freshwater marshlands.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
black swift *Cypseloides niger*	—/—/SSC	Coastal belt of Santa Cruz and Monterey counties; central and southern Sierra Nevada; San Bernardino and San Jacinto mountains. Breeds in small colonies on cliffs behind or adjacent to waterfalls in deep canyons and sea-bluffs above the surf; forages widely.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
white-tailed kite *Elanus leucurus*	—/—/FP	Rolling foothills and valley margins with scattered oaks and river bottomlands or marshes next to deciduous woodland. Open grasslands, meadows, or marshes for foraging close to isolated, dense-topped trees for nesting and perching.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
southwestern willow flycatcher *Empidonax traillii extimus*	E/E/—	Prefers dense vegetation throughout all vegetation layers present in riparian areas. Prefers nesting over or in the immediate vicinity of standing water.	**Low Potential:** Marginal habitat for the species occurs in the study area.
American peregrine falcon *Falco peregrinus anatum*	D/D/FP	Near wetlands, lakes, rivers, or other water; on cliffs, banks, dunes, mounds; also, human-made structures. Nest consists of a scrape or a depression or ledge in an open site.	**Not Expected:** No suitable nesting habitat for the species present in the study area. May forage in the study area.
yellow-breasted chat *Icteria virens*	—/—/SSC	Summer resident; inhabits riparian thickets of willow and other brushy tangles near watercourses. Nests in low, dense riparian, consisting of willow, blackberry, wild grape; forages and nests within 10 feet of ground.	**Present:** The species has been observed and is expected to use the study area for nesting and foraging.
California black rail *Laterallus jamaicensis coturniculus*	—/T/FP	Inhabits freshwater marshes, wet meadows and shallow margins of saltwater marshes bordering larger bays. Needs water depths of about 1 inch that do not fluctuate during the year and dense vegetation for nesting habitat.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
osprey *Pandion haliaetus*	—/—/WL	Ocean shore, bays, freshwater lakes, and larger streams. Large nests built in tree-tops within 15 miles of a good fish-producing body of water.	**Not Expected:** No suitable nesting or foraging habitat for the species present in the study area.
Belding's savannah sparrow *Passerculus sandwichensis beldingi*	—/E/—	Inhabits coastal salt marshes, from Santa Barbara south through San Diego County. Nests in Salicornia on and about margins of tidal flats.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
California brown pelican *Pelecanus occidentalis californicus*	D/D/FP	Colonial nester on coastal islands just outside the surf line. Nests on coastal islands of small to moderate size which afford immunity from attack by ground-dwelling predators. Roosts communally.	**Not Expected:** No suitable nesting habitat for the species present in the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
coastal California gnatcatcher *Polioptila californica californica*	T/—/SSC	Obligate, permanent resident of coastal sage scrub below 2500 feet in Southern California. Low, coastal sage scrub in arid washes, on mesas and slopes. Not all areas classified as coastal sage scrub are occupied.	**High Potential:** No suitable nesting habitat for the species present in the study area. However, the study area is within designated critical habitat for the species. The species is known to occur adjacent to the study area in the Montebello Hills and may occur in the study area as a transient. The species is not expected to occur within the river channel since suitable habitat for this species is not present in the river channel.
light-footed Ridgway's rail *Rallus obsoletus levipes*	E/E/FP	Found in salt marshes traversed by tidal sloughs, where cordgrass and pickleweed are the dominant vegetation. Requires dense growth of either pickleweed or cordgrass for nesting or escape cover; feeds on mollusks and crustaceans.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
bank swallow *Riparia riparia*	—/T/—	Colonial nester; nests primarily in riparian and other lowland habitats west of the desert. Requires vertical banks/cliffs with fine-textured/sandy soils near streams, rivers, lakes, ocean to dig nesting hole.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
black skimmer *Rynchops niger*	—/—/SSC	Nests on gravel bars, low islets, and sandy beaches, in unvegetated sites. Nesting colonies usually less than 200 pairs.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
yellow warbler *Setophaga petechia*	—/—/SSC	Riparian plant associations in close proximity to water. Also nests in montane shrubbery in open conifer forests in Cascades and Sierra Nevada. Frequently found nesting and foraging in willow shrubs and thickets, and in other riparian plants including cottonwoods, sycamores, ash, and alders.	**Present:** The species has been observed and is expected to use the study area for nesting and foraging.
California least tern *Sternula antillarum browni*	E/E/FP	Nests along the coast from San Francisco Bay south to northern Baja California. Colonial breeder on bare or sparsely vegetated, flat substrates: sand beaches, alkali flats, landfills, or paved areas.	**Not Expected:** No suitable nesting habitat for the species present in the study area.
least Bell's vireo *Vireo bellii pusillus*	E/E/—	Summer resident of Southern California in low riparian in vicinity of water or in dry river bottoms; below 2000 feet. Nests placed along margins of bushes or on twigs studying into pathways, usually willow, Baccharis, mesquite.	**Present:** The species has been observed and is expected to use the study area for nesting and foraging.
Mammals			
pallid bat *Antrozous pallidus*	—/—/SSC	Deserts, grasslands, shrublands, woodlands and forests. Most common in open, dry habitats with rocky areas for roosting. Roosts must protect bats from high temperatures. Very sensitive to disturbance of roosting sites.	**Not Expected:** No suitable roosting habitat for the species present in the study area. May forage in the study area.
Townsend's big-eared bat *Corynorhinus townsendii*	—/—/SSC	Throughout California in a wide variety of habitats. Most common in mesic sites. Roosts in the open, hanging from walls and ceilings. Roosting sites limiting. Extremely sensitive to human disturbance.	**Not Expected:** No suitable roosting habitat for the species present in the study area.
western mastiff bat	—/—/SSC	Many open, semi-arid to arid habitats, including conifer and deciduous woodlands, coastal scrub, grasslands, chaparral, etc. Roosts in crevices in cliff faces, high buildings, trees and tunnels.	**Medium Potential:** The species may roost under the bridges in the study area. The species is one of many bats species that are expected forage over the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
Eumops perotis californicus			
silver-haired bat *Lasionycteris noctivagans*	—/—/SA	Primarily a coastal and montane forest dweller, feeding over streams, ponds and open brushy areas. Roosts in hollow trees, beneath exfoliating bark, abandoned woodpecker holes, and rarely under rocks. Needs drinking water.	**Medium Potential:** The species may roost within the trees in the study area. The species is one of many bats species that are expected forage over the study area.
western red bat *Lasiurus blossevillii*	—/—/SA	Roosts primarily in trees, 2-40 feet above ground, from sea level up through mixed conifer forests. Roosts in the foliage of trees and shrubs in forests. Prefers habitat edges and mosaics with trees that are protected from above and open below with open areas for foraging.	**Medium Potential:** The species may roost within the trees in the study area. The species is one of many bats species that are expected forage over the study area.
hoary bat *Lasiurus cinereus*	—/—/SA	Prefers open habitats or habitat mosaics, with access to trees for cover and open areas or habitat edges for feeding. Roosts in dense foliage of medium to large trees. Feeds primarily on moths. Requires water.	**Medium Potential:** The species may roost within the trees in the study area. The species is one of many bats species that are expected forage over the study area.
western yellow bat *Lasiurus xanthinus*	—/—/SSC	Found in valley foothill riparian, desert riparian, desert wash, and palm oasis habitats. Roosts in trees, particularly palms. Forages over water and among trees.	**Medium Potential:** The species may roost within the trees in the study area. The species is one of many bats species that are expected forage over the study area.
San Diego black-tailed jackrabbit *Lepus californicus bennettii*	—/—/SSC	Intermediate canopy stages of shrub habitats and open shrub / herbaceous and tree / herbaceous edges. Coastal sage scrub habitats in Southern California.	**Low Potential:** The species may be extirpated from the study area due to the loss of suitable habitat.
south coast marsh vole *Microtus californicus stephensi*	—/—/SSC	Tidal marshes in Los Angeles, Orange and southern Ventura counties.	**Not Expected:** No suitable habitat for the species present in the study area.
pocketed free-tailed bat *Nyctinomops femorosaccus*	—/—/SSC	Variety of arid areas in Southern California; pine-juniper woodlands, desert scrub, palm oasis, desert wash, desert riparian, etc. Rocky areas with high cliffs.	**Not Expected:** No suitable roosting habitat for the species present in the study area. May forage in the study area.
big free-tailed bat *Nyctinomops macrotis*	—/—/SSC	A migratory species that forms maternity colonies in rock crevices and caves that are typically used long term. Roost mainly in crevices and rocks in cliff situations, with occasional roosts occurring in buildings, caves, and tree cavities.	**Not Expected:** No suitable roosting habitat for the species present in the study area. May forage in the study area.
southern grasshopper mouse *Onychomys torridus ramona*	—/—/SSC	Desert areas, especially scrub habitats with friable soils for digging. Prefers low to moderate shrub cover. Feeds almost exclusively on arthropods, especially scorpions and orthopteran insects.	**Not Expected:** No suitable habitat for the species present in the study area.

Species	Federal/State/ CDFW Status	Preferred Habitat	Probability of Occurrence in Study Area
Pacific pocket mouse *Perognathus longimembris pacificus*	E/—/SSC	Inhabits the narrow coastal plains from the Mexican border north to El Segundo, Los Angeles County. Seems to prefer soils of fine alluvial sands near the ocean, but much remains to be learned.	**Not Expected:** No suitable habitat for the species present in the study area.
southern California saltmarsh shrew *Sorex ornatus salicornicus*	—/—/SSC	Coastal marshes in Los Angeles, Orange and Ventura counties. Requires dense vegetation and woody debris for cover.	**Not Expected:** No suitable habitat for the species present in the study area.
American badger *Taxidea taxus*	—/—/SSC	Most abundant in drier open stages of most shrub, forest, and herbaceous habitats, with friable soils. Needs sufficient food, friable soils and open, uncultivated ground. Preys on burrowing rodents. Digs burrows.	**Not Expected:** The species is extirpated within the study area.

Definitions:
1. Federal status: USFWS Listing, other non-CA specific listing
BC – Bird of Conservation Concern
FE = Listed as endangered under the federal Endangered Species Act (ESA)
FT = Listed as threatened under ESA

2. State status: CDFW Listing
SE = Listed as endangered under the California Endangered Species Act (CESA)
ST = Listed as threatened under the CESA
SSC = Species of Special Concern as identified by the CDFW
FP = Listed as fully protected under CDFG code
WL = Listed as a Watchlist species by CDFW

3. Other status:
WBWG = Listing by the Western Bat Working Group

Least Bell’s Vireo *(Vireo bellii pusillus)*

A range-wide decline of least Bell’s vireo resulted in its being federally listed as endangered on May 2, 1986 (51 FR 16474). Critical habitat for the species was designated on February 2, 1994 (59 FR 4845; USFWS 1998a). The State of California listed the least Bell’s vireo as Endangered on June 27, 1980. The decline was attributed to extensive historic habitat loss and degradation and brood parasitism by brown-headed cowbirds (*Molothrus ater*).

The least Bell's vireo is a summer resident of cottonwood-willow forest, oak woodland, shrubby thickets, and dry washes with willow thickets at the edges. The cottonwood-willow habitat is the more commonly used habitat. The physical and biological habitat features that support feeding, nesting, roosting, and sheltering essential to the conservation of the vireo are described by USFWS as “riparian woodland vegetation that generally contains both canopy and shrub layers, and includes some associated upland habitats.”

The closest area of designated Critical Habitat for this species is at least 20 miles to the east of the study area in the Prado Basin located north of SR-91 and east of SR-71 in the Chino area, upstream from Prado Dam on the Santa Ana River. However, this species is known from multiple reports to occur along the reach of the San Gabriel River in Segments 2, 3, 4, and the upstream part of 5. It has also been observed in the WNRA although very recent data is not available. Most of the native riparian woodland and riparian scrub (e.g., black willow, mule fat), except very small (e.g., < 0.1 acre), isolated and disturbed patches, are considered to provide suitable breeding habitat in the study area. Blue elderberry stands in the WNRA provide additional foraging habitat and may offer suitable nesting opportunities

Project Impacts

The only sensitive species that occupy the study area are the California coastal gnatcatcher and the least Bell’s vireo. Reduced discharge to the stream channels would have no effect on the upland gnatcatcher habitat. Reduced discharge could reduce riparian habitats supporting least Bell’s vireo. **Table 3**, *Summary of Project Effects*, summarizes the effects of reduced discharges to habitats found in each channel segment.

The existing inconsistent discharges to the San Gabriel River above the Whittier Narrows Dam support Black Willow thickets occupied by least Bell’s vireo. This habitat type is reliant on consistent access to water. The proposed project would reduce total annual discharges to the river, but would maintain a consistent flow in areas that support riparian habitat. The project objectives include maintaining the existing riparian habitat acreage in the channels, resulting in no reduction of available vireo habitat due to reduced discharges.

Elimination of discharges from Pomona WRP would reduce freshwater within the concrete channels. This is not considered a significant impact since no sensitive species utilize this water, and flows would not be entirely eliminated. Reduction of discharges from San Jose Creek WRP would reduce flows within the WNRA, but would not be expected to reduce riparian habitat due to sustaining groundwater upwelling and the remaining discharges. Implementation of an Adaptive Management Plan would confirm this expectation. Below Whittier Narrows Dam, reduced flows from Pomona WRP and San Jose Creek WRP would have no impact on habitat since existing discharge flows do not reach these river segments. The discharge reductions from Los Coyotes WRP and Long Beach WRP would reduce freshwater within concrete channels. Similar to San Jose Creek, this is not considered a significant impact since no sensitive species utilize this water, and flows would not be entirely eliminated. Implementation of an Adaptive Management Plan would ensure that existing riparian habitats that sustain sensitive species in Segments 2 through 4 would not be reduced by the proposed project.

TABLE 3
SUMMARY OF PROJECT EFFECTS

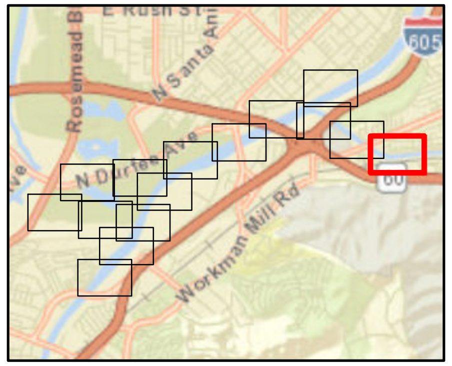
Segment	Habitat	Effects of Project	Impact Conclusion
Segment 1	Fresh water on concrete	Eliminated Pomona WRP discharge would reduce freshwater flow that could dry the channel periodically. Algae in channel may be reduced. Wildlife would find foraging elsewhere.	Less than significant due to lack of sensitive species utilizing concrete freshwater.
Segment 2	Black Willow Thicket with invasives	Eliminated Pomona WRP and reduced San Jose Creek WRP discharges would reduce in-stream flow, but groundwater upwelling would remain, supporting existing habitat.	Less than significant due to habitat sustaining groundwater upwelling and ponding water providing sufficient water to sustain existing riparian habitat.
Segment 3	Ruderal Forbland, Black Willow Thicket, Sand Bar Willow	Eliminated Pomona WRP and reduced San Jose Creek WRP discharges would reduce in-stream flow, but groundwater upwelling would remain, supporting existing habitat, including least Bell's vireo habitat.	Less than significant due to habitat sustaining groundwater upwelling and ponding water providing sufficient water to sustain existing riparian habitat.
Segment 4	Ruderal Forbland, Non-native Grassland, dry river bottom, Sand Bar Willow, Black Willow Thicket	Eliminated Pomona WRP and reduced San Jose Creek WRP would reduce in-stream flow, but remaining discharges would support existing habitat, including least Bell's vireo habitat.	Less than significant due to limited riparian habitat and remaining discharges sufficient to sustain existing riparian habitat.
Zone 1 Ditch and WNRA	Blue Elderberry Stands Ruderal Forbland, Non-native Grassland	Eliminated Pomona WRP and reduced San Jose Creek WRP would reduce periodic water deliveries, but remaining discharges would support existing habitat.	Less than significant due to limited riparian habitat and remaining discharges sufficient to sustain existing habitat.
Segment 5	Non-native Grassland and invasives	No Impact from discharge reductions.	No Impact due to lack of sensitive habitat and lack of flow impacts from project.
Segment 6	Non-native grass and invasives	No Impact from discharge reductions.	No Impact due to lack of sensitive habitat and lack of flow impacts from project.
Segment 7	Freshwater on concrete	Reduced discharges from Los Coyotes WRP and Long Beach WRP would reduce freshwater flow. Algae in channel may be reduced. Wildlife would find foraging elsewhere.	Less than significant due to lack of sensitive species utilizing concrete freshwater and availability of freshwater in other locations.
Segment 8	San Gabriel River Estuary Mixing Zone	Reduced discharges from Los Coyotes WRP and Long Beach WRP would reduce freshwater in mixing zone.	Less than significant due to limited values of freshwater mixing zone within rip-rap channel and remaining discharges sustaining habitat values.

Attachment A

San Gabriel River / San Jose Creek Vegetation Mapping (Amec Foster Wheeler)

Legend

- 🟫 Arroyo willow thickets
- 🟩 Black willow thickets
- 🟩 Cattail marshes
- ⬛ Developed
- 🟨 Eucalyptus semi-natural stands
- 🟥 Giant reed breaks
- 🟩 Mulefat thickets - Disturbed
- 🟦 Open Water



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Vegetation Communities
San Gabriel River
Los Angeles County, California

N

1 inch = 200 feet
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Feet

FIGURE

1

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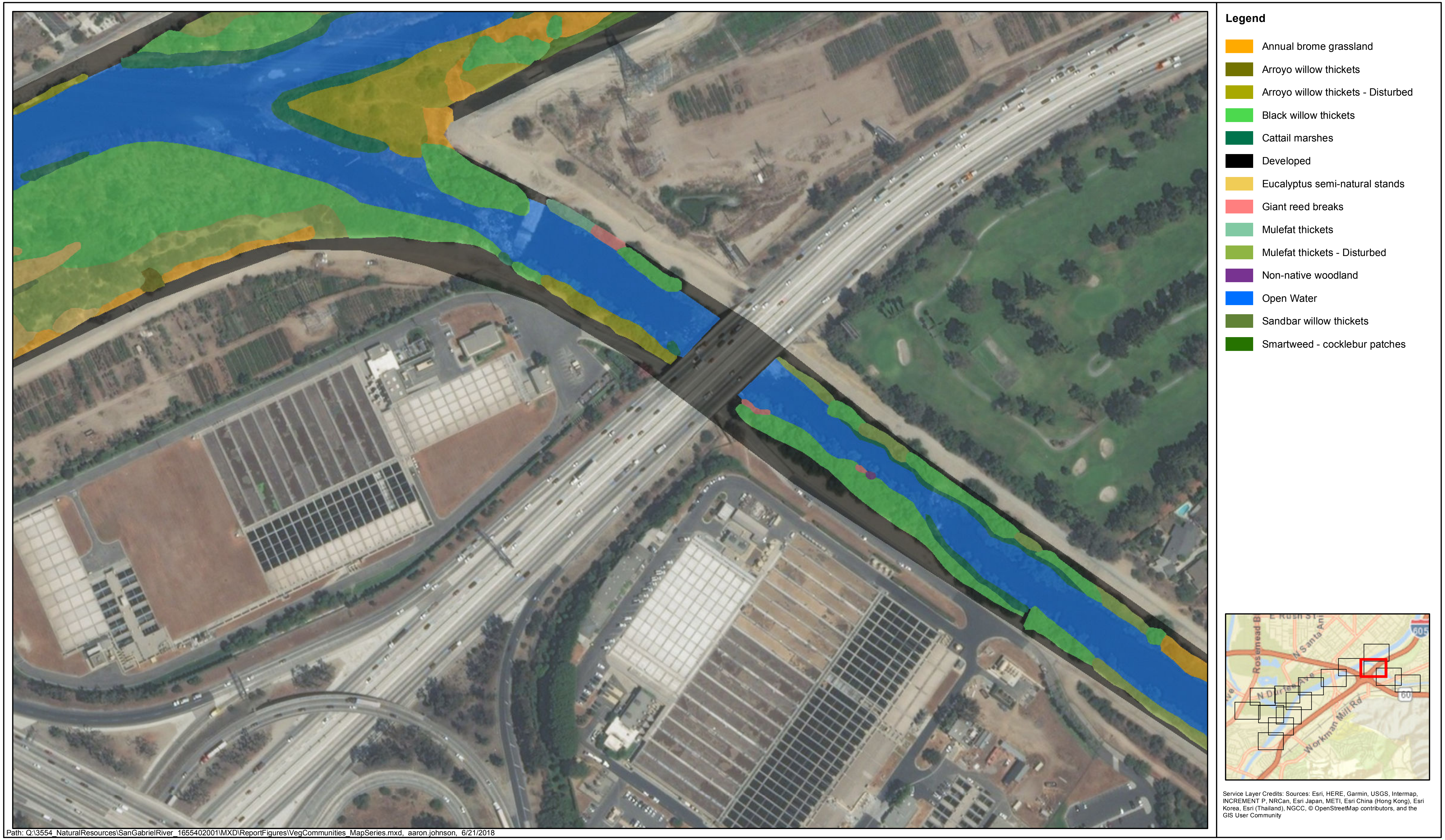

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Vegetation Communities
San Gabriel River
Los Angeles County, California

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FIGURE
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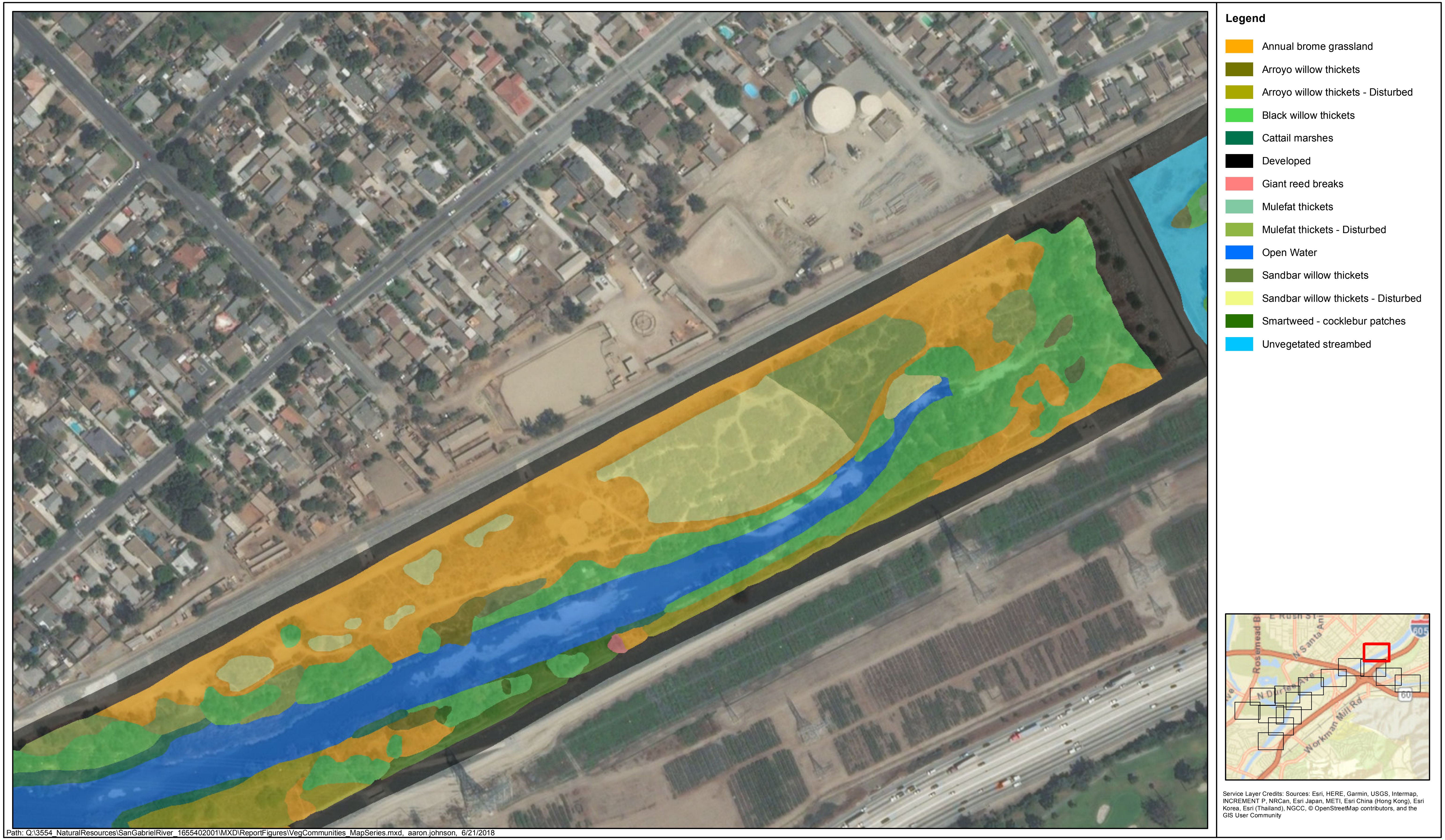

Legend

- 🟧 Annual brome grassland
- 🟫 Arroyo willow thickets
- 🟨 Arroyo willow thickets - Disturbed
- 🟩 Black willow thickets
- 🟩 Cattail marshes
- ⬛ Developed
- 🟥 Giant reed breaks
- 🟩 Mulefat thickets
- 🟩 Mulefat thickets - Disturbed
- 🟦 Open Water
- 🟩 Sandbar willow thickets
- 🟨 Sandbar willow thickets - Disturbed
- 🟩 Smartweed - cocklebur patches
- 🟦 Unvegetated streambed

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Vegetation Communities
San Gabriel River
Los Angeles County, California

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FIGURE

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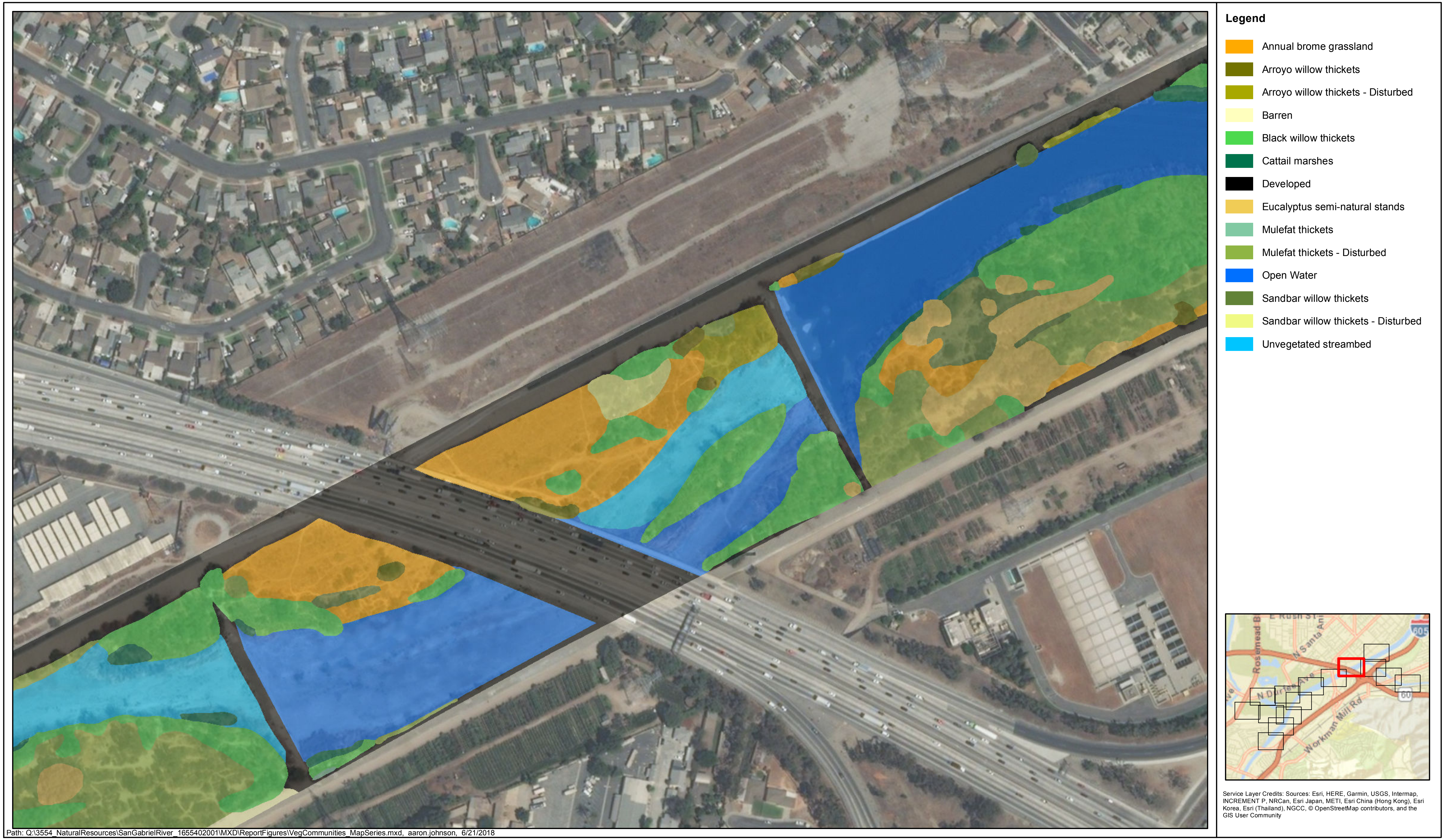

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1 inch = 200 feet
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FIGURE
5

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Vegetation Communities
San Gabriel River
Los Angeles County, California

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FIGURE
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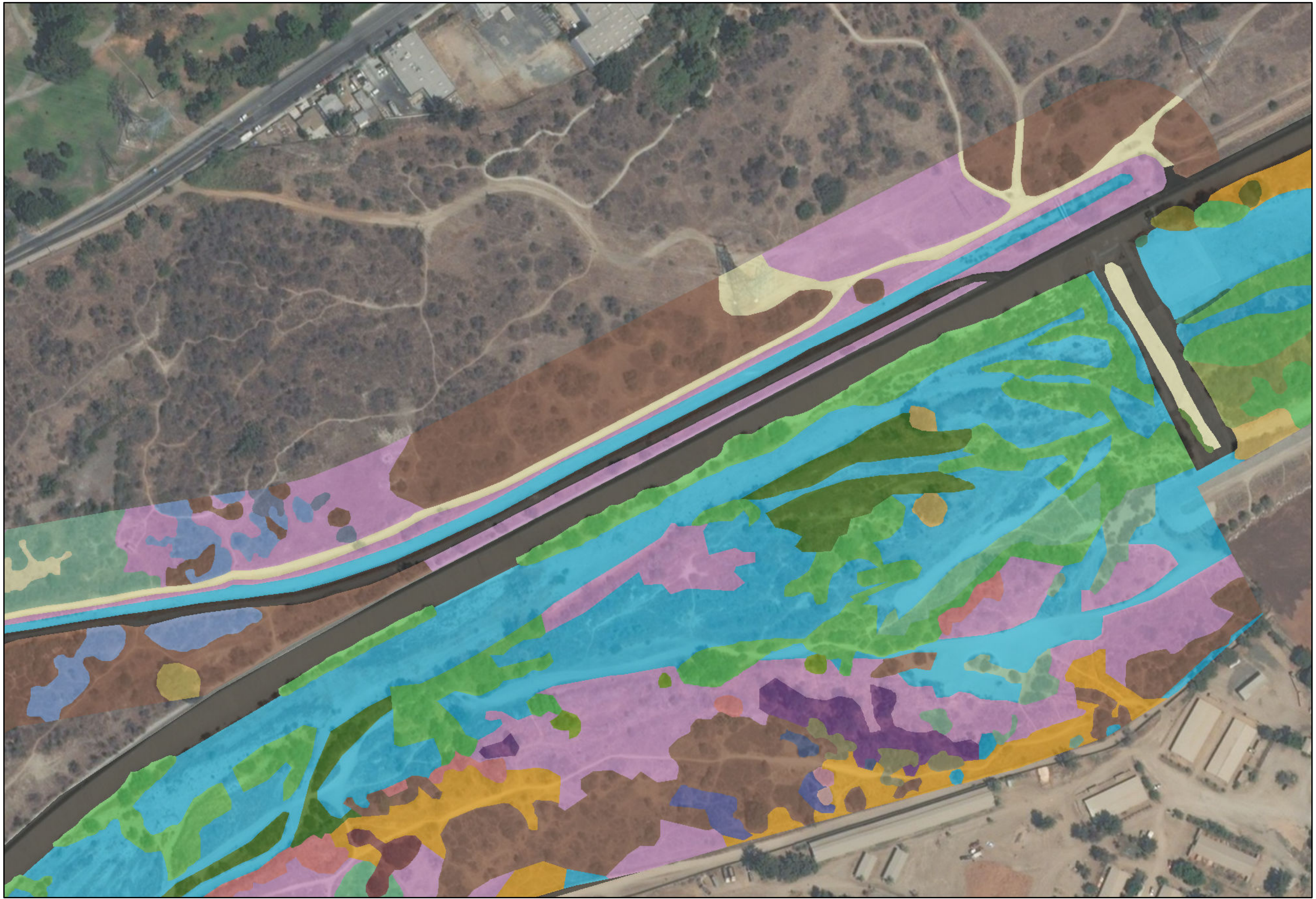

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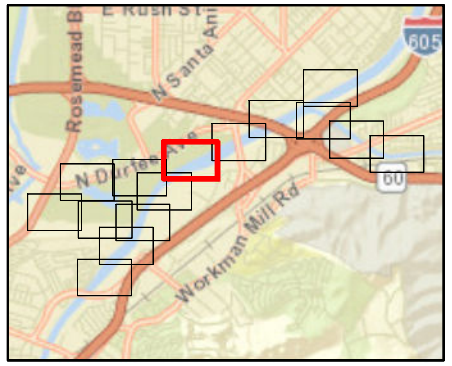
Legend

- 🟧 Annual brome grassland
- 🟫 Arroyo willow thickets
- 🟨 Barren
- 🟦 Basket bush patches
- 🟩 Black willow thickets
- 🟫 Blue elderberry stands
- 🟩 Box-elder forest
- 🟦 California buckwheat scrub
- 🟥 California walnut groves
- 🟦 California yerba santa scrub
- 🟩 Cattail marshes
- 🟦 Coast prickly pear scrub
- ⬛ Developed
- 🟨 Eucalyptus semi-natural stands
- 🟥 Giant reed breaks
- 🟩 Mulefat thickets
- 🟩 Mulefat thickets - Disturbed
- 🟪 Non-native woodland
- 🟩 Poison hemlock patches
- 🟫 Poison oak scrub
- 🟥 Scalebroom scrub
- 🟩 Smartweed - cocklebur patches
- 🟦 Unvegetated streambed
- 🟪 Mustard semi-natural stands
- 🟥 Wild grape shrubland



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Vegetation Communities
San Gabriel River
Los Angeles County, California

N

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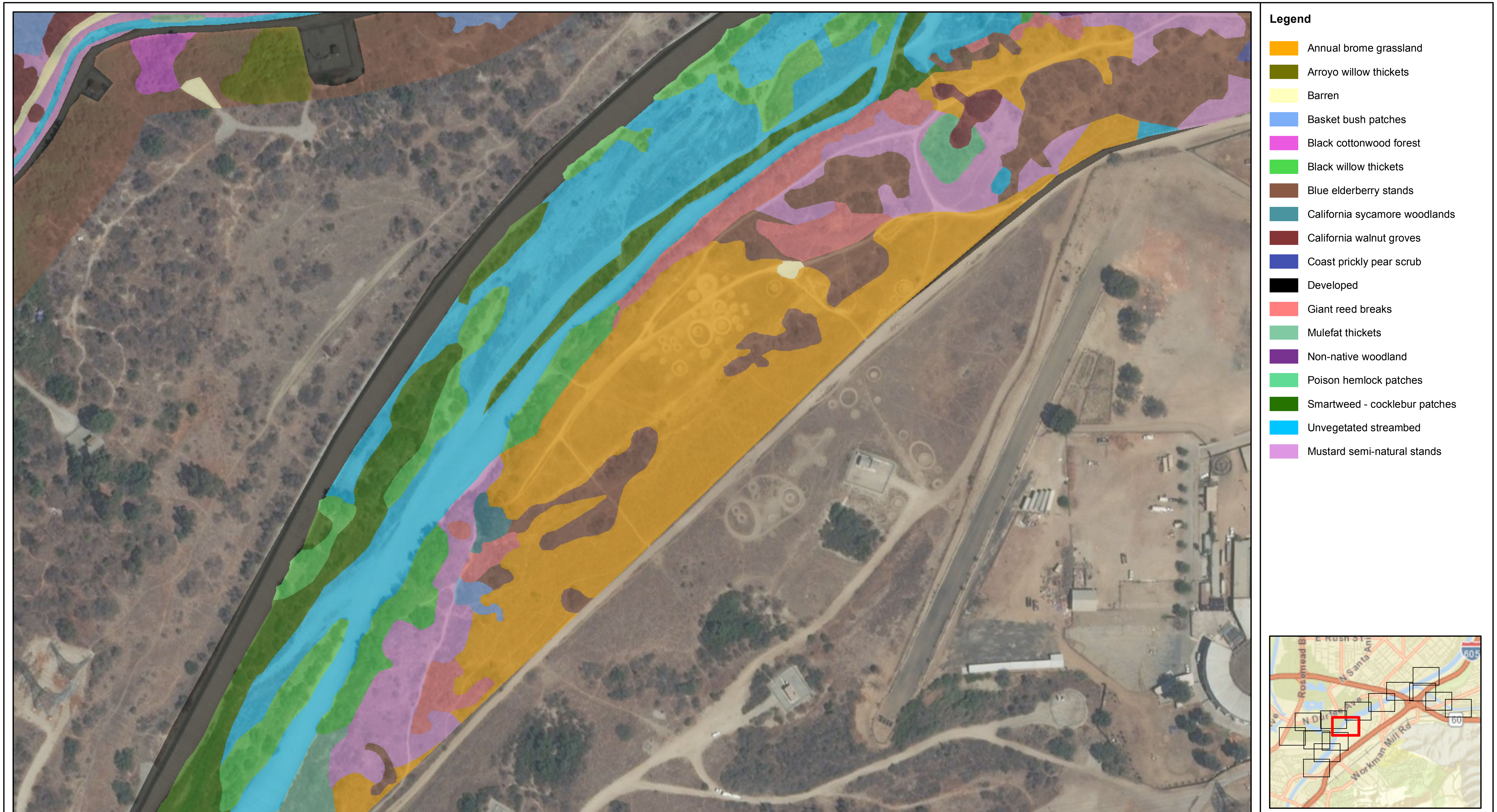
FIGURE

7



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San Gabriel River
Los Angeles County, California

N

1 inch = 200 feet
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Feet

FIGURE
8

Legend

- 🟧 Annual brome grassland
- 🟨 Barren
- 🟩 Black willow thickets
- 🟫 Blue elderberry stands
- 🟩 Cattail marshes
- ⬛ Developed
- 🟨 Eucalyptus semi-natural stands
- 🟥 Giant reed breaks
- 🟩 Mulefat thickets
- 🟪 Non-native woodland
- 🟥 Perennial pepper weed patches
- 🟩 Sandbar willow thickets
- 🟩 Smartweed - cocklebur patches
- 🟦 Unvegetated streambed
- 🟪 Mustard semi-natural stands
- 🟥 Wild grape shrubland

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1 inch = 200 feet
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FIGURE
9

Legend

- 🟨 Barren
- 🟩 Black willow thickets
- 🟫 Blue elderberry stands
- 🟩 Cattail marshes
- ⬛ Developed
- 🟨 Eucalyptus semi-natural stands
- 🟥 Giant reed breaks
- 🟩 Mulefat thickets
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- 🟩 Smartweed - cocklebur patches
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- 🟪 Mustard semi-natural stands
- 🟥 Wild grape shrubland

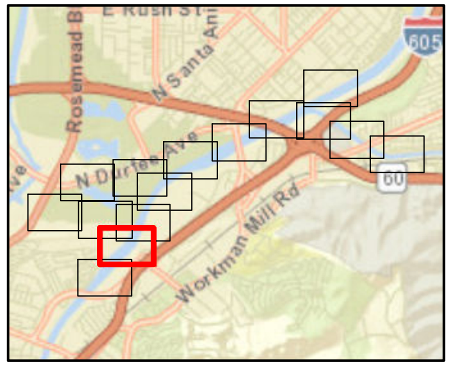

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FIGURE
10

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FIGURE
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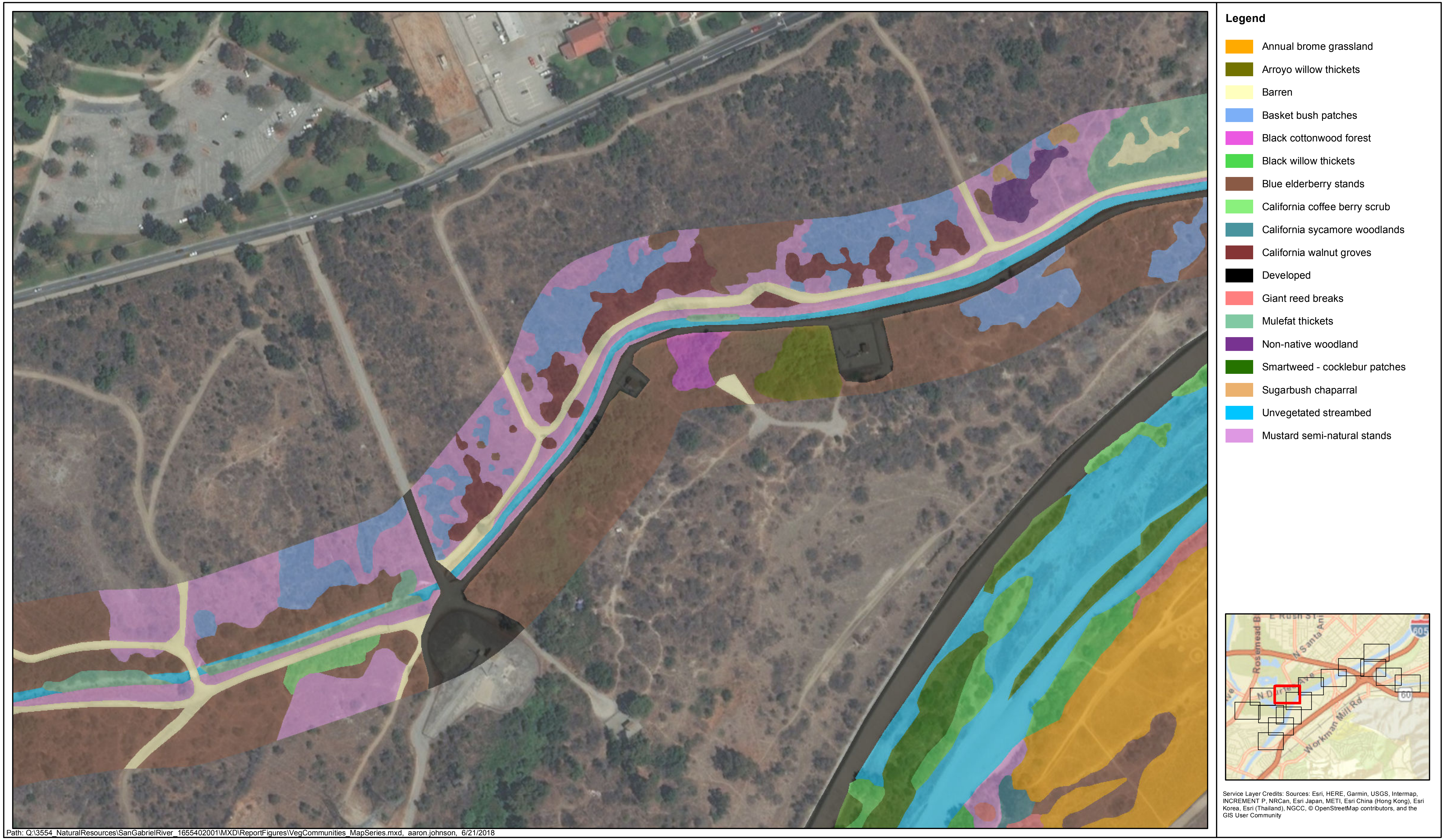

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FIGURE
12

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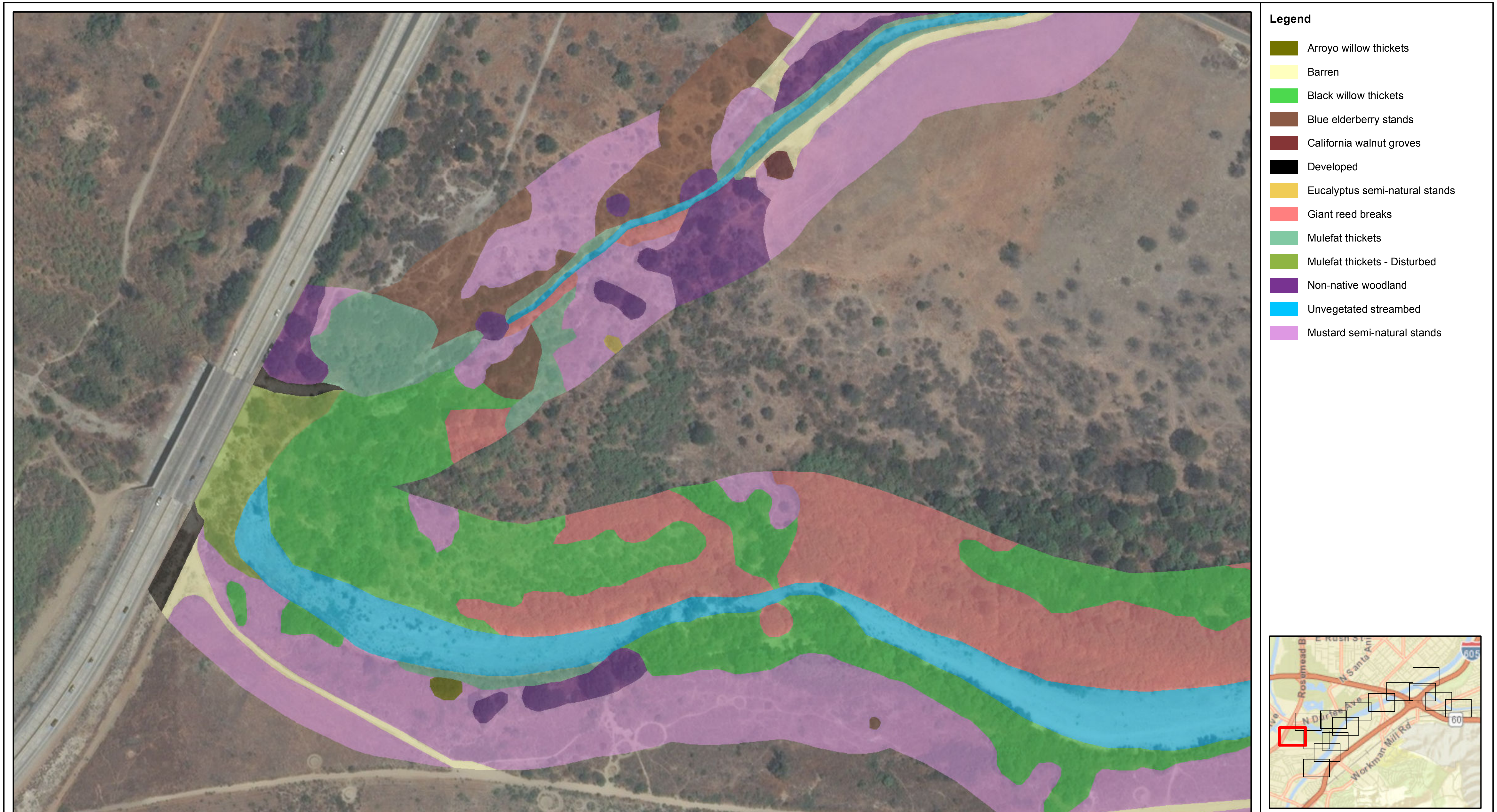
FIGURE
13



Legend

- 🟫 Arroyo willow thickets
- 🟨 Barren
- 🟩 Black willow thickets
- 🟫 Blue elderberry stands
- 🟥 California walnut groves
- ⬛ Developed
- 🟨 Eucalyptus semi-natural stands
- 🟥 Giant reed breaks
- 🟩 Mulefat thickets
- 🟩 Mulefat thickets - Disturbed
- 🟪 Non-native woodland
- 🟦 Unvegetated streambed
- 🟪 Mustard semi-natural stands

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FIGURE
14

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1 inch = 200 feet
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FIGURE
15

Appendix C

San Gabriel River Benthic Macroinvertebrate (BMI) Baseline Conditions Assessment

ESA

San Gabriel River Benthic Macroinvertebrate (BMI) Baseline Conditions Assessment

Summary

As part of their National Pollutant Discharge Elimination System (NPDES) monitoring requirements associated with the Long Beach, Los Coyotes, San Jose Creek, Pomona, Whittier Narrows, Valencia, and Saugus Water Reclamation Plant (WRP) permits, the Sanitation Districts have conducted bioassessment monitoring annually during the spring/summer index period (semi-annually between 2005 and 2007) since 2004. In addition to this localized monitoring program, the Sanitation Districts have also supported the present day form of the San Gabriel River Regional Monitoring Program (SGRRMP) and its bioassessment monitoring since 2009. Local and regional monitoring programs work complimentary to assess the condition specific areas of interest (e.g. near publicly owned treatment works [POTW] discharge) with regional context. Both programs follow California State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP) protocols for the collection of benthic macroinvertebrate (BMI), algae, and associated physical habitat data in wadeable streams[1]. The most widely accepted threshold for determining whether a site is similar to reference is the 10th percentile of the reference distribution, which corresponds to a California Stream Condition Index (CSCI) of 0.79. A CSCI score above 0.79 indicates support of aquatic life beneficial uses, as they relate to BMI assemblages. Lower San Gabriel River watershed stream reaches consistently fail to meet this threshold independent of whether or not there is discharge from Sanitation Districts' water reclamation plants.

Condition Monitoring The regional and local monitoring programs each are structured to answer specific management questions in regards to the support of aquatic life beneficial uses. The SGRRMP was developed in 2004 by stakeholders representing water quality permittees, regulatory and management agencies, and conservations groups and is designed to evaluate the current condition of streams in the watershed using in-stream bioassessments. The SGRRMP, under the administration of Aquatic Bioassay & Consulting Labs selects sites using a randomized design for 1st and 2nd order streams in the entire watershed. The program also conducts annual bioassessments at a subset of fixed sites in order to evaluate whether conditions are changing over time. These measures of watershed wide condition (at stressed and non-stressed sites) provides context for local programs. The Sanitation Districts' local program monitors fixed locations exclusively in order to evaluate the impacts of point source discharges on the BMI community. Repeat measures at these fixed stations also allows for evaluation of temporal trends.

Areas Monitored

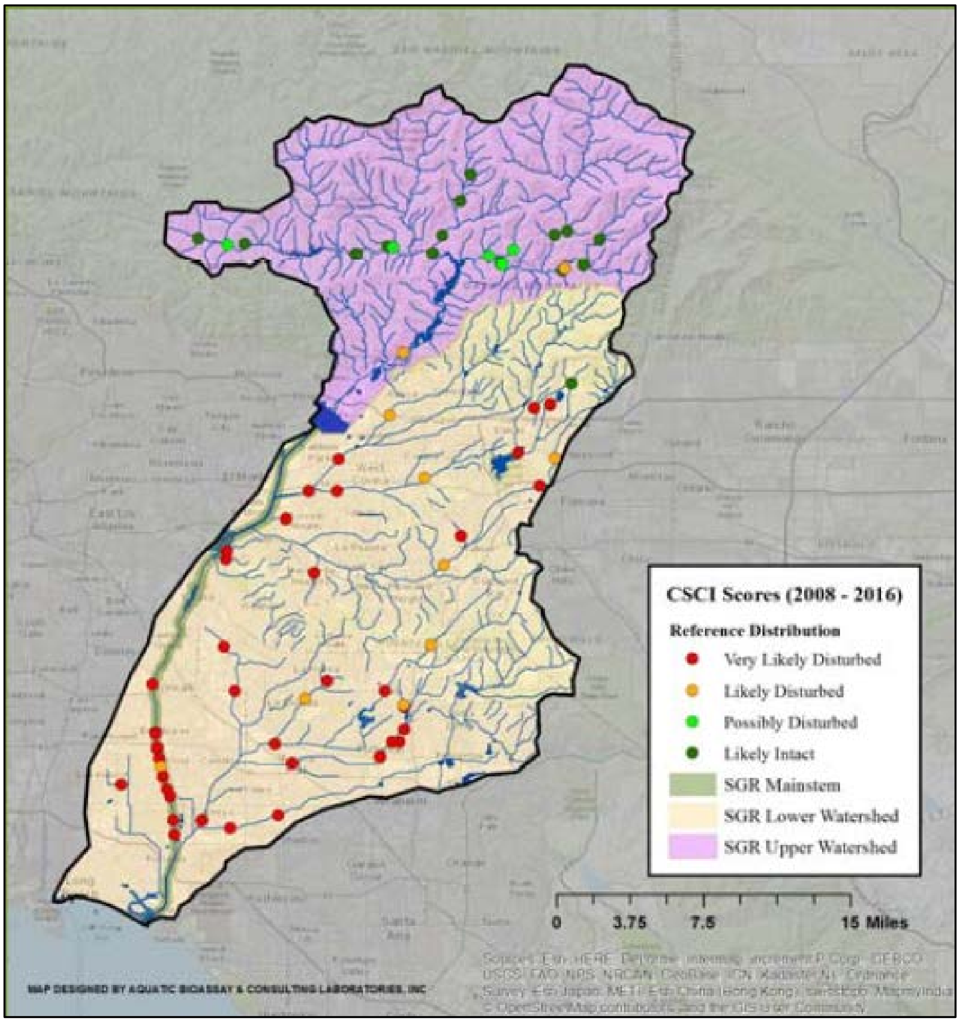
The San Gabriel River watershed encompasses 678 square miles from the San Gabriel Mountains to the Pacific Ocean. The SGRRMP divides the watershed into three hydrologically distinct sub-regions. The

---

[1] Ode, P.R., Fetscher, A.E., and Busse, L.B. (2016) Standard Operating Procedures (SOP) for the collection of Field Data for Bioassessments of California Wadeable Streams: Benthic Macroinvertebrates, Algae, and Physical Habitat

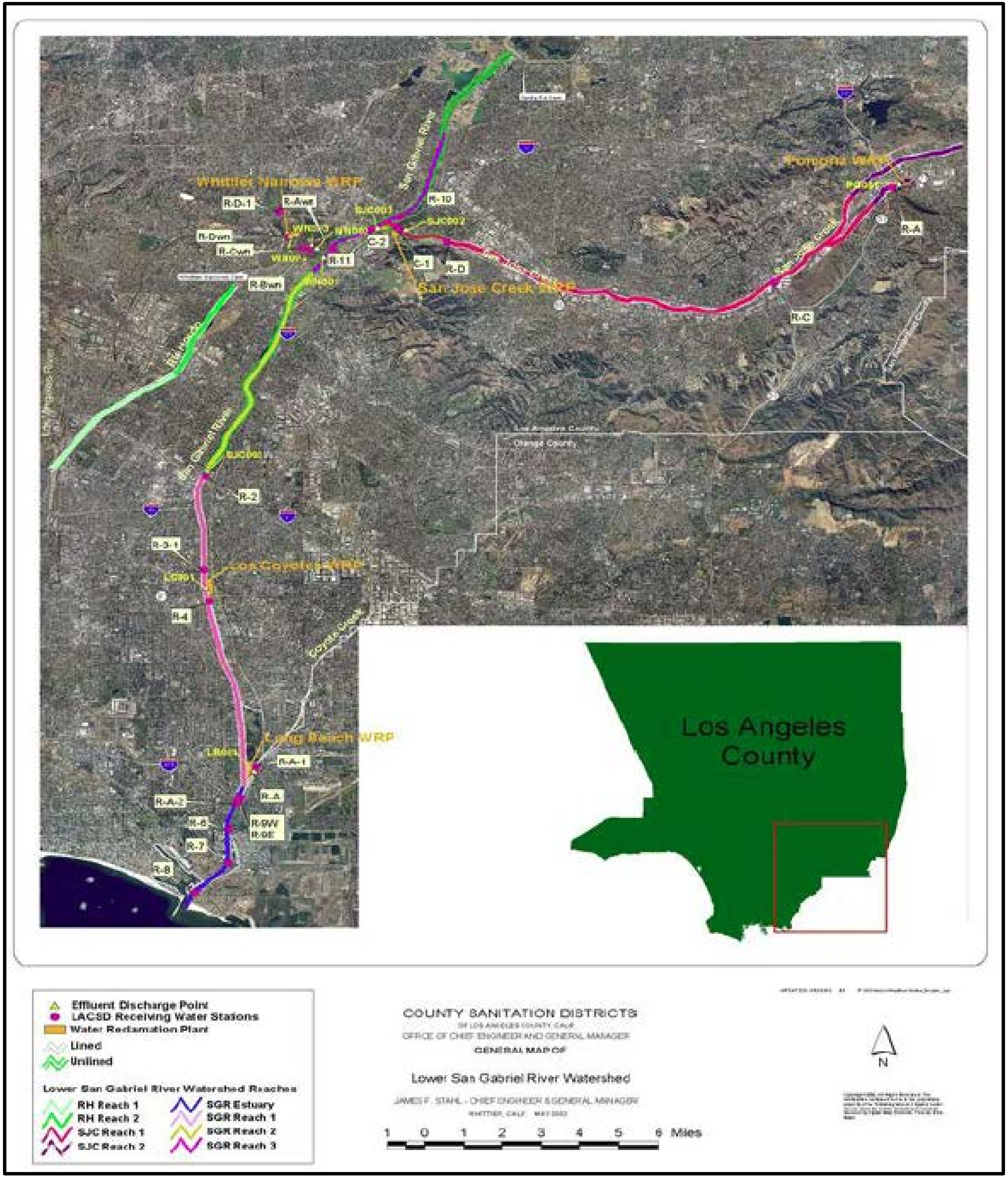
upper watershed (upstream of Santa Fe Dam) consists of steep, undeveloped, mountainous terrain. The lower watershed is densely populated and is located on a relatively flat (<1% gradient) alluvial fan. Flood control and groundwater recharge efforts have diverted or highly modified flow regimes in the lower watershed. The main stem channel extends approximately 25 miles from Santa Fe Dam through Whittier Narrows Dam to the San Gabriel River Estuary. The lower 10 miles is concrete-lined. The SGRRMP has an extensive bioassessment dataset covering all three of these sub-regions (Figure 1).

Figure 1. SGRRMP Monitoring Locations (2009 – 2017)



The Sanitation Districts' local program monitors 13 fixed stations annually (Figure 2) in the San Gabriel River watershed (including the Zone 1 Ditch). These stations typically bracket water reclamation plant discharge points. Bioassessment is not conducted on impounded reaches including San Jose Creek below discharge point 002, the San Gabriel River upstream of the Zone 1 Ditch, and the San Gabriel River near discharge points 001A/001B. The Los Angeles Regional Water Quality Control Board consulted with the SWAMP bioassessment coordinator, Dr. Pete Ode, and determined that the methodological modifications required for sampling impoundments would be inappropriate and would limit comparability.

Figure 2. Sanitation Districts San Gabriel River Monitoring Stations

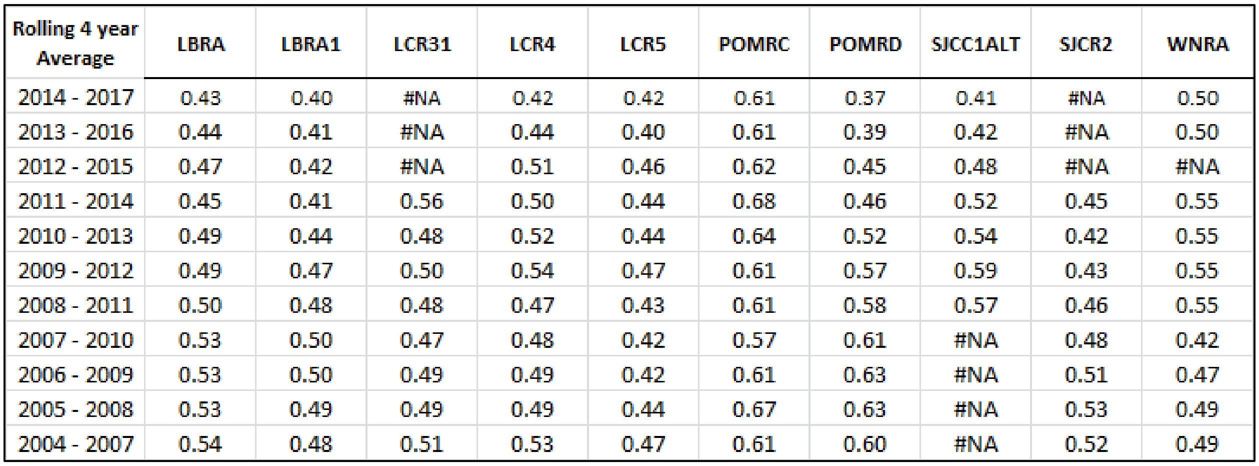


Results

The SGRRMP has observed a clear distinction between biotic condition in the upper and lower San Gabriel River sub-watersheds. Nearly all sites in the upper watershed, upstream of all Sanitation Districts discharge locations, have CSCI scores indicative of communities in reference condition. Conversely, the CSCI is consistently below reference condition across the highly urbanized lower watershed and main channel. The Sanitation Districts' local monitoring program has observed similar results; all stations monitored in the San Gabriel River watershed consistently score below the reference threshold (CSCI >0.79). The local program has also consistently demonstrated no discernable differences in the biotic communities upstream and downstream of discharge points. This suggests that water quality or water reclamation plant discharges are not causing the depressed CSCI scores.

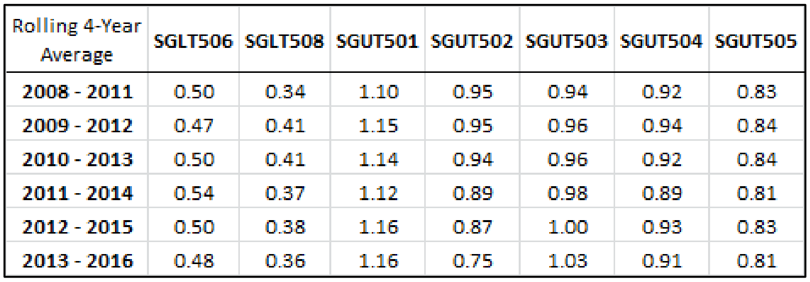
Both programs have monitored biotic condition trends in the lower watershed. Biotic condition in the lower watershed sites has been very consistent across time and no trends have been observed. Stream reaches in the lower watershed have had CSCI scores below 0.79 (i.e. not in reference condition) since monitoring began (Table 1).

Table 1. Sanitation Districts Local Monitoring CSCI History



Rolling 4 year Average	LBRA	LBRA1	LCR31	LCR4	LCR5	POMRC	POMRD	SJCC1ALT	SJCR2	WNRA
2014 - 2017	0.43	0.40	#NA	0.42	0.42	0.61	0.37	0.41	#NA	0.50
2013 - 2016	0.44	0.41	#NA	0.44	0.40	0.61	0.39	0.42	#NA	0.50
2012 - 2015	0.47	0.42	#NA	0.51	0.46	0.62	0.45	0.48	#NA	#NA
2011 - 2014	0.45	0.41	0.56	0.50	0.44	0.68	0.46	0.52	0.45	0.55
2010 - 2013	0.49	0.44	0.48	0.52	0.44	0.64	0.52	0.54	0.42	0.55
2009 - 2012	0.49	0.47	0.50	0.54	0.47	0.61	0.57	0.59	0.43	0.55
2008 - 2011	0.50	0.48	0.48	0.47	0.43	0.61	0.58	0.57	0.46	0.55
2007 - 2010	0.53	0.50	0.47	0.48	0.42	0.57	0.61	#NA	0.48	0.42
2006 - 2009	0.53	0.50	0.49	0.49	0.42	0.61	0.63	#NA	0.51	0.47
2005 - 2008	0.53	0.49	0.49	0.49	0.44	0.67	0.63	#NA	0.53	0.49
2004 - 2007	0.54	0.48	0.51	0.53	0.47	0.61	0.60	#NA	0.52	0.49

Table 2. SGRRMP Trend Site Monitoring CSCI History



Rolling 4-Year Average	SGLT506	SGLT508	SGUT501	SGUT502	SGUT503	SGUT504	SGUT505
2008 - 2011	0.50	0.34	1.10	0.95	0.94	0.92	0.83
2009 - 2012	0.47	0.41	1.15	0.95	0.96	0.94	0.84
2010 - 2013	0.50	0.41	1.14	0.94	0.96	0.92	0.84
2011 - 2014	0.54	0.37	1.12	0.89	0.98	0.89	0.81
2012 - 2015	0.50	0.38	1.16	0.87	1.00	0.93	0.83
2013 - 2016	0.48	0.36	1.16	0.75	1.03	0.91	0.81

Appendix D

Evaluating Effects of Reduced WWTP Discharge on the Ecology of the San Gabriel River Estuary, Final Study Results, January 12, 2018

Evaluating Effects of Reduced WWTP Discharge on the Ecology of the San Gabriel River Estuary

Final Study Results

January 12, 2018

David J. Gillett, Eric D. Stein, and Liesl Tiefenthaler

Southern California Coastal Water Research Project

Background and Motivation

In accordance with the 2014 Governor of California's Executive Order to facilitate the use of treated wastewater as a means to reduce the demand on potable water supplies, the Sanitation Districts of Los Angeles County (Sanitation Districts) are proposing to divert treated wastewater discharges to the San Gabriel River (SGR) for reuse from the five (5) Water Reclamation Plants (WRPs) that currently discharge at various location along the SGR. The Sanitation Districts have been asked to consider the potential ecological effects associated with the proposed reduced discharges to the SGR.

Objectives and Scenarios Being Assessed

The goal of this work is to develop a conceptual framework to assess potential ecosystem changes to the SGR estuary in consideration of both reduced wastewater discharge and the required cessation of discharge of once through cooling (OTC) water from the Haines and AES power generating stations. This analysis was constructed to consider the removal of discharge from the three (3) WRP discharge points to the SGR/Coyote Creek. The specific parts of the SGR that will be considered are the portion from the mouth of the estuary where it meets the Pacific Ocean near Seal Beach upstream to the confluence of the SGR with Coyote Creek. For reference, we have divided the study area into two parts (Figure 1). Both segments are extensively channelized, limiting the amount of intertidal habitat, however the segments differ based influence of once through cooling discharges, patterns in water column characteristics and estuarine/tidal circulation (Rosenberger et al. 2005; LACSD, *pers comm*): a) The High Mesohaline/Polyhaline reach, which extends from the concrete sill to the OTC discharge and is tidally influenced, is relatively stratified (vertically) and is the primary mixing zone of fresh and marine/estuarine waters; and b) the Well Mixed Polyhaline reach, which extends from the OTC discharge down to the mouth of the estuary, and is the most marine influenced portion of the estuary.

We have developed a series of hypotheses regarding physical and ecological changes associated with three different discharge scenarios (Figure 2). The three scenarios and the potential changes to the physical environment contrasted to existing conditions are:

1. ***Current conditions*** – Under current conditions, both OTC and the normal effluent discharge, as well as dry and wet weather runoff, occur in the system. Effluent discharge represents 25 – 80% of freshwater flow, varying by month/season (Table 1). In this scenario, there is reduced influence of the tides along the length of the estuary above the power plant discharge. The salinity and, to a lesser degree, temperature exhibit some vertical stratification upstream of OTC discharge (Figure 3). Temperatures are slightly cooler above the discharge and exhibit 3-4 degree diurnal oscillations. Downstream of the OTC discharge, temperature and salinity are relatively homogeneous throughout the water column due to mixing (Figure 4). This represents the baseline against which the other scenarios would be evaluated.
2. ***Once-Through Cooling Only –*** This represents potential future scenario where WRP effluent discharge has stopped, but OTC continues as presently observed. This scenario is very similar to that of current conditions, as the relative influence of freshwater input to

the SGR estuary is relatively small, compared to the influence of the OTC discharges (Rosenberger et al. 2005). Temperature and salinity should be relatively homogeneous throughout the water column and the sharp break between marine and lower salinity, estuarine conditions would most likely persist.

3. ***WRP Effluent Only*** – This represents a potential future scenario where OTC has stopped, but the effluent discharge continues at normal rates. In this scenario, it is presumed that there would be a return to a more natural, density-driven, salt-wedge type of estuarine circulation and tidal fluctuation. There would be an increase in water column stratification (lower salinity near the surface), a decrease in average salinity at low tide and, potentially, a slight decrease in average water temperature across the entire reach. The estuary will most likely comprise a gradual transition from marine to estuarine conditions that will fluctuate with the size of the tide (i.e., spring to neap). The estuary would most likely stay connected to the lotic parts of the river during the majority of the year, irrespective of tidal stage and there would likely be a small increase in the amount of intertidal habitat across the length of the estuary, dependent upon sediment transport.
4. ***No WRP or Once-Through Cooling Discharge***– This represents a potential future scenario where OTC has stopped and effluent discharge has stopped as well. In this scenario, it is presumed that the estuary would return to a more Mediterranean estuary type of circulation and tidal fluctuation. There would be an increased potential for water column stratification during wet weather paired with an overall increase in average salinity and decrease in water temperature. Circulation in the estuary would be dominated by tidal currents and there would be a potential for a marked increase in the amount of intertidal area and a seasonal disconnect of the lotic portions of the San Gabriel River from the estuarine/marine portions.

Assumptions about changes in the stratification, salinity, temperature, etc. can be inferred from the observations of Rosenberger et al. (2005) and the modelling work of Ackerman and Stein (2007). That said, the salinity, temperature, and current conditions hypothesized in each scenario should be tested and validated in the future with existing or newly supplemented SGR estuary circulation models (e.g., Ackerman and Stein 2007).

Table 1. Average Non-Tidal Estuary Flow (CFS)* (Effluent, Runoff, and OTC) by Month 2012 – 2016

	January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
POTW Q	82	68	76	71	63	63	58	51	54	53	64	70
Upstream Q	147	97	63	52	100	19	88	77	97	112	155	270
OTC Q	645	953	1045	1741	1602	1752	2239	2756	2319	2069	1507	1022
% Effluent	9%	6%	6%	4%	4%	3%	2%	2%	2%	2%	4%	5%

*Flow data from LACDPW gaging stations, CIWQS Reports, and Sanitation Districts effluent discharge records

Baseline Sediment Ecosystem Condition

Benthic community composition and assessment scores can be influenced by a variety of factors, both natural (e.g., salinity, sediment composition, food availability) and anthropogenic (disturbance, toxic chemicals, low dissolved oxygen). Dry season flow in the SGR estuary is dominated by cooling water discharge from the two power generating stations. Conversely, dry weather WRP discharge is a relatively minor force, representing <5% of discharge to the estuary. As part of the Southern California Bight Regional Monitoring Program in 2003 (7 samples), 2008 (2 samples), and 2013 (2 samples), the macrobenthic community of the lower San Gabriel River estuary downstream of Westminster Ave was used to assess the ecological condition of the high salinity estuary. In each survey (conducted during the dry season), the majority of samples from the estuary were assessed as moderately disturbed (category 3) under the California Sediment Quality Objectives framework – a 4-category scale from reference to highly disturbed. No samples were in found in reference condition, but alternatively only two samples (located in the scour-prone mouth of the estuary) were indicative of highly disturbed conditions (Table 2). The most frequently observed condition scores among the SGR, LAR, and SAR were low (7) or moderate disturbance (11), though average assessment condition score in the SGR across multiple years (2.63) was lower (i.e., better condition) than the LAR (3.33), but higher (worse condition) than the SAR (2.4).

Evaluation of Ecological Consequences

Our approach for understanding the potential changes to the SGR estuary under the different flow scenarios was to use other estuarine systems from the region with differing hydrologic regimes as analogues for the SGR under the different scenarios. These other systems were selected with the assumption that in an unaltered state they would have had relatively similar environmental conditions and biological composition to the SGR. However, during the present day each estuary has a different volume and type(s) of effluent discharge added to it that supplements the natural base flow, as well as the upstream and downstream sediment dynamics. These factors potentially influence the biological composition of their respective systems and coincidentally approximates the different scenarios we have proposed for the SGR.

For our comparative study, the SGR estuary represented the Current Conditions and Once-Through Cooling Only scenarios (#1 & #2), the Los Angeles River (LAR) estuary represents the WRP Effluent Only scenario (#3), and the Santa Ana River (SAR) estuary represents the No WRP or Once-Through Cooling Discharge scenario (#4).

We aggregated existing data on the biotic components of each system from a variety of different, publicly available sources (Tables 3 and 4). The final data set spanned a range of precision and stringency from spatially explicit, randomly sampled density counts of benthic infauna collected by professional scientists to bird observations reported by the lay public from recreational areas and later verified by professional scientists. This assemblage composition data – a product of their present-day environmental setting – was then used to infer the potential consequences of each of the proposed scenarios for the SGR. Each scenario will most likely alter the physical conditions of the estuary, changing the relative influence of the tides, the amount of intertidal area, and the physical/chemical profile of the water column. These environmental changes will, in turn, change the resident fauna of the estuary – likely expanding the habitat for the more marine taxa and contracting that of the low salinity taxa, as well as potentially increasing the amount of intertidal habitat, while decreasing the amount of sub-tidal habitat.

Similarity of Observed Taxa Between Estuaries

The potential influence of the different flow scenarios within the SGR estuary on its resident biotic communities was estimated by comparing observations of biotic assemblages between the three analogue estuaries (Appendix A). The biotic groups considered were: benthic invertebrates, fish, and birds. These assemblages were our primary focus as they explicitly use the water and intertidal area of the estuaries, as opposed to the surrounding upland or open water environments, which presumably would not be influenced by the proposed changes in flow.

Observed taxa lists for each assemblage were created for each estuarine system and Bray-Curtis dissimilarity values (Bray and Curtis 1957) using presence/pseudo-absence were calculated between each list. Dissimilarity values were calculated in R v3.2.4 using the vegdist routine in the Vegan package (Oksanen et al. 2016, R Core Team 2016).

No consistent pattern in similarity of taxa between the three systems across the different assemblages were observed (Table 5). There was little similarity of the fish and benthic invertebrate assemblages among the three systems, with the SGR being as different from the LAR and SAR as they were from each other. Conversely, the bird assemblages were similar across the three systems.

The SGR had the most diverse fish and benthic invertebrate assemblages, with the LAR second, and the SAR having the lowest number of observed taxa for either assemblage (Table 6). Conversely, though compositionally similar, the SGR bird assemblage was much less diverse than either of the other two systems, which had a relative similar number of observed bird taxa.

Biological Composition Related to Environmental Conditions

The rationale of this study was based upon using the different local estuarine systems to serve as analogues for the SGR estuary under different flow scenarios (detailed above). The Los Angeles River was used to represent the scenario of no OTC, but continued waste water treatment plant discharge. The SAR was used to represent potential conditions under the scenario of no OTC and no WWTP discharge.

As detailed physical, hydrological, and tidal circulation data were not available for all three systems, we made a comparison of their resident fauna to infer if the different flow scenarios created detectable differences in the biota.

At the base of the food web, the benthic macroinvertebrates from the SGR were rather different than those from the other two systems. The SGR assemblage was much more diverse than the other two systems, though all three estuaries had a relatively standard mix of high-salinity taxa, including some stenohaline taxa (e.g., *Amphiodia* spp., *Phoronis* spp.) that do not tolerate fluctuating salinities well. The higher taxonomic richness in the SGR was responsible for the difference in composition between the systems, with neither the LAR or SAR having many unique taxa that were not found in the SGR. This pattern may be indicative of the greater spatial extent of stable, high salinity habitat throughout the estuary produced by the OTC induced circulation. The differences between the LAR and SAR benthic invertebrate assemblages may be indicative of sandier sediments observed in the SAR. However, sediment composition of each system was probably not related to presence/absence of WWTP discharge and was more likely related to watershed characteristics (i.e., upland erodibility and sediment-related management actions) and alongshore sediment transport and deposition from the nearshore environment.

Moving up the food web to higher-level consumers, the fish assemblages of all three systems were all distinctly different from each other and composed of a mix of resident (e.g., goby, croaker, tilapia) and transient fish taxa (rockfish, anchovy). The SGR had the most diverse fish assemblage and included most of the fish observed in the LAR. In contrast, the observed assemblage from the SAR was not particularly speciose and had very little overlap with the other two systems. The high diversity in the SGR could be attributed to the relatively stable salinity and temperature conditions created by the OTC. As the LAR assemblage was effectively a subset of that observed at the SGR, the differences in fish assemblage composition could be attributed to greater environmental variability as estuarine and tidal circulation becomes more important. In contrast, the differences in the SAR fish assemblage from the other two systems was most likely related to the tidally dominated circulation patterns and greater intertidal area in the system most likely due to the absence of both OTC and WWTP discharges. Four of the six species of fish observed in the SAR were high salinity, transient species that likely only utilize the system at high tide, with non-native tilapia (*Oreochromis* spp.) as the only observed resident taxa. This would suggest that estuaries like the SAR may have limited utility as fish habitat.

Unlike the fishes and benthic invertebrates, the bird assemblages between the three analogue systems were relatively similar. Bird utilization of the estuaries is less influenced by the salinity and temperature aspects of the ecosystem and more by the available intertidal area and attendant vegetation. The LAR and SAR systems had greater diversity than the SGR, notably with respect to song and wading birds (e.g., sandpipers, godwits, etc). This parallels the relative lack of intertidal area and marsh vegetation in the SGR, which is most likely a function of OTC circulation obscuring the tidal influence observed in the other two systems.

One caveat should be noted when inferring linkages between the biological observations of fishes and birds and the environmental setting of their associated estuary. The observations used to characterize many of the assemblages (Table 4) were made with a non-standardized level of “sampling” effort produced and reported by citizen monitoring efforts. The accuracy of many of the taxonomic identifications had been validated as part of dataset submission, but among the three estuarine systems there may have been an uneven pattern of visitation that could produce more effort and therefore greater diversity in some estuaries in a way we could not account for. Similarly, as most of these data were the product of non-exhaustive, observation-based sampling, that a taxon was not observed does not imply that it was absent from the system. As a consequence, all “absences” were more appropriately referred to as pseudo- abundance.

Additional fauna of interest

Green sea turtles have frequently been observed in the waters of Southern California's embayment habitats over the last decade. There have been a number of observations of these turtles in the SGR. It is known that these turtles move in and out of the SGR, in what is thought to be a search for submerged aquatic vegetation and food (Crear et al. 2017). No turtles were observed in either the LAR or SAR and it is thought that the turtles have been taking advantage of the stable salinity and (warmer) water temperature in the SGR compared to other estuarine systems. This would suggest that the cessation of OTC discharges may negatively impact the utility of the SGR as habitat for the turtles. Cessation of the WWTP discharge is not expected to greatly affect the water column stability in absence of the once- through cooling discharge, which should not directly affect the utility of the SGR as habitat for the turtles. However, if the cessation of WWTP discharge leads to more intertidal area within the estuary, that will reduce the amount of subtidal habitat in the system, reducing the total area in which the turtles could reside at low tides.

Conclusions

- The San Gabriel, Los Angeles, and Santa Ana River estuaries had benthic macroinvertebrate and fish assemblages that differ in both composition and taxonomic diversity. All of the assemblages were representative of a high salinity estuarine setting for the region that are minimally influenced by presence or volume of WWTP discharges across the three systems. The San Gabriel estuary had the most diverse lists of taxa for both assemblages.
- The San Gabriel, Los Angeles, and Santa Ana river estuaries support relatively similar bird assemblages, though the San Gabriel appears to support fewer wading and song bird taxa.
- If the Los Angeles and Santa Ana rivers are indeed sufficient analogues for the potential changes in flow in the San Gabriel River estuary, then these patterns may suggest that the diversity of benthic infauna and fishes in the SGR will decline with the cessation of once-through cooling (e.g, Scenario 3). This potential decline could possibly be attributed to a more dynamic salinity and temperature profile along the length of the estuary driven by natural estuarine and tidal circulation. However, given the disturbance-adapted nature of many of the fish and infaunal taxa observed in both the SGR and LAR (e.g., Scenario 1 vs. 3), it is unclear if the potential changes in assemblage composition will represent any significant differences in ecosystem integrity or health. The cessation of OTC discharge could potentially cause an increase in the diversity of the bird assemblage by most likely increasing the amount of intertidal area on spring tides. In contrast, it is assumed that the sea turtle population will migrate out of the estuary with the loss of warmer water created by the OTC discharge.
- If there is cessation of both OTC and then WWTP discharge (e.g., Scenario 4), the ecological consequences will likely be less dramatic then the shifts from Scenario 1 to Scenario 3, with a further reduction in fish and benthic invertebrate diversity (e.g., more like the SAR estuary) due to greater tidal and reduced estuarine circulation caused by

reduced freshwater inputs. This would make the estuarine water column more variable, but also likely increase the amount of intertidal area, which would possibly further increase the diversity of the bird assemblage.

Recommendations

The results of our biological assemblage comparisons would suggest that the two aspects of the San Gabriel River estuary that could possibly change under the different flow scenarios are: 1.) a reduction in the stability of salinity and temperature patterns in the water along the length of the estuary; and 2) a change in the amount of intertidal and supralittoral area in the system. These two types of changes will influence nearly all of the biota that presently do or could utilize the estuary.

Our conclusions were based solely on the use of the Los Angeles and Santa Ana Rivers as regional analogues for the San Gabriel River under the different scenarios. As such, the veracity of those conclusions is contingent upon how accurately these other estuaries represent the potential trajectory of the San Gabriel River, which is ultimately an unknown. If a more thorough and less speculative consideration of how removal of OTC and/or waste water treatment plant discharge from the system would manifest itself were desired, we would recommend a series of modelling simulation exercises with intertidal area and spatial/temporal fluctuations of salinity and temperature as endpoints. Specific recommendations could include development and parameterization of SGR-specific models of estuarine flow/circulation and sediment transport that could be linked to the appropriate biological assemblages.

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Table 1. Average Freshwater Flow (CFS)* (Effluent and Runoff) by Month 2012 – 2016

	January	February	March	April	May	June	July	August	September	October	November	Dece
POTW Q	82	68	76	71	63	63	58	51	54	53	64	7
Upstream Q	147	97	63	52	100	19	88	77	97	112	155	27
OTC Q	645	953	1045	1741	1602	1752	2239	2756	2319	2069	1507	10
% Effluent	9%	6%	6%	4%	4%	3%	2%	2%	2%	2%	4%	5

*Flow data from LACDPW gaging stations, CIWQS Reports, and Sanitation Districts effluent discharge records

Table 2 California Sediment Quality Objectives benthic index scores collected from the San Gabriel River (SGR), Los Angeles River (LAR), and Sant Ana River (SAR) estuaries as part of the Southern California Bight Regional Condition Assessment Survey. Condition scores can vary from 1 – Reference, 2 – Low Disturbance, 3 – Moderate Disturbance, or 4 – High Disturbance.

System	Station ID	Sample Date	Latitude	Longitude	SQO Score	Condition Class
LAR	B03-4142	7/24/2003	33.78067	-118.20583	4	High Disturbance
LAR	B03-4788	9/16/2003	33.7794	-118.205317	4	High Disturbance
LAR	B03-4600	9/16/2003	33.773667	-118.205967	3	Moderate Disturbance
LAR	B03-4440	9/16/2003	33.76563	-118.205917	3	Moderate Disturbance
LAR	B03-4856	9/17/2003	33.77013	-118.206	3	Moderate Disturbance
LAR	B08-6500	7/14/2008	33.78056	-118.20581	4	High Disturbance
LAR	B13-8390	9/9/2013	33.76074	-118.20169	2	Low Disturbance
LAR	B13-8391	9/9/2013	33.76273	-118.20478	3	Moderate Disturbance
LAR	B13-8403	9/9/2013	33.78083	-118.20569	4	High Disturbance
SAR	B03-4072	7/24/2003	33.636767	-117.954667	3	Moderate Disturbance
SAR	B03-4273	7/24/2003	33.64223	-117.953267	2	Low Disturbance
SAR	B08-6355	8/12/2008	33.63655	-117.95382	3	Moderate Disturbance
SAR	B13-8286	7/26/2013	33.635776	-117.956208	2	Low Disturbance
SAR	B13-8287	7/26/2013	33.636618	-117.953748	2	Low Disturbance
SGR	B03-4002	7/29/2003	33.75505	-118.10261	3	Moderate Disturbance
SGR	B03-4258	7/29/2003	33.75891	-118.0987	3	Moderate Disturbance
SGR	B03-4520	7/29/2003	33.75599	-118.10123	3	Moderate Disturbance
SGR	B03-4322	8/4/2003	33.74943	-118.11081	3	Moderate Disturbance
SGR	B03-4194	8/4/2003	33.75313	-118.10504	3	Moderate Disturbance
SGR	B03-4034	8/20/2003	33.74664	-118.11377	2	Low Disturbance
SGR	B08-6468	7/14/2008	33.75299	-118.10511	2	Low Disturbance
SGR	B13-8378	8/19/2013	33.75302	-118.10528	2	Low Disturbance

Table `3. Inventory of the different types of biotic data aggregated for this study for each of the three analogue systems

Source	Verifiable Data	Estuary																				
		Los Angeles River (LAR)							San Gabriel River (SGR)							Santa Ana River (SAR)						
		Birds	Fishes	Insects	BMI	Mammals	Reptiles	Plants	Birds	Fishes	Insects	BMI	Mammals	Reptiles	Plants	Birds	Fishes	Insects	BMI	Mammals	Reptiles	Plants
CALVEG[1]	Yes							X							X							
Orange Co Vegetation Dataset	Yes																					X
CNDDB[2]	Yes	X	X	X		X	X	X	X	X	X			X	X	X	X	X	X			X
FishNet2[3]	Yes		X							X							X					
FOLAR[4]	Yes	X	X					X														
GBIS[5]	Yes	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
iNaturalist[6]	Yes	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Landscape Profiles[7]	Yes	X				X	X	X	X				X	X	X	X				X	X	X
PISCES[8]	Yes		X							X							X					
VertNet[3]	Yes	X	X		X	X	X		X	X		X	X	X		X	X		X	X	X	
CRAM and Bioaccumulation Studies	Yes		X					X		X					X							
Impingement, Mortaliy & Entrainment Reports	Yes		X							X												
SC Regional Bight Surveys	Yes		X		X					X		X					X		X			

Table 4. Source information for the biotic data inventoried in Table3

Source	Agency/Steward	DataType	Time Span	Url
CALVEG[1]	USDA Forest Service	shapefile	1997-Present	http://frap.fire.ca.gov/data/frapgisdata-subset
Orange Co Vegetation Dataset	CDFW	shapefile	2012-Present	https://www.wildlife.ca.gov/Data/GIS/Vegetation-Data
CNDDB[2]	CDFW	shapefile	2013-Present	https://www.wildlife.ca.gov/Data/CNDDB/Maps-and-Data
FishNet2[3]	Los Angeles Museum of Natural History	.csv; .kml exports	1900-Present	https://nhm.org/site/research-collections/ichthyology/view-collections
FOLAR[4]	Lewis Macadams	pdf export	2014-15; 2002	https://folar.org/advocacy-now/#published-works
GBIS[5]	Regional Networks	.csv exports	1999-Present	https://www.gbif.org/what-is-gbif
iNaturalist[6]	CAS	.csv exports	2008-Present	https://www.inaturalist.org/
Landscape Profiles[7]	CARI	pdf export	2011-Present	https://ecoatlas.org/
PISCES[8]	UC Davis Center for Watershed Sciences	shapefile	Historical-Present	https://pisces.ucdavis.edu/
VertNet[3]	Los Angeles Museum of Natural History	.csv; .kml exports	1900-Present	https://nhm.org/site/research-collections/ichthyology/view-collections
CRAM and Bioaccumulation Studies	ABC	.csv exports	2009; 2012	
Impingement, Mortaliy & Entrainment Reports	MBC	pdf documents	1975-2008	
SC Regional Bight Surveys	SCCWRP	access db	2003; 2008; 2013	http://www.sccwrp.org/ResearchAreas/RegionalMonitoring.aspx

[1] CALVEG (Classification and Assessment with LANDSAT of Visible Ecological Groupings)

[2] California Natural Diversity Database (CNDDB)

[3] The Natural History Museum's catalogued Ichthyology collection are searchable at VertNet and at FishNet2.

[4] Friends of the Los Angeles River (FOLAR)

[5] Global Biodiversity Information Facility (GBIS)

[6] iNaturalist = online wildlife observation collection by a general audience

[7] Landscape Profiles using California Aquatic Resources Inventory (CARI) and California Wildlife Habitat Relationships (CWHR) datasets

[8] PISCES is software and data describing the best-known ranges for California's 133 native fish and numerous non-native fish. PISCES was developed with initial funding from the USDA Forest Service Region 5 and additional funding from California Department of Fish and Wildlife: Biogeographic Data Branch, in collaboration with numerous experts in fish biology and distribution in California.

California Dept. of Fish and Wildlife (CDFW)
California Academy of Sciences (CAS)
Aquatic Bioassays Consulting Laboratories (ABC)
MBC Applied Environmental Sciences
Alamitos Generating Station Impingement, Mortality and Entrainment Study

Table 5. Bray-Curtis dissimilarity for the bird (**B**), fish (**F**), and benthic invertebrate (**I**) assemblages for the three estuarine systems. Green indicates similar assemblages, red indicates dissimilar assemblages.

Site		**LAR**			**SGR**			**SAR**		
		B	F	I	B	F	I	B	F	I
Los Angeles River Estuary	**(LAR)**				0.26	0.79	0.61	0.92	0.21	0.72
San Gabriel River Estuary	**(SGR)**	0.26	0.79	0.61				0.96	0.28	0.65
Santa Ana River Estuary	**(SAR)**	0.21	0.92	0.72	0.28	0.96	0.65			

Table 6. Taxonomic richness of the bird, fish, and benthic invertebrate assemblages at each of the three estuarine systems. The number of taxa unique to each site is also presented

Site		Birds		Fishes		Benthic Invertebrates	
		Taxa Richness	Unique Taxa	Taxa Richness	Unique Taxa	Taxa Richness	Unique Taxa
Los Angeles River Estuary	**(LAR)**	259	41	18	11	181	87
San Gabriel River Estuary	**(SGR)**	180	10	49	42	246	131
Santa Ana River Estuary	**(SAR)**	277	56	6	5	91	22

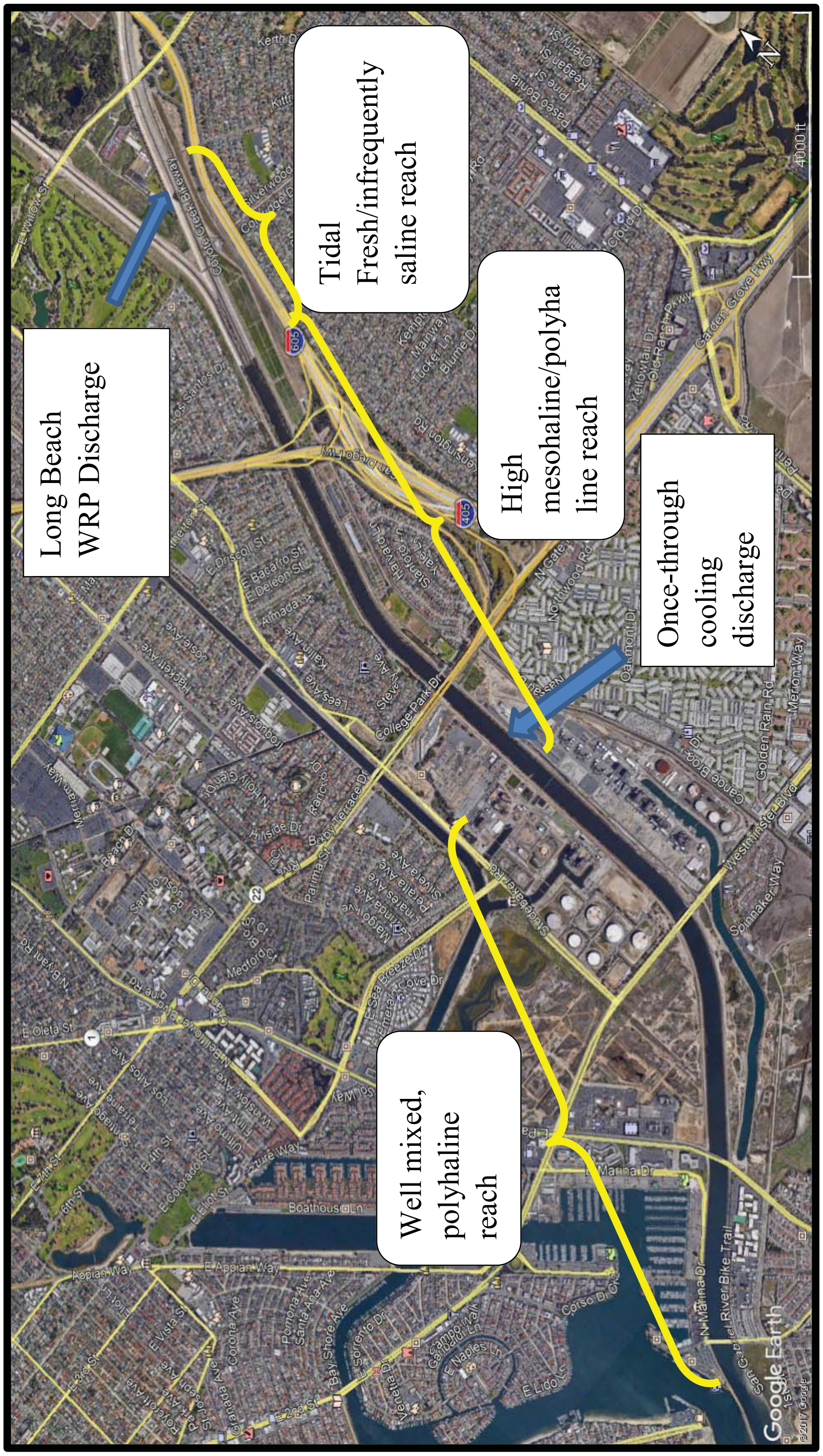

Figure 1 A map depicting the study area in the lower San Gabriel River, in Long Beach, CA with reference points to the relevant effluent discharges and identification of the three parts of the system we have delineated.

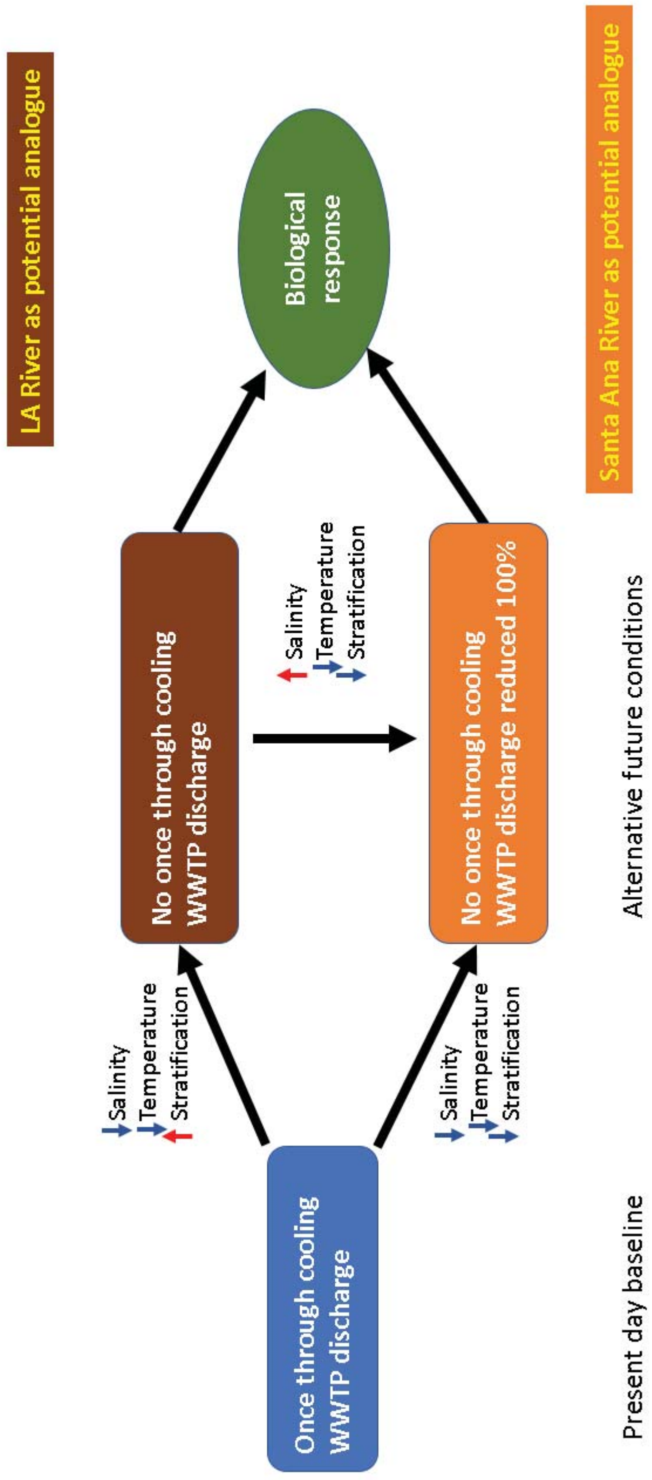

Figure 2: Conceptual approach to assessing effects of reduced WWTP discharges on the ecology of the San Gabriel River estuary.

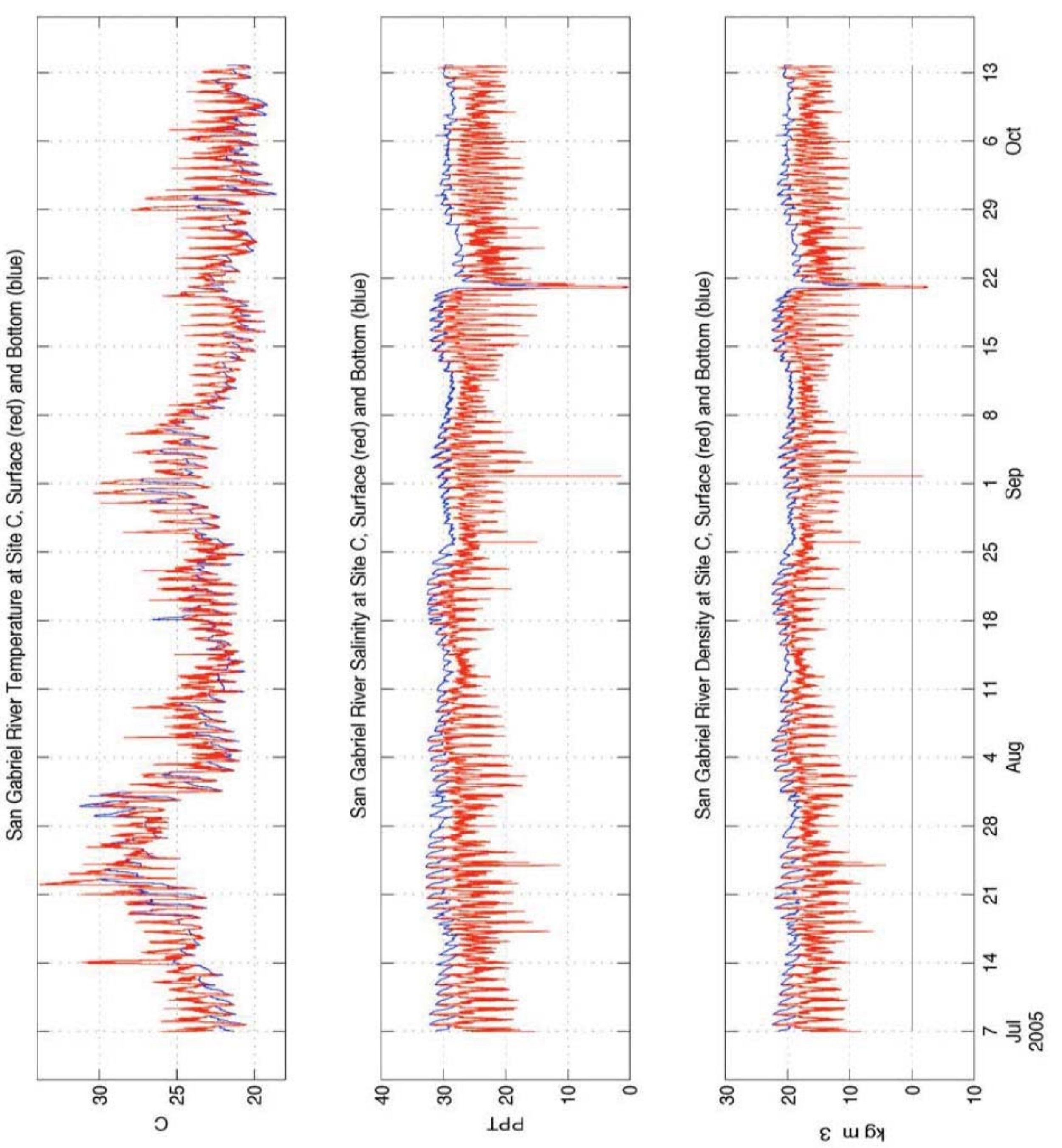

Figure 3 Hourly water temperature, salinity (ppt), and density from a fixed monitoring station upstream of the OTC discharge. Red line indicates surface water values and the blue line indicates bottom water values. Originally Figure 18 in Rosenberg et al. 2005.

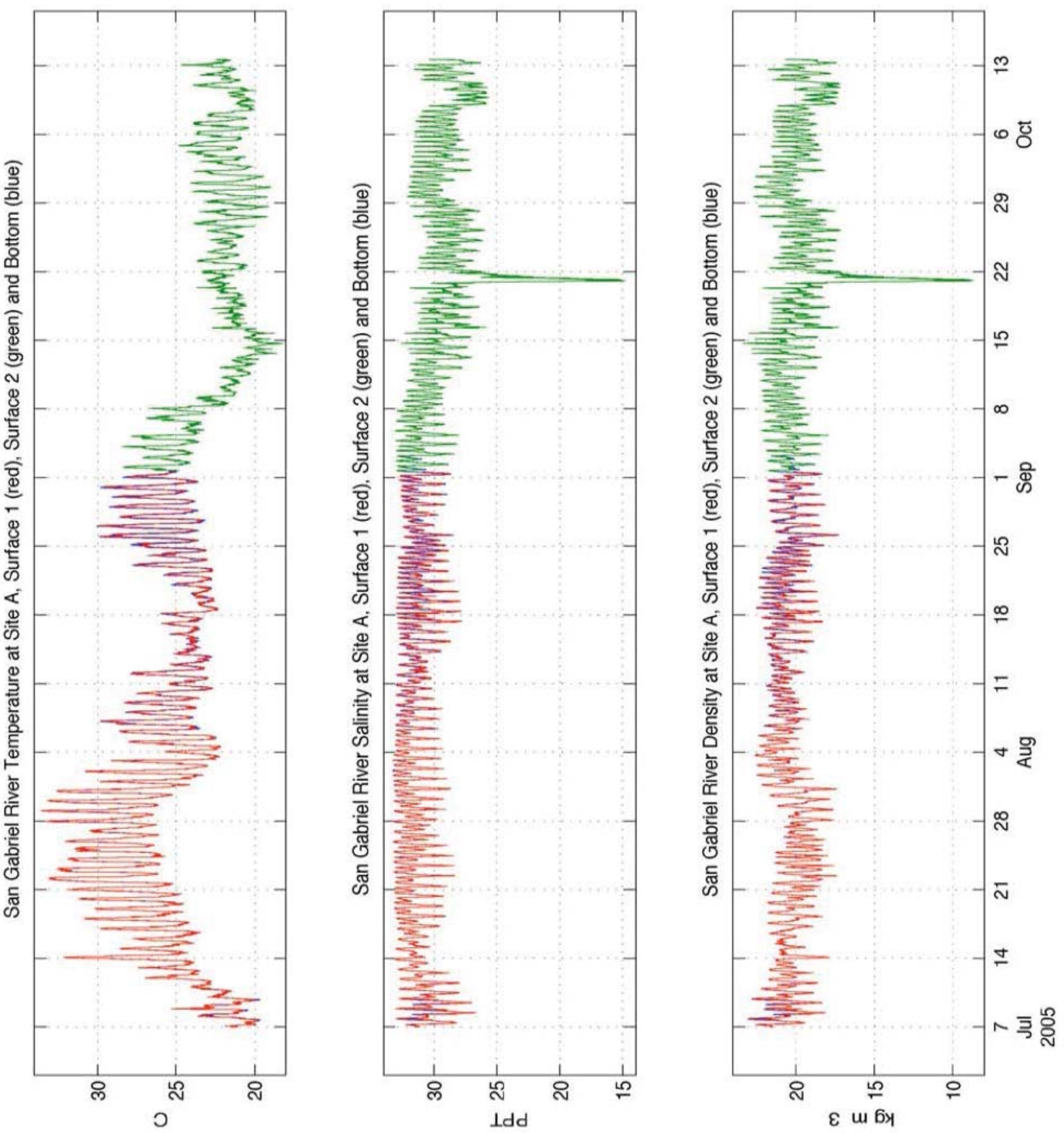

Figure 4 Hourly water temperature, salinity (ppt), and density from a fixed monitoring station downstream of the OTC discharge. The red and green lines indicate surface water values (two separate deployments) and the blue line indicates bottom water values. Originally Figure 16 in Rosenberg et al. 2005.

Appendix A. Observation records for benthic invertebrate assemblages at each of the three estuarine systems

Species	Estuary		
	Los Angeles River	San Gabriel River	Santa Ana River
Acanthinucella spirata	Yes	Yes	Yes
Acteocina carinata	No	Yes	Yes
Acteocina culcitella	No	Yes	No
Acteocina inculta	No	Yes	Yes
Actiniaria	No	Yes	No
Actiniaria sp 1	No	Yes	No
Alpheus californiensis	No	Yes	No
Amaeana occidentalis	No	Yes	No
Ampharete labrops	Yes	Yes	No
Ampharete sp	No	Yes	No
Amphicteis scaphobranchiata	Yes	Yes	No
Amphideutopus oculatus	No	Yes	No
Amphiodia digitata	Yes	Yes	No
Amphiodia sp	No	Yes	No
Amphiodia urtica	Yes	Yes	Yes
Amphipholis sp	No	Yes	No
Amphipholis squamata	No	Yes	No
Amphiuridae	No	Yes	No
Ampithoe sp	No	Yes	No
Ampithoe valida	No	Yes	No
Ancistrosyllis groenlandica	Yes	No	No
Anoplodactylus erectus	No	Yes	No
Anoplodactylus viridintestinalis	No	Yes	No
Anthopleura sola	Yes	No	No
Aphelochaeta monilaris	Yes	No	No
Aphelochaeta petersenae	No	Yes	No
Aphelochaeta sp SD5	No	No	Yes
Apionsoma murinae	No	Yes	No
Aplidium californicum	No	Yes	No
Aplysia californica	Yes	No	No
Arcuatula senhousia	Yes	Yes	No
Argopecten irradians	No	Yes	No
Argopecten ventricosus	No	No	Yes
Armandia brevis	Yes	Yes	No
Ascidia zara	Yes	No	No
Asthenothaerus diegensis	No	Yes	Yes
Aurelia aurita	Yes	Yes	No

Barleeia sp	Yes	Yes	No
Bipalponephtys cornuta	Yes	Yes	No
Bivalvia	Yes	No	No
Boccardia proboscidea	No	Yes	No
Boccardia sp	Yes	No	No
Boccardiella hamata	Yes	Yes	Yes
Boccardiella sp	No	Yes	Yes
Bombycilla cedrorum	No	Yes	No
Botrylloides diegensis	No	Yes	No
Botrylloides violaceus	Yes	Yes	No
Botryllus perspicuum	Yes	Yes	No
Botryllus schlosseri	Yes	Yes	No
Branchinecta sandiegonensis	No	No	Yes
Brania californiensis	No	Yes	No
Brissopsis pacifica	Yes	No	No
Bugulina stolonifera	No	Yes	No
Bulla gouldiana	No	Yes	Yes
Caecognathia crenulatifrons	Yes	No	No
Caecum crebricinctum	No	Yes	No
Calliostoma gemmulatum	No	Yes	No
Calyptraea fastigiata	No	Yes	No
Calyptraeidae	Yes	No	No
Campylaspis hartae	Yes	No	No
Capitella capitata	Yes	Yes	No
Capitella capitata Cmplx	Yes	Yes	Yes
Caprella alaskana	No	Yes	No
Caprella californica	No	Yes	No
Caprella sp	No	Yes	No
Carinoma mutabilis	No	Yes	Yes
Cerebratulus sp	No	Yes	No
Cerithidea californica	No	Yes	Yes
Chaetozone corona	Yes	Yes	No
Chaetozone senticosa	No	Yes	No
Chaetozone sp	Yes	Yes	No
Chama arcana	No	No	Yes
Chione californiensis	No	Yes	Yes
Chione undatella	No	No	Yes
Chone mollis	No	Yes	No
Ciona intestinalis	Yes	Yes	No
Ciona savignyi	Yes	Yes	No
Cirratulidae	Yes	No	No
Cirratulus sp	No	Yes	No
Cirriformia sp	No	Yes	No

Cirriformia sp SD1	Yes	Yes	No
Compressidens stearnsii	Yes	No	No
Conus californicus	No	Yes	No
Cooperella subdiaphana	No	Yes	Yes
Cornu aspersum	No	No	Yes
Corophium acherusicum	Yes	Yes	Yes
Corophium insidiosum	Yes	Yes	Yes
Cossura candida	No	Yes	No
Crepidula dorsata	No	Yes	No
Crepidula onyx	Yes	No	No
Crepipatella dorsata	No	Yes	No
Crucibulum spinosum	No	Yes	No
Cryptomya californica	Yes	Yes	No
Cryptonemertes actinophila	No	Yes	No
Decamastus gracilis	No	Yes	Yes
Delectopecten vancouverensis	No	Yes	No
Dentalium vallicolens	Yes	No	No
Diadumene leucolena	No	Yes	No
Diadumene sp	No	Yes	No
Dialychone albocincta	Yes	No	No
Diopatra ornata	Yes	No	No
Diplodonta orbella	No	No	Yes
Diplosoma listerianum	No	Yes	No
Dipolydora socialis	Yes	No	No
Dipolydora sp	Yes	Yes	No
Donax californicus	No	Yes	No
Donax gouldii	No	Yes	Yes
Dorvillea (*Schistomeringos*) sp	Yes	Yes	No
Elasmopus bampo	No	Yes	No
Elasmopus sp	No	Yes	No
Eochelidium sp A	Yes	No	Yes
Ericthonius brasiliensis	No	Yes	No
Eteone pigmentata	Yes	No	No
Euchone incolor	Yes	No	No
Euchone limnicola	Yes	Yes	No
Eulalia quadrioculata	Yes	No	No
Eumida longicornuta	Yes	No	No
Eunicidae	No	Yes	No
Euphilomedes carcharodonta	No	Yes	No
Exogone lourei	Yes	Yes	Yes
Exogone sp A	No	Yes	No
Fabricinuda limnicola	No	Yes	No
Falcidens hartmanae	Yes	No	No

Gadila tolmiei	Yes	No	No
Gammaridea	Yes	No	No
Gari fucata	No	Yes	No
Geukensia demissa	No	Yes	No
Gibberosus devaneyi	No	Yes	No
Glycera americana	No	No	Yes
Glycera macrobranchia	No	Yes	No
Glycera tenuis	Yes	No	No
Goniada littorea	No	Yes	Yes
Grandidierella japonica	Yes	Yes	Yes
Haminoea vesicula	No	Yes	Yes
Harmothoe imbricata	Yes	No	No
Harmothoe imbricata Cmplx	Yes	No	No
Harpacticoida	Yes	No	No
Helix aspersa	Yes	No	No
Helix lactea	No	Yes	No
Hemigrapsus oregonensis	No	Yes	No
Hermissenda opalescens	Yes	No	No
Heteronemertea	No	No	Yes
Heteronemertea sp SD2	No	No	Yes
Heteroserolis carinata	No	Yes	No
Hiatella arctica	Yes	Yes	No
Huxleyia munita	Yes	No	No
Imogine exiguus	No	Yes	No
Kurtiella tumida	No	Yes	No
Laevicardium substriatum	Yes	Yes	Yes
Lamispina schmidtii	Yes	Yes	No
Leitoscoloplos pugettensis	Yes	Yes	Yes
Lepidopa californica	No	Yes	No
Leptopecten latiauratus	Yes	Yes	No
Leptosynapta sp	No	Yes	Yes
Leukoma staminea	No	Yes	Yes
Ligia occidentalis	No	Yes	No
Limifossor fratula	Yes	No	No
Limnoria tripunctata	No	Yes	No
Lineidae	Yes	Yes	Yes
Listriella goleta	No	Yes	No
Littorina scutulata	No	Yes	No
Lottia cona	No	Yes	No
Lottia gigantea	No	Yes	No
Lottia limatula	No	Yes	Yes
Lottia scabra	Yes	Yes	No
Lumbrineridae	Yes	No	No

Lyonsia californica	No	Yes	No
Lyonsiidae	No	Yes	No
Lyrodus pedicellatus	No	Yes	No
Macoma indentata	No	No	Yes
Macoma nasuta	No	Yes	Yes
Macoma yoldiformis	No	Yes	No
Mactromeris sp	No	No	Yes
Mactrotoma californica	No	No	Yes
Magelona pitelkai	No	Yes	No
Marphysa angelensis	No	Yes	No
Mayerella acanthopoda	Yes	Yes	Yes
Mediomastus sp	Yes	Yes	Yes
Mercenaria mercenaria	No	Yes	No
Metamysidopsis elongata	No	Yes	No
Microcosmus squamiger	Yes	No	No
Microdeutopus schmitti	No	Yes	No
Micrura alaskensis	Yes	No	No
Molgula manhattensis	No	Yes	No
Molgula verrucifera	No	Yes	No
Monocorophium acherusicum	Yes	Yes	Yes
Monocorophium insidiosum	Yes	Yes	Yes
Monocorophium sp	Yes	No	No
Monticellina cryptica	Yes	Yes	No
Monticellina siblina	Yes	Yes	No
Monticellina sp	Yes	No	No
Mopalia acuta	No	Yes	No
Mopalia muscosa	Yes	No	No
Morants duplex	Yes	Yes	Yes
Musculista senhousia	Yes	Yes	No
Myrianida pachycera	No	Yes	No
Mytilidae	Yes	No	No
Mytilus galloprovincialis	Yes	No	No
Naineris dendritica	Yes	No	No
Nassarius fossatus	No	Yes	No
Nassarius tiarula	No	Yes	Yes
Navanax inermis	No	Yes	No
Neanthes acuminata	Yes	Yes	No
Neanthes acuminata Cmplx	Yes	Yes	No
Nebalia pugettensis Cmplx	Yes	No	No
Nemertea	No	Yes	No
Neotrypaea californiensis	No	Yes	Yes
Neotrypaea gigas	Yes	No	No
Neotrypaea sp	Yes	No	Yes

Nephtys caecoides	No	Yes	Yes
Nephtys cornuta	Yes	No	No
Nereis sp A	No	Yes	No
Nerocila californica	No	Yes	No
Neverita reclusiana	No	Yes	No
Notomastus magnus	No	Yes	No
Notomastus sp	No	No	Yes
Notomastus sp A	No	No	Yes
Notomastus tenuis	Yes	No	Yes
Nudibranchia	Yes	No	No
Nuttallina californica	Yes	No	No
Odontosyllis phosphorea	Yes	No	No
Odostomia sp	No	Yes	No
Oligochaeta	Yes	Yes	Yes
Olivella baetica	No	Yes	No
Ophiodromus pugettensis	Yes	No	No
Ophiuridae	No	Yes	No
Oxydromus pugettensis	Yes	No	No
Oxyurostylis pacifica	Yes	Yes	No
Pachygrapsus crassipes	Yes	Yes	No
Palaeonemertea	No	Yes	Yes
Palaeonemertea	Yes	No	No
Panopeidae	Yes	No	No
Paracerceis sculpta	No	Yes	No
Paradexamine sp SD1	No	Yes	No
Paramicrodeutopus schmitti	No	Yes	No
Paranemertes californica	Yes	Yes	Yes
Paranthura elegans	No	Yes	No
Paranthura japonica cmplx	No	Yes	No
Paraonella platybranchia	No	Yes	Yes
Paraprionospio pinnata	No	Yes	No
Parasterope barnesi	No	Yes	No
Parvilucina tenuisculpta	Yes	No	Yes
Parviplana hymani	Yes	No	No
Patiria miniata	Yes	Yes	No
Pectinaria californiensis	No	Yes	No
Periploma discus	No	Yes	No
Petaloclymene pacifica	No	Yes	No
Petricola hertzana	No	Yes	No
Pherusa capulata	Yes	No	No
Pherusa negligens	Yes	Yes	No
Pherusa neopapillata	No	Yes	No
Phoronida	Yes	No	No

Phoronis sp	No	Yes	No
Phragmatopoma californica	No	Yes	No
Pisaster ochraceus	Yes	No	No
Pista brevibranchiata	No	No	Yes
Pista estevanica	Yes	No	No
Pista percyi	No	Yes	No
Pista wui	No	Yes	Yes
Podarkeopsis glabrus	Yes	No	No
Podocopida	Yes	No	No
Polyandrocarpa zorritensis	No	Yes	No
Polycera hedgpethi	No	Yes	No
Polycladida	Yes	No	No
Polycladida sp HYP2	No	Yes	No
Polydora cirrosa	Yes	No	No
Polydora cornuta	Yes	Yes	Yes
Polydora limicola	Yes	No	No
Polydora nuchalis	Yes	Yes	Yes
Polydora sp	Yes	No	No
Polyophthalmus pictus	Yes	No	No
Potamethus sp A	Yes	No	No
Prionospio (*Minuspio*) *lighti*	Yes	No	Yes
Prionospio (*Prionospio*) *heterobranchia*	Yes	Yes	Yes
Prionospio pygmaeus	No	Yes	No
Procambarus clarkii	Yes	No	No
Protothaca sp	Yes	No	No
Protothaca staminea	No	No	Yes
Psammotreta obesa	Yes	No	No
Pseudopolydora kempi	No	Yes	No
Pseudopolydora paucibranchiata	Yes	Yes	Yes
Pseudotanais makrothrix	Yes	No	No
Pyromaia tuberculata	No	Yes	No
Quietula y-cauda	Yes	No	No
Rhachotropis sp	Yes	No	No
Roperia poulsoni	Yes	Yes	No
Rudilemboides stenopropodus	Yes	Yes	Yes
Rumina decollata	No	No	Yes
Runcinidae	Yes	No	No
Sabellidae	Yes	No	No
Saccella taphria	Yes	Yes	No
Salvatoria californiensis	Yes	Yes	No
Saxidomus nuttalli	Yes	No	No
Scalibregma californicum	Yes	No	No

Schizoporella japonica	No	Yes	No
Scleroplax granulata	Yes	Yes	No
Scolelepis (Parascolelepis) texana	Yes	No	Yes
Scolelepis bullibranchia	Yes	No	No
Scolelepis sp SD1	Yes	Yes	No
Scolelepis tridentata	Yes	Yes	No
Scoletoma sp	Yes	No	No
Scoletoma sp C	Yes	No	Yes
Scoletoma tetraura Cmplx	Yes	No	No
Scoloplos acmeceps	Yes	Yes	No
Scoloplos sp	Yes	Yes	No
Scyphoproctus oculatus	Yes	Yes	No
Sinocorophium heteroceratum	Yes	Yes	No
Sipuncula	Yes	No	No
Nassarius fossatus	No	Yes	No
Solariella peramabilis	Yes	No	No
Solen sicarius	Yes	Yes	No
Sphaeromatidae	Yes	No	No
Sphaerosyllis californiensis	Yes	Yes	No
Sphaerosyllis sp	Yes	Yes	No
Sphenia fragilis	Yes	Yes	No
Spio maculata	No	Yes	Yes
Spiochaetopterus costarum	Yes	Yes	No
Spionidae	Yes	No	No
Spiophanes berkeleyorum	No	Yes	No
Spiophanes bombyx	No	Yes	No
Spiophanes duplex	Yes	No	Yes
Streblosoma sp	No	Yes	No
Streblosoma sp B	No	Yes	No
Streblosoma uncinatus	No	Yes	No
Streblospio benedicti	Yes	Yes	Yes
Strongylocentrotus purpuratus	No	Yes	No
Styela clava	Yes	Yes	No
Styela plicata	Yes	Yes	No
Stylochoplana longipenis	Yes	No	No
Stylochoplana longipennis	No	Yes	No
Stylochus exiguus	No	Yes	No
Stylochus franciscanus	Yes	Yes	No
Syllides sp	No	Yes	No
Syllis (*Typosyllis*) *nipponica*	No	Yes	No
Syllis gracilis Cmplx	No	Yes	No
Synaptotanais notabilis	No	Yes	No
Tagelus affinis	Yes	Yes	No

Tagelus californianus	No	Yes	Yes
Tagelus sp	Yes	Yes	Yes
Tagelus subteres	No	Yes	Yes
Tellina cadieni	No	Yes	Yes
Tellina carpenteri	Yes	Yes	No
Tellina modesta	No	Yes	No
Tellina sp B	No	Yes	No
Tenonia priops	Yes	Yes	No
Terebellidae	No	Yes	No
Tetraclita rubescens	Yes	No	No
Theora lubrica	Yes	Yes	Yes
Thylacodes squamigerus	Yes	No	No
Timarete luxuriosa	Yes	Yes	No
Tresus nuttallii	No	Yes	No
Tresus sp	No	Yes	Yes
Tubulanus polymorphus	Yes	Yes	Yes
Tubulanus sp A	No	No	Yes
Typosyllis nipponica	No	No	Yes
Veneridae	No	No	Yes
Venerupis philippinarum	No	Yes	Yes
Vitrinella sp	No	Yes	Yes
Watersipora cucullata	Yes	No	No
Watersipora subtorquata	Yes	No	No
Xanthidae	No	No	Yes
Zaolutus actius	Yes	No	Yes
Zeuxo normani	Yes	No	Yes
Zygeupolia rubens	Yes	Yes	Yes
Zygonemertes virescens	No	Yes	Yes

Appendix B. Observation records for fish assemblages at each of the three estuarine systems

Species	**Estuary**		
	Los Angeles River	**San Gabriel River**	**Santa Ana River**
Acanthogobius flavimanus	No	Yes	No
Albula vulpes	Yes	Yes	No
Anchoa compressa	No	Yes	No
Anchoa delicatissima	No	Yes	No
Atherinops affinis	Yes	Yes	No
Atherinopsis californiensis	Yes	No	No
Atractoscion nobilis	No	Yes	No
Chloroscombrus orqueta	Yes	No	No
Chromis punctipinnis	Yes	No	No

Citharichthys sordidus	No	No	Yes
Clevelandia ios	No	Yes	No
Clupea pallasii	No	Yes	No
Ctenogobius sagittula	Yes	No	No
Cymatogaster aggregata	Yes	Yes	No
Cyprinus carpio	Yes	No	No
Dasyatis dipterura	No	Yes	No
Embiotoca jacksoni	Yes	No	No
Engraulis mordax	No	Yes	No
Fundulus parvipinnis	No	Yes	No
Genyonemus lineatus	No	Yes	No
Gibbonsia elegans	Yes	No	No
Gila orcuttii	No	Yes	No
Girella nigricans	No	Yes	No
Gobiesox rhessodon	No	Yes	No
Heterostichus rostratus	No	Yes	No
Hippoglossina stomata	No	No	Yes
Hypsoblennius gentilis	Yes	No	No
Hypsoblennius gilberti	No	Yes	No
Hypsopsetta guttulata	No	Yes	No
Ilypnus gilberti	No	Yes	No
Lepidopsetta bilineata	No	Yes	No
Lepidopus caudatus	No	Yes	No
Lepomis cyanellus	Yes	No	No
Leptocottus armatus	No	Yes	No
Leuresthes tenuis	Yes	Yes	No
Menticirrhus undulatus	No	Yes	No
Mugil cephalus	No	Yes	No
Myliobatis californica	No	Yes	No
Neoclinus stephensae	No	Yes	No
Ophichthus zophochir	Yes	Yes	No
Oreochromis mossambicus	Yes	Yes	Yes
Paralabrax clathratus	Yes	No	No
Paralichthys californicus	No	Yes	No
Peprilus simillimus	No	Yes	No
Phanerodon furcatus	No	Yes	No
Phanerodon stripes	No	Yes	No
Platyrhinoidis triseriata	No	Yes	No
Pleuronichthys ritteri	No	Yes	No
Pleuronichthys verticalis	No	No	Yes
Porichthys myriaster	No	Yes	No
Quietula y-cauda	No	Yes	No
Roncador stearnsii	No	Yes	No

Sarda chiliensis	No	Yes	No
Sebastes jordani	No	No	Yes
Sebastes semicinctus	No	No	Yes
Seriphus politus	No	Yes	No
Sphoeroides lobatus	No	Yes	No
Strongylura exilis	No	Yes	No
Tilapia zillii	No	Yes	No
Trachipterus fukuzakii	No	Yes	No
Trichiurus lepturus	No	Yes	No
Tridentiger trigonocephalus	Yes	No	No
Umbrina roncador	No	Yes	No
Urobatis halleri	Yes	Yes	No
Urolophus halleri	No	Yes	No

Appendix C. Observation records for bird assemblages at each of the three estuarine systems

Species	**Estuary**		
	Los Angeles River	**San Gabriel River**	**Santa Ana River**
Accipiter cooperii	Yes	Yes	Yes
Accipiter striatus	Yes	No	Yes
Actitis macularius	Yes	Yes	Yes
Aechmophorus clarkii	Yes	Yes	Yes
Aechmophorus occidentalis	Yes	Yes	Yes
Aeronautes saxatalis	Yes	Yes	Yes
Agelaius phoeniceus	Yes	Yes	Yes
Agelaius tricolor	No	No	Yes
Aimophila ruficeps	Yes	No	No
Aix sponsa	Yes	No	No
Alopochen aegyptiaca	No	No	Yes
Amazona viridigenalis	No	No	Yes
Anas acuta	Yes	Yes	Yes
Anas americana	Yes	Yes	Yes
Anas clypeata	Yes	Yes	Yes
Anas crecca	Yes	Yes	Yes
Anas cyanoptera	Yes	Yes	Yes
Anas discors	Yes	Yes	Yes
Anas penelope	Yes	No	Yes
Anas platyrhynchos	Yes	Yes	Yes
Anas strepera	Yes	Yes	Yes
Anser albifrons	Yes	Yes	No
Anthus rubescens	Yes	Yes	Yes
Aphelocoma californica	Yes	Yes	Yes
Aratinga mitrata	Yes	Yes	Yes
Archilochus alexandri	Yes	Yes	Yes
Ardea alba	Yes	Yes	Yes
Ardea herodias	Yes	Yes	Yes
Arenaria interpres	Yes	Yes	Yes
Arenaria melanocephala	Yes	Yes	Yes
Asio flammeus	No	No	Yes
Athene cunicularia	No	Yes	Yes
Aythya affinis	Yes	Yes	Yes
Aythya americana	Yes	Yes	Yes
Aythya collaris	Yes	Yes	Yes
Aythya marila	Yes	No	Yes
Aythya valisineria	Yes	Yes	Yes

Baeolophus inornatus	Yes	No	No
Bartramia longicauda	Yes	No	No
Bombycilla cedrorum	Yes	No	Yes
Botaurus lentiginosus	No	Yes	No
Branta bernicla	Yes	Yes	Yes
Branta canadensis	Yes	Yes	Yes
Branta hutchinsii	Yes	No	Yes
Brotogeris chiriri	Yes	No	No
Bubo virginianus	No	No	Yes
Bubulcus ibis	Yes	No	Yes
Bucephala albeola	Yes	Yes	Yes
Bucephala clangula	Yes	Yes	Yes
Buteo jamaicensis	Yes	Yes	Yes
Buteo lineatus	Yes	Yes	Yes
Buteo regalis	No	Yes	No
Buteo swainsoni	No	No	Yes
Butorides virescens	Yes	Yes	Yes
Cairina moschata	Yes	No	No
Calcarius lapponicus	No	No	Yes
Calidris acuminata	Yes	No	No
Calidris alba	Yes	Yes	Yes
Calidris alpina	Yes	Yes	Yes
Calidris bairdii	Yes	No	No
Calidris canutus	Yes	Yes	Yes
Calidris ferruginea	Yes	No	Yes
Calidris himantopus	Yes	No	No
Calidris mauri	Yes	Yes	Yes
Calidris melanotos	Yes	No	Yes
Calidris minuta	Yes	No	No
Calidris minutilla	Yes	Yes	Yes
Calidris pusilla	Yes	No	Yes
Calidris ruficollis	Yes	No	No
Calidris virgata	Yes	Yes	Yes
Callipepla californica	No	No	Yes
Calypte anna	Yes	Yes	Yes
Calypte costae	Yes	No	Yes
Cardellina pusilla	Yes	Yes	Yes
Cardellina rubrifrons	No	No	Yes
Cardinalis sinuatus	No	No	Yes
Cathartes aura	Yes	Yes	Yes
Catharus guttatus	Yes	Yes	Yes
Catharus ustulatus	No	Yes	Yes
Cerorhinca monocerata	No	No	Yes

Chaetura pelagica	Yes	No	No
Chaetura vauxi	Yes	Yes	Yes
Chamaea fasciata	No	No	Yes
Charadrius alexandrinus nivosus	No	No	Yes
Charadrius nivosus	Yes	Yes	Yes
Charadrius semipalmatus	Yes	Yes	Yes
Charadrius vociferus	Yes	Yes	Yes
Chen caerulescens	Yes	Yes	Yes
Chen rossii	Yes	No	Yes
Chlidonias niger	Yes	No	No
Chondestes grammacus	Yes	Yes	Yes
Chroicocephalus philadelphia	Yes	Yes	Yes
Chroicocephalus ridibundus	No	No	Yes
Circus cyaneus	Yes	Yes	Yes
Cistothorus palustris	Yes	Yes	Yes
Clangula hyemalis	Yes	Yes	No
Coccyzus americanus occidentalis	Yes	No	Yes
Colaptes auratus	Yes	Yes	Yes
Columba livia	Yes	No	Yes
Columba livia domestica	Yes	No	No
Columbina passerina	No	Yes	Yes
Contopus cooperi	Yes	No	Yes
Contopus sordidulus	Yes	Yes	Yes
Corvus brachyrhynchos	Yes	Yes	Yes
Corvus corax	Yes	Yes	Yes
Cygnus olor	Yes	Yes	Yes
Cypseloides niger	Yes	No	No
Dolichonyx oryzivorus	Yes	No	No
Egretta rufescens	No	Yes	Yes
Egretta thula	Yes	Yes	Yes
Egretta tricolor	No	No	Yes
Elanus leucurus	Yes	Yes	Yes
Empidonax difficilis	Yes	No	Yes
Empidonax hammondii	Yes	No	Yes
Empidonax minimus	No	Yes	Yes
Empidonax oberholseri	No	No	Yes
Empidonax traillii	Yes	No	Yes
Empidonax wrightii	No	No	Yes
Eremophila alpestris	No	Yes	Yes
Estrilda melpoda	No	No	Yes
Euphagus cyanocephalus	Yes	Yes	Yes
Euplectes franciscanus	Yes	No	Yes
Falco columbarius	Yes	No	Yes

Falco peregrinus	Yes	Yes	Yes
Falco sparverius	Yes	Yes	Yes
Fulica americana	Yes	Yes	Yes
Fulmarus glacialis	Yes	No	Yes
Gallinago delicata	Yes	No	Yes
Gallinula chloropus	Yes	Yes	Yes
Gavia immer	Yes	Yes	Yes
Gavia pacifica	Yes	Yes	Yes
Gavia stellata	Yes	Yes	Yes
Gelochelidon nilotica	No	No	Yes
Geothlypis formosa	No	No	Yes
Geothlypis philadelphia	No	No	Yes
Geothlypis tolmiei	Yes	No	Yes
Geothlypis trichas	Yes	Yes	Yes
Gull Larus californicus	Yes	No	No
Haematopus bachmani	Yes	Yes	No
Haematopus palliatus	Yes	No	No
Haemorhous cassinii	No	Yes	No
Haemorhous mexicanus	Yes	Yes	Yes
Haemorhous purpureus	Yes	Yes	Yes
Haliaeetus leucocephalus	No	Yes	No
Hawk Buteo lineatus	No	No	Yes
Himantopus mexicanus	Yes	Yes	Yes
Hirundo rustica	Yes	Yes	Yes
Hydrocoloeus minutus	No	No	Yes
Hydroprogne caspia	Yes	Yes	Yes
Icteria virens	No	No	Yes
Icterus bullockii	Yes	Yes	Yes
Icterus cucullatus	Yes	Yes	Yes
Icterus spurius	No	No	Yes
Junco hyemalis	Yes	No	Yes
Lanius ludovicianus	Yes	No	Yes
Larus argentatus	Yes	Yes	Yes
Larus californicus	Yes	Yes	Yes
Larus canus	Yes	Yes	Yes
Larus crassirostris	No	Yes	No
Larus delawarensis	Yes	Yes	Yes
Larus glaucescens	Yes	Yes	Yes
Larus glaucoides	Yes	No	No
Larus heermanni	Yes	Yes	Yes
Larus hyperboreus	Yes	No	No
Larus occidentalis	Yes	Yes	Yes
Larus smithsonianus	Yes	No	No

Larus thayeri	Yes	No	No
Leiothlypis celata	Yes	Yes	Yes
Leiothlypis peregrina	No	No	Yes
Leiothlypis ruficapilla	Yes	Yes	Yes
Leucophaeus atricilla	Yes	No	Yes
Leucophaeus pipixcan	Yes	No	No
Limnodromus griseus	Yes	Yes	Yes
Limnodromus scolopaceus	Yes	Yes	Yes
Limosa fedoa	Yes	Yes	Yes
Lonchura punctulata	Yes	Yes	Yes
Lophodytes cucullatus	Yes	Yes	Yes
Megaceryle alcyon	Yes	Yes	Yes
Melanerpes formicivorus	Yes	No	No
Melanerpes lewis	No	Yes	No
Melanitta fusca	Yes	No	Yes
Melanitta nigra	Yes	Yes	No
Melanitta perspicillata	Yes	Yes	Yes
Melospiza georgiana	No	No	Yes
Melospiza lincolnii	Yes	Yes	Yes
Melospiza melodia	Yes	Yes	Yes
Melozone crissalis	Yes	Yes	Yes
Mergus merganser	Yes	No	Yes
Mergus serrator	Yes	Yes	Yes
Mimus polyglottos	Yes	Yes	Yes
Molothrus ater	Yes	Yes	Yes
Motacilla alba	Yes	No	No
Myiarchus cinerascens	Yes	Yes	Yes
Myioborus pictus	No	No	Yes
Numenius americanus	Yes	Yes	Yes
Numenius phaeopus	Yes	Yes	Yes
Nycticorax nycticorax	Yes	Yes	Yes
Oreothlypis celata	Yes	No	No
Oxyura jamaicensis	Yes	Yes	Yes
Pandion haliaetus	Yes	Yes	Yes
Passer domesticus	Yes	Yes	Yes
Passerculus sandwichensis	Yes	Yes	Yes
Passerculus sandwichensis beldingi	No	Yes	Yes
Passerella iliaca	Yes	No	Yes
Passerina amoena	Yes	No	Yes
Passerina caerulea	Yes	No	Yes
Patagioenas fasciata	Yes	No	Yes
Pavo cristatus	Yes	No	No

Pelecanus erythrorhynchos	Yes	Yes	Yes
Pelecanus occidentalis	Yes	Yes	Yes
Pelecanus occidentalis californicus	Yes	No	No
Petrochelidon pyrrhonota	Yes	Yes	Yes
Phaethon aethereus	No	No	Yes
Phainopepla nitens	No	No	Yes
Phalacrocorax auritus	Yes	Yes	Yes
Phalacrocorax pelagicus	Yes	Yes	Yes
Phalacrocorax penicillatus	Yes	Yes	Yes
Phalaropus fulicarius	Yes	No	Yes
Phalaropus lobatus	Yes	No	Yes
Phalaropus tricolor	Yes	No	Yes
Pheucticus ludovicianus	No	No	Yes
Pheucticus melanocephalus	Yes	No	Yes
Philomachus pugnax	Yes	No	No
Picoides nuttallii	Yes	No	Yes
Picoides pubescens	Yes	No	Yes
Pipilo maculatus	No	No	Yes
Piranga ludoviciana	Yes	Yes	Yes
Piranga rubra	No	No	Yes
Plegadis chihi	Yes	Yes	Yes
Pluvialis fulva	No	No	Yes
Pluvialis squatarola	Yes	Yes	Yes
Podiceps auritus	Yes	Yes	Yes
Podiceps grisegena	No	Yes	No
Podiceps nigricollis	Yes	Yes	Yes
Podilymbus podiceps	Yes	Yes	Yes
Polioptila caerulea	Yes	Yes	Yes
Polioptila californica	Yes	No	Yes
Polioptila californica californica	No	No	Yes
Porzana carolina	Yes	Yes	Yes
Psaltriparus minimus	Yes	Yes	Yes
Psittacula krameri	Yes	No	No
Ptychoramphus aleuticus	Yes	No	No
Puffinus creatopus	Yes	No	No
Puffinus griseus	Yes	No	No
Puffinus opisthomelas	Yes	No	No
Quiscalus mexicanus	Yes	Yes	Yes
Rallus limicola	Yes	No	Yes
Rallus longirostris	No	Yes	No
Rallus obsoletus	No	Yes	Yes
Rallus obsoletus levipes	No	No	Yes

Recurvirostra americana	Yes	Yes	Yes
Regulus calendula	Yes	Yes	Yes
Riparia riparia	Yes	No	Yes
Rynchops niger	Yes	Yes	Yes
Salpinctes obsoletus	Yes	Yes	Yes
Sayornis nigricans	Yes	Yes	Yes
Sayornis phoebe	No	No	Yes
Sayornis saya	Yes	Yes	Yes
Selasphorus rufus	Yes	Yes	Yes
Selasphorus sasin	Yes	Yes	Yes
Setophaga americana	No	No	Yes
Setophaga coronata	Yes	Yes	Yes
Setophaga nigrescens	Yes	No	Yes
Setophaga occidentalis	No	No	Yes
Setophaga palmarum	Yes	No	Yes
Setophaga pensylvanica	Yes	No	Yes
Setophaga petechia	Yes	No	Yes
Setophaga pinus	No	No	Yes
Setophaga ruticilla	No	No	Yes
Setophaga townsendi	Yes	No	Yes
Sialia mexicana	Yes	Yes	Yes
Sitta canadensis	No	No	Yes
Spatula clypeata	No	No	Yes
Sphyrapicus nuchalis	No	No	Yes
Sphyrapicus ruber	No	No	Yes
Spinus lawrencei	Yes	No	Yes
Spinus psaltria	Yes	Yes	Yes
Spinus tristis	Yes	Yes	Yes
Spizella breweri	Yes	No	No
Spizella pallida	No	Yes	No
Spizella passerina	Yes	Yes	Yes
Squatarola squatarola	No	Yes	No
Stelgidopteryx serripennis	Yes	Yes	Yes
Stercorarius maccormicki	Yes	No	No
Stercorarius parasiticus	No	No	Yes
Stercorarius pomarinus	Yes	No	Yes
Sterna forsteri	Yes	Yes	Yes
Sterna hirundo	Yes	Yes	Yes
Sternula albifrons	No	No	Yes
Sternula antillarum	Yes	Yes	Yes
Sternula antillarum browni	Yes	Yes	Yes
Streptopelia chinensis	Yes	Yes	No
Streptopelia decaocto	Yes	Yes	Yes

Sturnella neglecta	Yes	Yes	Yes
Sturnus vulgaris	Yes	Yes	Yes
Sula dactylatra	Yes	No	No
Sula leucogaster	Yes	No	No
Tachycineta bicolor	Yes	Yes	Yes
Tachycineta thalassina	Yes	Yes	Yes
Thalasseus elegans	Yes	Yes	Yes
Thalasseus maximus	Yes	Yes	Yes
Thryomanes bewickii	Yes	Yes	Yes
Toxostoma bendirei	No	No	Yes
Toxostoma redivivum	No	No	Yes
Tringa flavipes	Yes	Yes	Yes
Tringa incana	Yes	No	Yes
Tringa melanoleuca	Yes	Yes	Yes
Tringa semipalmata	Yes	Yes	Yes
Tringa semipalmata inornata	Yes	No	No
Tringa solitaria	Yes	No	No
Troglodytes aedon	Yes	Yes	Yes
Troglodytes pacificus	No	No	Yes
Turdus migratorius	Yes	No	Yes
Turdus rufopalliatus	No	No	Yes
Tyrannus melancholicus	No	No	Yes
Tyrannus verticalis	Yes	Yes	Yes
Tyrannus vociferans	Yes	Yes	Yes
Tyto alba	Yes	No	Yes
Uria aalge	Yes	No	Yes
Vidua macroura	Yes	No	Yes
Vireo bellii	Yes	No	Yes
Vireo bellii pusillus	No	No	Yes
Vireo flavifrons	No	No	Yes
Vireo gilvus	Yes	No	Yes
Vireo huttoni	Yes	No	Yes
Xanthocephalus xanthocephalus	Yes	Yes	Yes
Xema sabini	Yes	No	No
Zenaida asiatica	Yes	No	Yes
Zenaida macroura	Yes	Yes	Yes
Zonotrichia albicollis	No	No	Yes
Zonotrichia atricapilla	Yes	Yes	Yes
Zonotrichia leucophrys	Yes	Yes	Yes
Zosterops japonicus	No	No	Yes

Appendix E1

Using an Environmental Hydrology Model of the San Gabriel River to Assess Water Reclamation Plant Flow Reductions, June 3, 2019

Draft

USING AN ENVIRONMENTAL HYDROLOGY MODEL OF THE SAN GABRIEL RIVER TO ASSESS WATER RECLAMATION PLANT FLOW REDUCTIONS

Prepared for
County of Los Angeles Sanitation Districts

June 3, 2019

Draft

USING AN ENVIRONMENTAL HYDROLOGY MODEL OF THE SAN GABRIEL RIVER TO ASSESS WATER RECLAMATION PLANT FLOW REDUCTIONS

Prepared for
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June 3, 2019

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EXECUTIVE SUMMARY

Introduction and Project Description

Environmental Science Associates (ESA) has prepared this report to evaluate the "San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse" (Project). The Project is being developed by the Sanitation Districts of Los Angeles County (Sanitation Districts). The Project will reuse tertiary treated wastewater that is currently discharged as effluent into the San Gabriel River and its tributaries from several Sanitation Districts-operated Water Reclamation Plants (WRPs). Tertiary treated WRP effluent currently makes up a large amount of the dry season baseflow in parts of the San Gabriel River, raising the question of whether reductions could cause an impact to riparian habitat. At the same time, the river's existing flow regime is both naturally variable and highly modified by multiple water management agencies with differing and uncoordinated objectives, resulting in a sub-optimal riparian conditions that could potentially be improved by better water management. This report is focused on identifying:

- How and where existing riparian vegetation is influenced by hydrology along the San Gabriel River, and the role of WRP discharge in that mixture of sources.
- The area of vegetation that appears to be strongly influenced by flows in the range that will be affected by the Project, and the way those flows will change in frequency and magnitude.
- Whether the Project can optimize the location and frequency of WRP releases in a way that minimizes habitat impact or even provides a net improvement over the existing hydrologic regime. In other words, finding the balance between delivering less volume of water, but delivering it with a frequency that is better suited to riparian plant uptake.

Although the Project includes flow reductions from five WRPs in total, this report only considers three that send flows into earth-bottom sections of the San Gabriel River: Pomona WRP (PWRP), San Jose Creek WRP (SJCWRP), and Whittier Narrows WRP (WNWRP). Note that SJCWRP has two discharge outlets in the study area: SJC002 in San Jose Creek and SJC003 in this reach of the San Gabriel River. Three additional outlets discharge downstream of the study area. The riparian habitat area analyzed is from the confluence of the San Gabriel River and San Jose Creek to a point 5,000 feet downstream of the Whittier Narrows Dam (Figure 1). In addition, a more qualitative analysis of Zone 1 Ditch (Rio Hondo Diversion) was conducted and is reported in a separate memo. The existing and proposed operation of the relevant WRPs is provided in the Draft Environmental Impact Report (EIR) Project Description, and briefly summarized below, followed by a discussion of existing conditions related to surface hydrology in the project area.

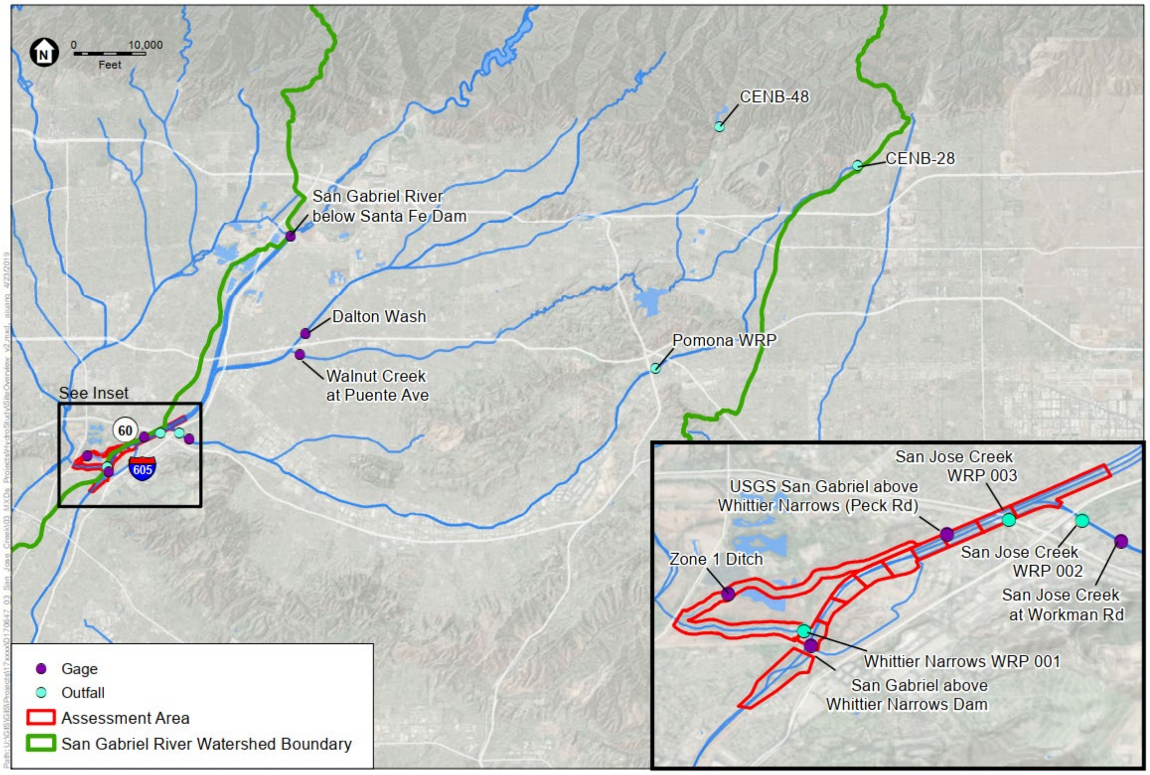


Figure 1
Study Site Location, Model Cells, and Gages

The existing and proposed discharges are shown in Table 1.

TABLE 1
EXISTING AND PROPOSED FUTURE ANNUAL DAILY AVERAGE DISCHARGES

Treatment Plant	Existing Annual Daily Average Discharge (MGD)[1]	Proposed Future Annual Daily Average Discharge (MGD)	New Purpose of Use
San Jose Creek WRP (SJC002)	9.48	5	All Title 22 Recycled Water Uses Allowed
San Jose Creek WRP (SJC003)	0.04	0	All Title 22 Recycled Water Uses Allowed
Pomona WRP (POM001)	3.27	0	All Title 22 Recycled Water Uses Allowed
Whittier Narrows WRP[2] (WN001)	1.19	1.18	All Title 22 Recycled Water Uses Allowed

NOTE: Only discharges made to the study area and considered in this report are shown in this table: other flow reductions are planned for locations downstream of the study area.

[1] Based on average flow data from Water Year 2014-2018.

[2] The Whittier Narrows WRP discharges to both the Rio Hondo/LA River watershed and the San Gabriel River watershed. The proposed project and table only assesses changes in discharges to the San Gabriel River watershed. Proposed reductions to the Rio Hondo/LA River watershed would be a separate and distinct project and the environmental impacts of those reductions will be considered in a separate CEQA document.

SOURCE: Sanitation Districts 2019.

Existing Flow Regime

For this study a five-year period was used to establish a baseline against which to evaluate project conditions. The period was Water Year (WY) 2014-2018. Water years run from October 1st to September 30th. These WYs were selected because they represent a range of recent conditions including a mix of wet (WY2015) and dry (WY2018) years. Under existing conditions, the Project area receives very variable flows. Figure 2 shows flows during the baseline period on the San Gabriel River at Peck Road (middle of the study area) and Whittier Narrows Dam (almost the downstream limit of the study area), and Figure 3 offers a close-up of Figure 2 where the y-axis limits are tightened in order to show lower flows. Figure 4 shows the contributions from the three relevant WRPs during the same period. The study was supported by analysis of 15 Google Earth images, which cover the last ten years, to shed light on how water moves through the system (Table 2). The flow data and aerial photos show several features, referenced to the map of the study area in Figure 5 which breaks the study reach into 11 Hydrology Assessment Areas (HAAs):

- Flow in the river is highly variable, often zero, and diminishes downstream.
- Natural flows from watershed runoff vary from zero to intense flash floods. During the baseline period there were 12 events of between 1000 and 5000 cubic feet per second (cfs).
- There are lengthy periods of no flow: flow at Peck Road was zero about 20% of the time, and 96% of the time at Whittier Narrows Dam. (Note that based on review of aerial photos in Google Earth on days when no flow was shown at the Whittier Narrows gage we believe that sheet flows of up to a few cfs may pass through the dam gate without being gaged).
- There are significant losses along the reach. The average flow at Peck Road during the baseline period was 56 cfs; the average flow at Whittier Narrows was 18 cfs. The loss between gages is a combination of percolation, evapotranspiration and diversion of water from the San Gabriel River to Rio Hondo via the Zone 1 Ditch.
- The upper reaches (HAA1-4) are affected by imported water deliveries. These have a characteristic hydrograph with relatively steady flows in the 100-200 cfs range lasting 2-4 weeks at a time. Imported water deliveries are generally diverted out of the river at the Zone 1 Ditch, but a few overflow the weir at HAA4 and generate continuous flow through the Whittier Narrows Dam.
- The river receives more regular, but still sporadic, flows from the Pomona, San Jose Creek and Whittier Narrows WRPs (Figure 4). These vary considerably in frequency and magnitude. SJC002 outlet (which discharges to San Jose Creek just above the confluence with the San Gabriel River) varies from zero to 40 cfs. Zero flow periods occur when the plant discharges further downstream in the river at one of three other discharge locations. Pomona WRP contributes more steadily, but with daily and seasonal oscillations. Whittier Narrows WRP is a very sporadic contributor since it also has alternative outfalls outside the project area.
- HAA1-2 are almost always ponded, and receive water from a variety of sources including groundwater upwelling in San Jose Creek and discharges from San Jose Creek and Pomona WRPs.
- HAA3-4 are mostly wet in most years, but had long dry periods during the 2017-18 drought.
- There is a big reduction in hydrologic regime at the downstream end of HAA4 where water can be diverted into the Zone 1 Ditch.
- HAA5-8 are much drier than HAA4, and progressively dry out downstream.
- HAA9 is wetter than HAA8 due to the input of water from WNWRP and potential groundwater upwelling. This water also flows through to HAA10 under most conditions.

- Google Earth captured five days in which there was connected flow from HAA1 to HAA10 (out of 15 total images between 2008 and 2018, of which 11 were taken during the wet season). Of the five days, four involved either a high flow event on the mainstem San Gabriel River (e.g. a winter flow) or imported water releases. Only one photo example could be found where WRP water appeared to be the only source of connected flow.

Proposed Project Changes to the Flow Regime

The proposed annual average daily discharges under Project conditions is shown in Table 1, and represents a reduction in flow volume of 7.8 MGD (12 cfs, or 20% of the annual average flow rate at Peck Road). However, the Sanitation Districts have some flexibility in how and where flows from SJCWRP and WNWRP are released, providing the opportunity to release flow in a way that minimizes impacts or even improves conditions. To determine whether flows could be released in a way that benefits habitat, six operational scenarios were assessed that just involve varying flow from SJCWRP. Operational scenarios 1a-c involve releasing the 5 MGD average flow from the SJC002 outfall only, with 1a being a uniform 5 MGD flow and 1b and 1c concentrating the average flow into shorter duration, higher rate releases to overcome percolation rates in HAA1-2 and 'push' water further downstream (see Table 3). Operational scenarios 2a-c have the same flow rates and durations as 1a-c but alternate the release from SJC002 and SJC003. While SJC002 is located on San Jose Creek, SJC003 is located further downstream on the San Gabriel River in HAA2. Releases from SJC003 are less exposed to percolation losses than those from SJC002, providing an additional means of pushing water to riparian habitat further downstream. The five year hydrographs associated with the operational scenarios are shown in Figures 6 and 7, and expanded for Water Year 2018 to show more detail in Figures 8 and 9.

Linking Flow Regime to Riparian Habitat

This report section outlines the study approach and key conceptual assumptions, with the technical model set up being described in more detail in an associated technical memorandum.

The goal of this study was to estimate how reductions in WRP discharge may impact riparian habitat, and whether managing the timing and location of flow releases may be used to offset or even reverse those potential impacts. As a first step it was necessary to understand how riparian vegetation in the Project area is influenced by existing hydrology, and how that hydrology will change. This has been accomplished by two linked models:

1. A habitat-elevation model that characterizes vegetation density relative to elevation above the channel of the San Gabriel River, species, the typical maximum root length for the species, and the availability of seepage from the river. Based on these parameters, we identified vertical bands of given vegetation types that could likely obtain root water from baseflows in the San Gabriel River versus those that were likely obtaining water from rainfall or winter floodplain inundation.

2. A numerical hydrology model that predicts the hydroperiod of elevational bands within a series of percolation areas along the river for existing and Project conditions. The revised hydroperiods are then used to assess the effects of reduced low flows on riparian habitat, whose current distribution of species is shown in Figure 10.

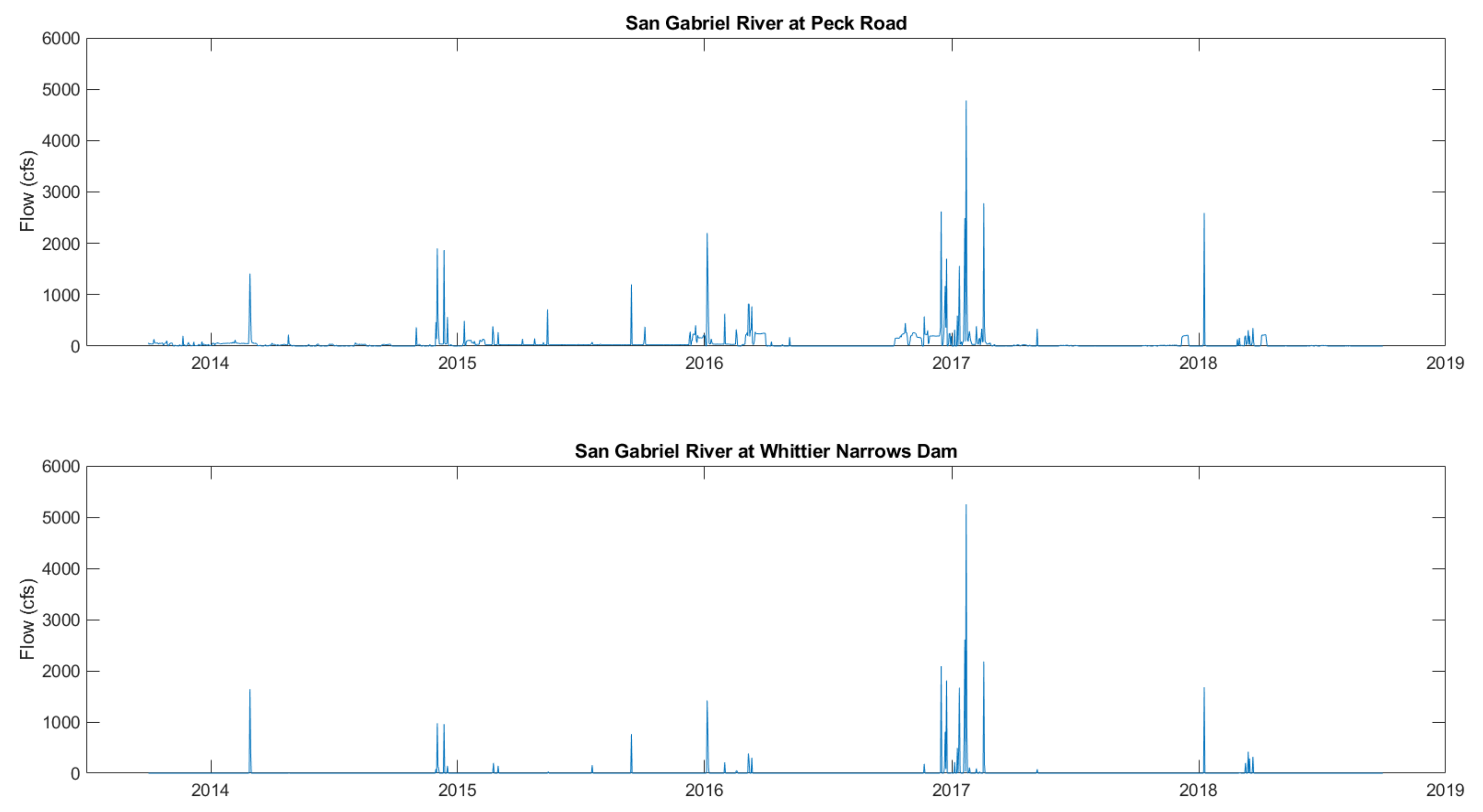
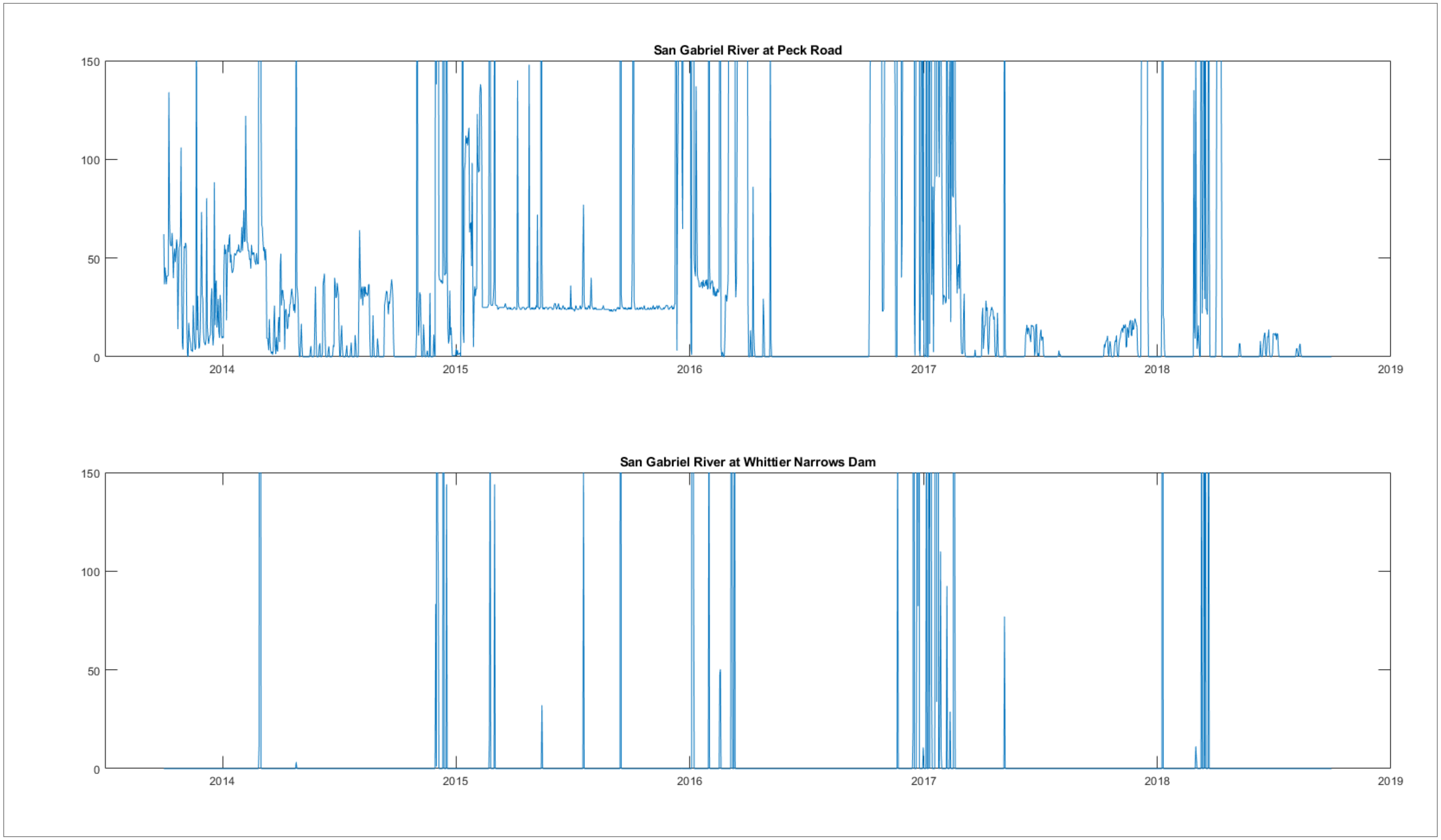


Figure 2
Flow on the San Gabriel River at Peck Road and
Whittier Narrows during the Water Year 2014-18 Baseline Period



NOTE: The Peck Road USGS gage reported errors in recording low flows in 2015

Figure 3
Close-up of Low Flows on the San Gabriel River at Peck Road and Whittier Narrows during the Water Year 2014-18 Baseline Period

Imagery Date	Season	Pomona Ck	HAA0 (above SJC confluence)	SJC002	HAA1	HAA2	HAA3	HAA4	Zone 1 Ditch	HAA5	HAA6	HAA7	HAA8	WNWRP	HAA9	WN Dam	HAA10	Source of water in study area
6/8/2018	dry	flowing	dry	discharging	spilling	wet	dry	dry	dry	dry	dry	dry	dry	discharging	wet	spilling	wet	WRP discharge (SJC, Pomona, WN)
3/29/2018	wet	flowing	dry but recently wet	no flow	spilling	wet	dry	dry	dry	dry	dry	dry	dry	no flow	dry	dry	dry	WRP discharge (Pomona)
12/3/2017	wet	flowing	dry	no flow	spilling	wet	dry	dry	dry	dry	dry	dry	dry	no flow	dry	dry	dry	WRP discharge (Pomona)
3/16/2017	wet	flowing	dry	no flow	trickling	damp	dry	dry	dry	dry	dry	dry	dry	discharging	wet	spilling	wet	WRP discharge (Pomona + WN)
10/18/2016	wet	flowing	spilling (Source: Dalton Wash)	discharging	spilling	spilling	spilling	spilling	wet	wet	wet	dry	dry	no flow	dry (recently wet)	dry	dry	WRPs + CENB-48 import from Dalton being transferred to Zone 1 Ditch
2/2/2016	wet	flowing	wet, turbid, recently spilled	discharging	spilling	spilling	spilling	spilling	damp	wet	wet	damp	wet	no flow?	wet	spilling	wet	WRPs + turbid water from upper SGR - rainfall event on mainstem?
3/24/2015	wet	flowing	spilling (Source: Dalton Wash)	discharging	spilling	spilling	spilling	spilling	dry	wet	wet	wet	wet	no flow?	wet	spilling	wet	WRPs + CENB-48 import from Dalton? Daton wash water appears clean, not turbid.
4/23/2014	wet	flowing	dry	no flow	spilling	spilling	spilling	spilling	dry	wet	wet	dry	dry	discharging	wet	spilling	wet	WRP discharge (Pomona + SJC003)
8/11/2013	dry	flowing	dry	no flow	spilling	spilling	spilling	full	wet	dry	dry	dry	dry	discharging	wet	spilling	wet	WRP discharge (Pomona)
4/16/2013	wet	flowing	dry	discharging	spilling	spilling	spilling	full	wet	dry	dry	dry	dry	no flow	dry	dry	dry	Zone 1 diverting CENB-28 water import via San Jose Creek
9/17/2011	dry	flowing	dry	no flow	spilling	spilling	spilling	full	wet	wet	dry	dry	dry	no flow	dry	dry	dry	Zone 1 diverting CENB-28 water import via San Jose Creek
3/7/2011	wet	flowing	wet, recently spilled (Source: Morris)	discharging	spilling	spilling	spilling	spilling	wet	wet	wet	wet	wet	no flow	wet	spilling	wet	Flow down mainstem SGR from Morris Reservoir
11/14/2009	wet	flowing	dry	discharging	spilling	spilling	spilling	full	wet	dry	dry	dry	dry	no flow	dry	dry	dry	WRP discharge (Pomona)
5/24/2009	dry	flowing	dry	discharging	spilling	spilling	spilling	spilling	dry	wet	wet	wet	wet	no flow?	wet	spilling	wet	WRP discharge (SJC, Pomona, WN)
1/8/2008	wet	flowing	spilling (Source: Dalton Wash)	discharging	spilling	spilling	spilling	spilling	dry	wet	wet	wet	wet	discharging	wet	spilling	wet	WRPs + Dalton Wash

TABLE 2

FLOW CONDITION AND WATER SOURCE FOR THE PROJECT REACH BASED ON GOOGLE EARTH IMAGES OVER THE LAST TEN YEARS

NOTE: Dry season is defined as May 1st to September 30th

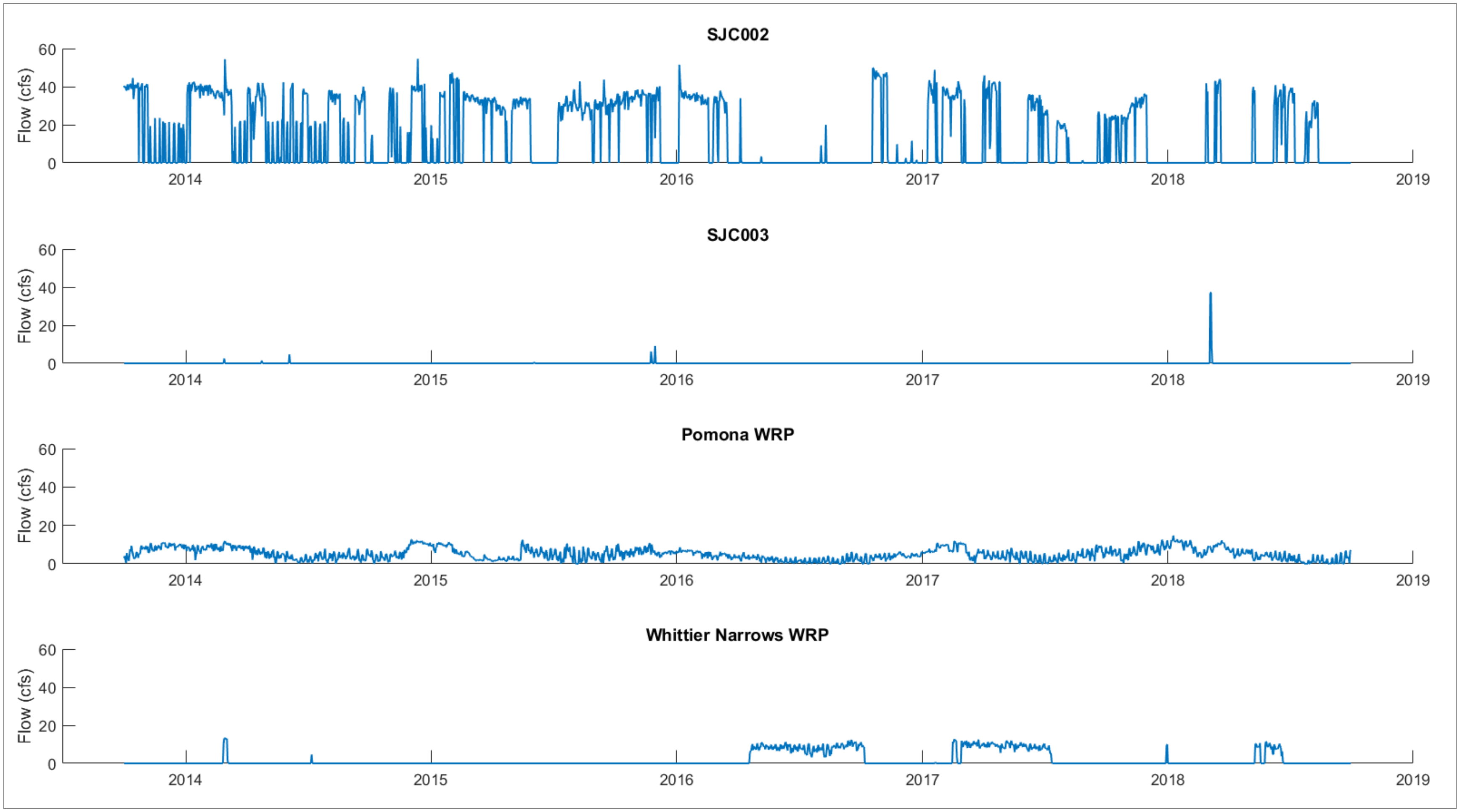


Figure 4
Treated Water Inputs to the San Gabriel River from San Jose Creek,
Pomona and Whittier Narrows WRP Outlets during the Water Year 2014-18 Baseline Period

Figure 5
Model Hydrology Assessment Areas and Nearby Gages

TABLE 3
OPERATIONAL SCENARIOS FOR RELEASING WATER FROM SAN JOSE CREEK WRP UNDER PROJECT CONDITIONS

		Week 1							Week 2							
Operational Scenario	**Description**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**average release MGD**
Existing conditions	9.5 MGD long term average, variable day to day	variable - 9.5 MGD average							variable - 9.5 MGD average							9.5
OS 1a	5 MGD every day from SJC002	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5.0
OS 1b	9 MGD 4 days per week from SJC002	0	0	0	9	9	9	9	9	9	9	9	0	0	0	5.1
OS 1c	15 MGD 2.5 days per week from SJC002	0	0	0	0	0	14	14	14	14	14	0	0	0	0	5.0
OS 2a	5 MGD every day alternating between SJC002 and SJC003	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5.0
OS 2b	9 MGD 4 days per week alternating between SJC002 and SJC003	0	0	0	9	9	9	9	9	9	9	9	0	0	0	5.1
OS 2c	15 MGD 2.5 days per week alternating between SJC002 and SJC003	0	0	0	0	0	14	14	14	14	14	0	0	0	0	5.0

🟦 Water released from SJC002
🟩 Water released from SJC003

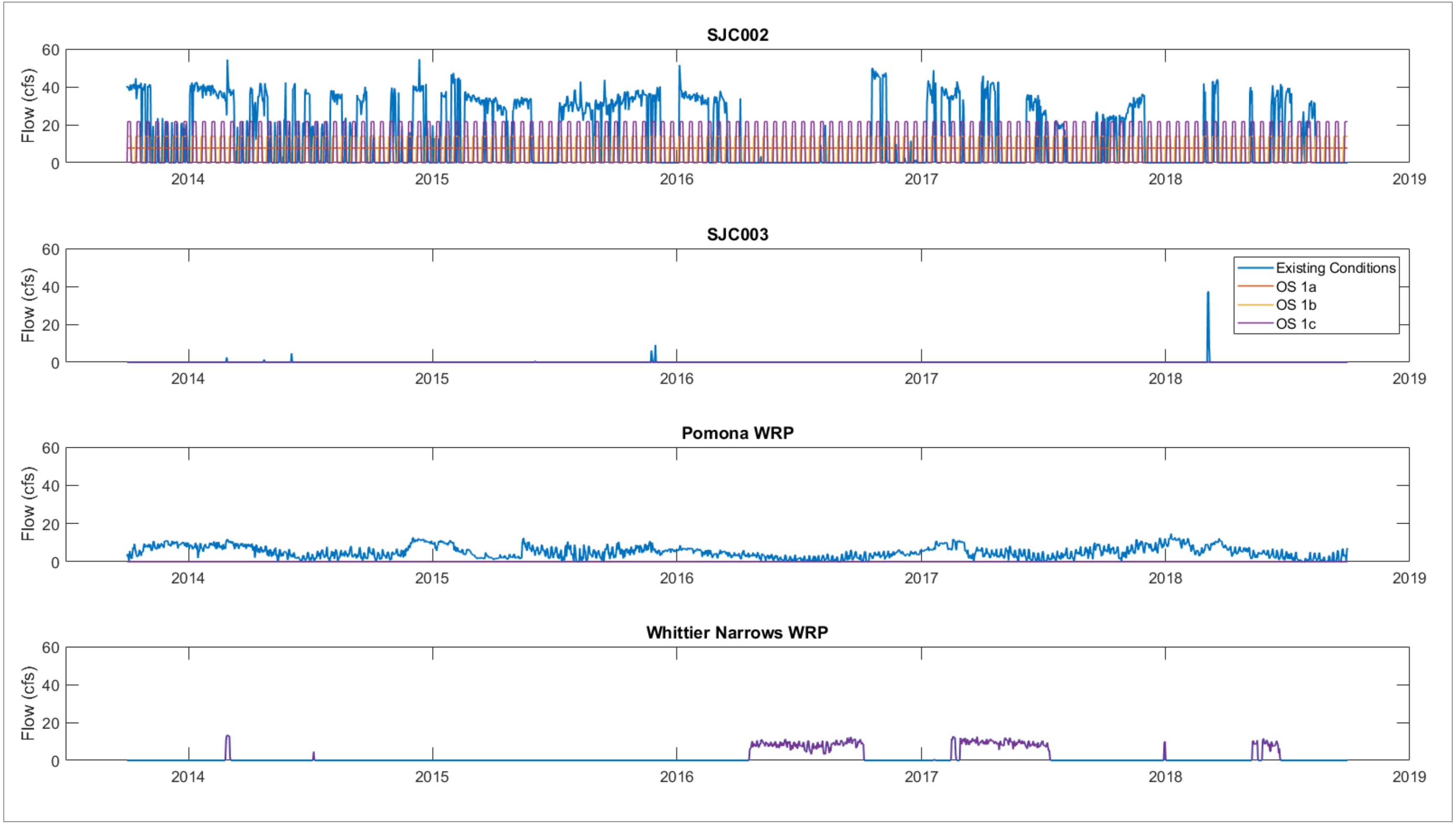


Figure 6
Existing and Project Flow Inputs from the Four WRP Outlets
(Operational Scenarios 1a-c – All SJCWRP Flows Released from SJC002)

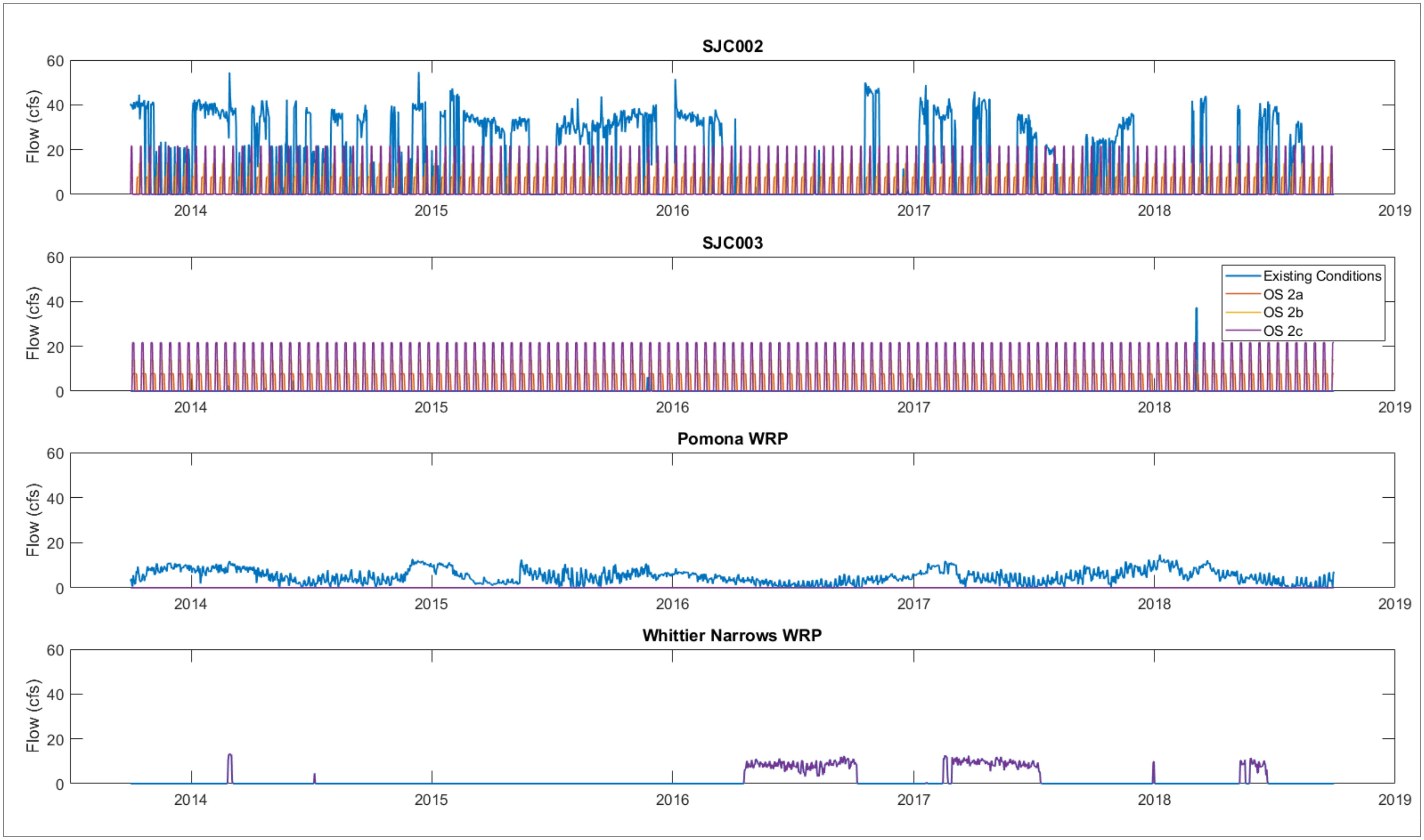


Figure 7
Existing and Project Flow Inputs from the Four WRP Outlets
(Operational Scenarios 2a-c – SJCWRP Flows Alternated Between SJC002 and SJC003)

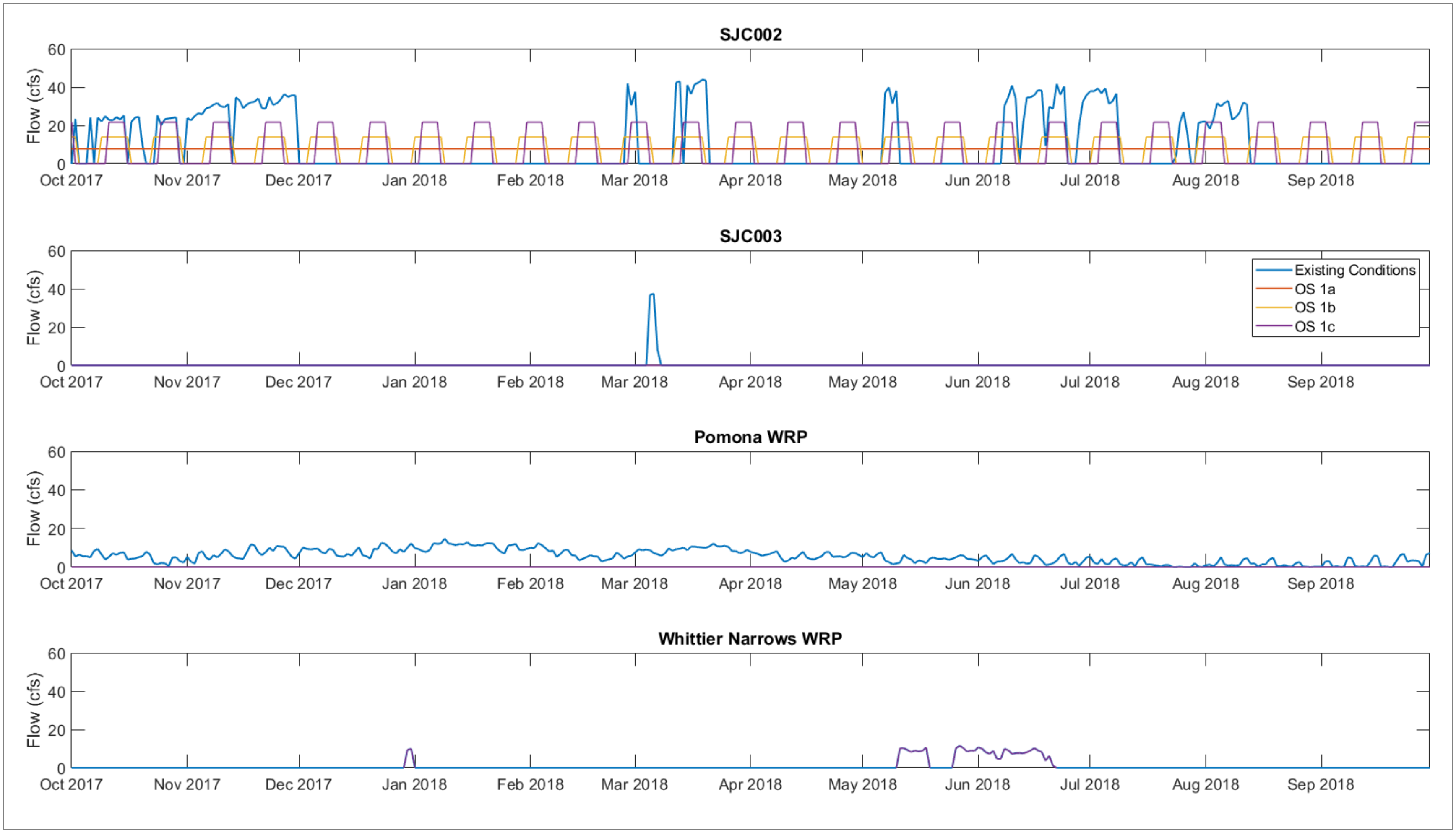


Figure 8
Existing and Project Flow Inputs from the Four WRP Outlets Under Operational Scenarios 1a-c: Expanded View of 2018 Water Year

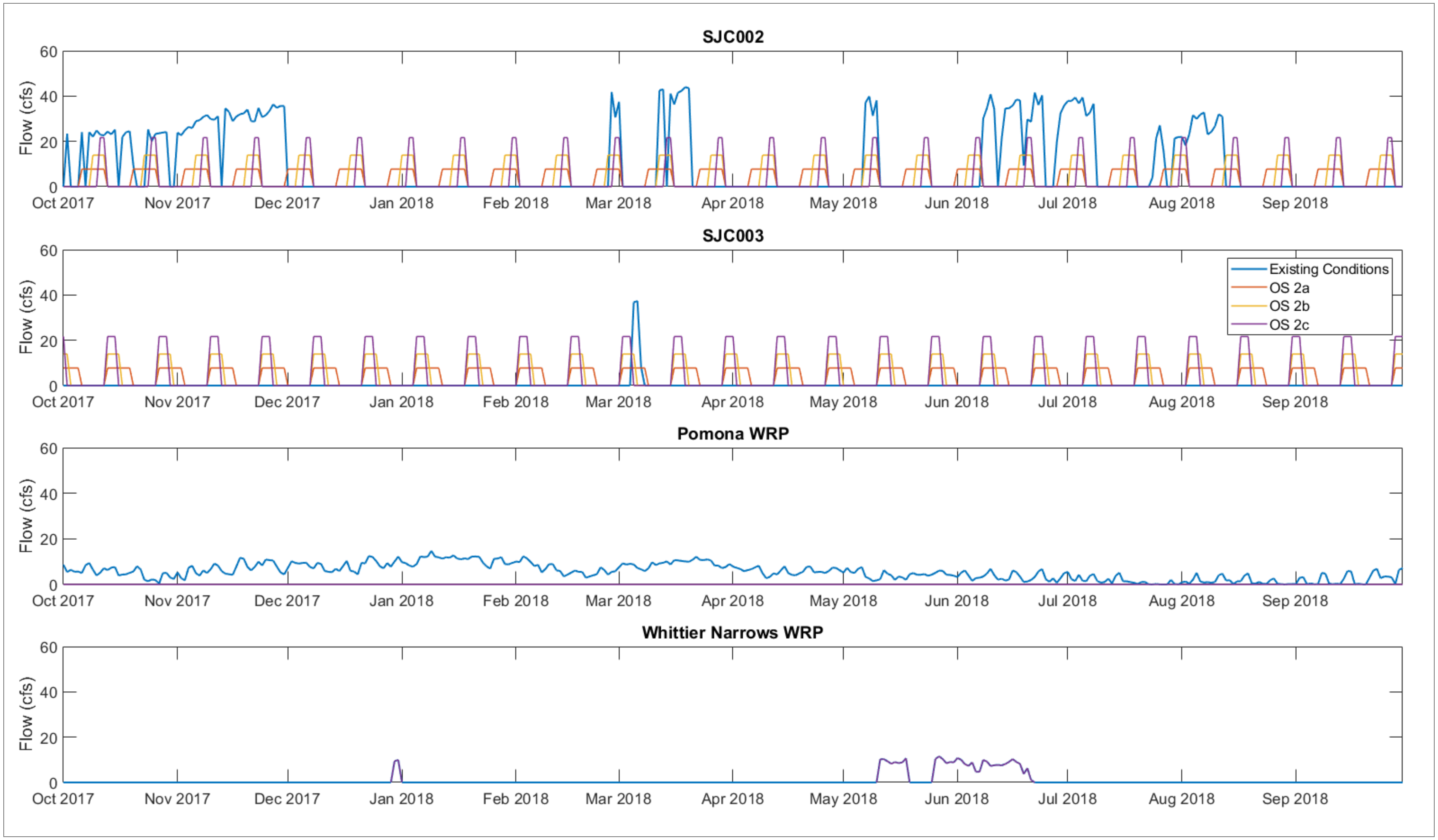


Figure 9
Existing and Project Flow Inputs from the Four WRP Outlets Under Operational Scenarios 2a-c: Expanded View of 2018 Water Year

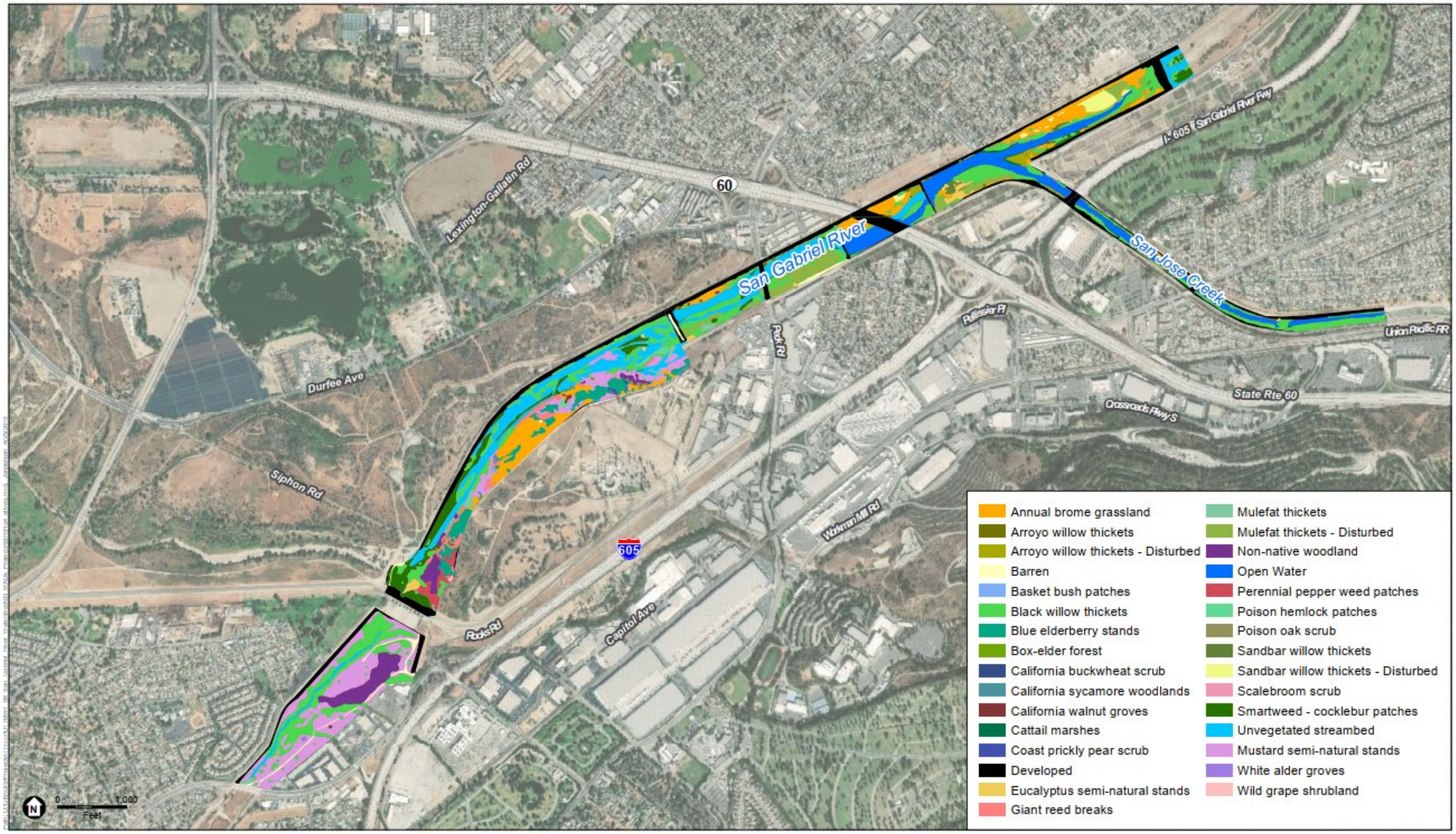


Figure 10

Distribution of Vegetation along the San Gabriel River Study Area

(Source: Chambers Group 2016; Wood, Inc. 2018)

The habitat-elevation model was driven by the observation that vegetation along the San Gabriel River forms distinct elevation bands relative to the channel. For some species (e.g. willow) the bands extend above the channel by a height that matches the typical maximum depth of their root zones, suggesting that they are dependent on seepage from the channel that supports a local wetted zone. Other species (e.g. blue elderberry) grow higher up and occupy areas where their maximum root depth doesn't reach the channel, suggesting that they are sustained by other water sources such as rainfall or less frequent floodplain flows. These two situations are shown schematically in Figure 11 and with data from the HAA5 reach of the San Gabriel River in Figure 12. Vegetation-elevation histograms like the one shown in Figure 12 were produced for all 10 Project reaches by superimposing the 2016 vegetation survey GIS data on a 2016 LiDAR-based elevation model.

For example, as shown in Figure 12, black willows are mostly found in a narrow band between the limit of channel scour and the typical limit of their root zone relative to an elevation that is wetted about one day a week in the dry season. The implication of this distribution is that black willows are dependent on channel flow seeping laterally and wetting their root zones a number of times during the dry season, and that if the hydroperiod is significantly reduced black willow habitat in the 3-10 ft elevational band might be impacted to some degree, ranging from temporary stress to eventual death. By comparison, blue elderberry, sycamore and walnut are mostly found above the 2-year floodplain and below the 10-year floodplain, and the distance to frequently inundated elevations is greater than the typical maximum root zone for these species (see Table 4). We would therefore assume that these species are obtaining water from other sources such as rainfall and occasional floodplain wetting from higher flows such as the two-year flood. These flows would not be affected by the Project, and so we would not expect that habitat to be impacted. By overlaying the frequency and elevation of flows under existing and proposed conditions on the elevation of vegetation, we can estimate Project effects. Because there was not a suitable 'off the shelf' hydrology model that captured the hydrologic processes of interest, the frequency and elevation of flows was estimated using a hydrology model developed specifically for this project.

TABLE 4
MAXIMUM ROOT DEPTH FOR SELECTED RIPARIAN SPECIES

Species	Max root depth (ft)	Notes
Cattail marsh	2	Source: Stromberg 2013, as cited in TNC 2019
Mulefat	2	Source: Stromberg 2013, as cited in TNC 2019
Arroyo willow	7	No data: assumed to be the same as Black willow
Black willow	7	Source: Stromberg 2013, as cited in TNC 2019
Sandbar willow	7	No data: assumed to be the same as Black willow
Blue elderberry	9	Source: Kourik 2015, as cited in TNC 2019; and USDA
California sycamore	6	Source: USDA
Walnut groves	6	Source: Faber 2017, as cited in TNC 2019
Box elder forest	13	Source: Stromberg 2013, as cited in TNC 2019

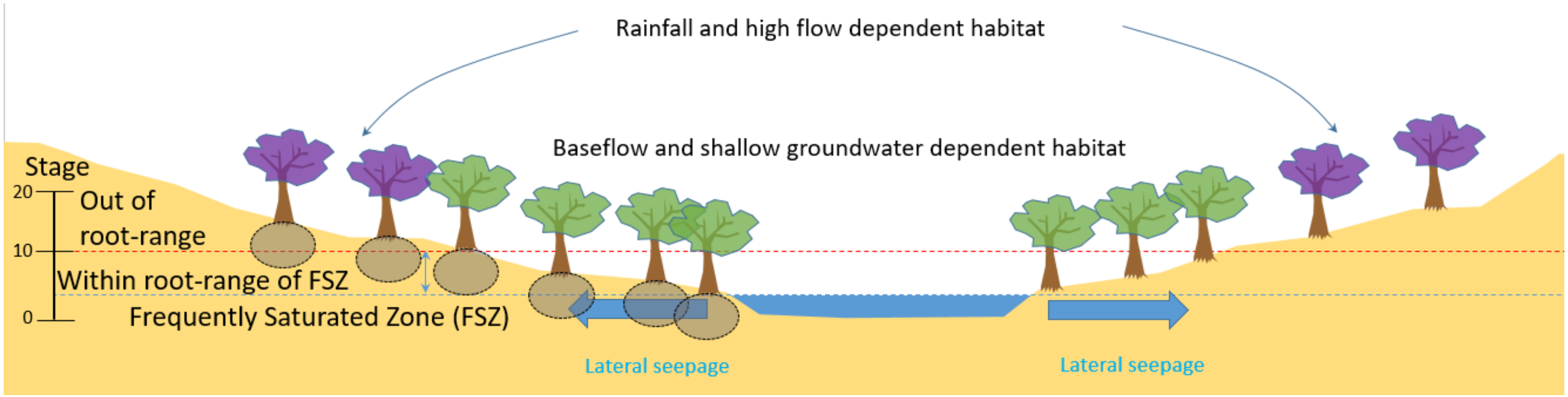


Figure 11
Conceptual Schematic of Vegetation Distribution Relative to Water Sources

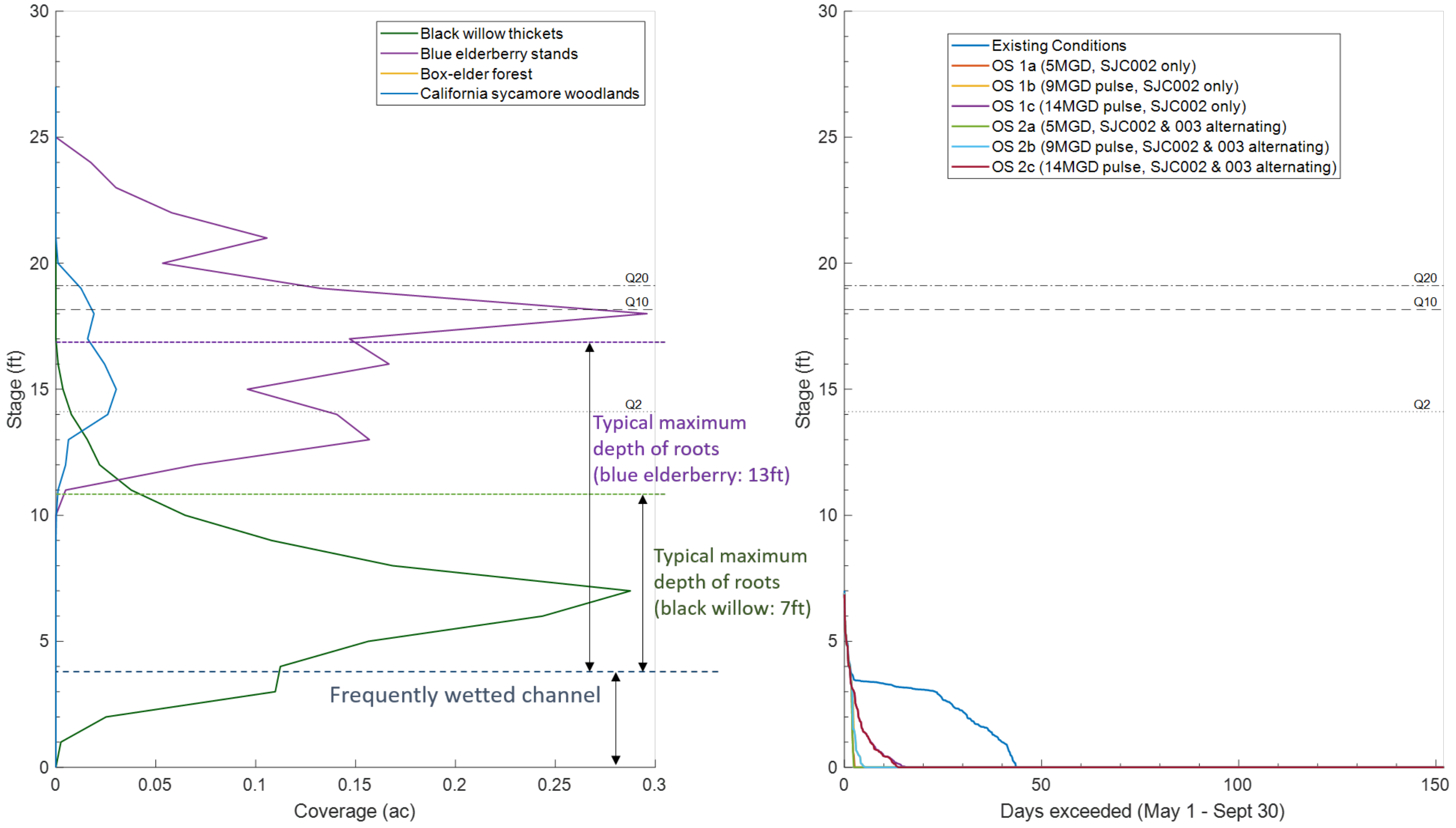


Figure 12

Sample Distribution of Riparian Habitat (left) and Hydroperiod (right) of Different Elevation Bands

The numerical hydrology model divides the San Gabriel River project area into 11 cells referred to as Hydrology Assessment Areas (Figure 5). Cell HAA0 lies upstream of the study area and is used to account for bed percolation losses from tributaries between their gaged locations and the study area. HAA1-4 coincide with the four weir-controlled percolation basins below San Jose Creek, with HAA5-9 subdividing the single long section of river from Zone 1 ditch to the Whittier Narrows dam into a series of similar size cells. HAA10 covers the area of river immediately downstream of Whittier Narrows Dam. For each HAA, a daily water balance was calculated that accounted for water flow in, storage, percolation, and water flow downstream (Figure 13). Evaporation is assumed to be negligible compared to percolation, and is lumped in as a loss with percolation. The model was calibrated by adjusting percolation losses based on measured flow losses between San Jose Creek and the Peck Road USGS gage. The applied percolation loss rate was 1.3 feet per day applied to the area of the low flow channel when wetted. Additional information on the hydrology model and the goodness of fit between observed and modeled conditions is included in the modelling appendix.

Based on the volume of water stored and a stage-storage curve, a daily water surface elevation was calculated. The numerical model was run on a daily timestep for the five-year baseline period (Oct 2013 – Sept 2018) to represent existing conditions, and then re-run for the same period with the WRP inputs modified per the Project description with the six operational scenarios (Table 3). The result was a series of hydrographs for each elevational band under existing and Project conditions. The elevations of the higher flows (2, 10 and 20-year flood event) were estimated using a hydraulic model of the project area and a flow frequency analysis of the Peck Road USGS gage, which lies in the middle of the study area. The hydrology model results were analyzed in three ways: looking at the changes in average discharge over the course of a year, comparing the stage exceedance curves under existing and proposed conditions which focuses on the *volume* of water reaching the root zones of different areas of habitat, and comparing the frequency of wetting around the root zone, which focusses on *periodicity*. All three approaches shed light on how the Project is likely to affect riparian vegetation, and should be considered collectively.

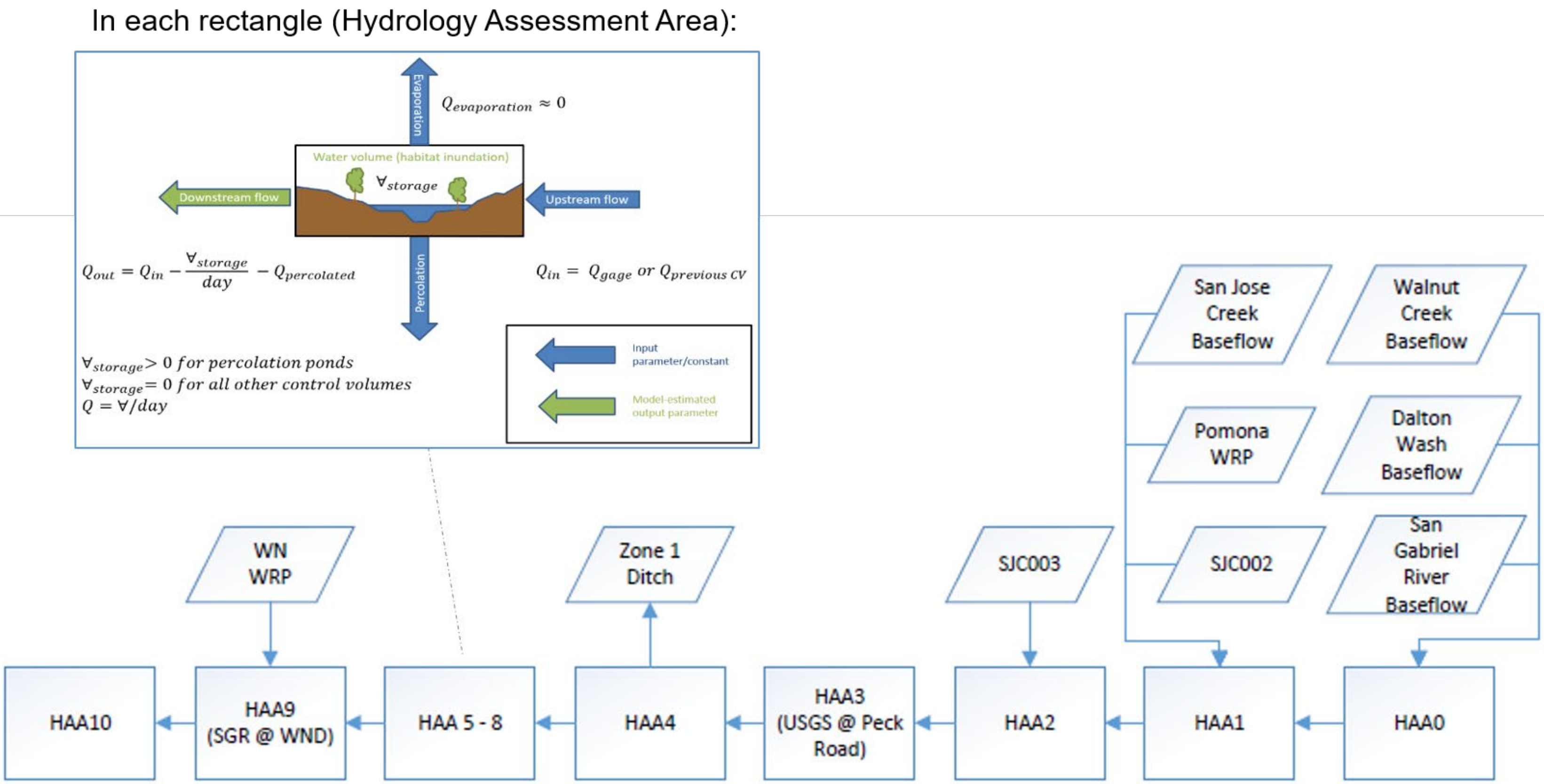


Figure 13
Schematic Representation of the Water Balance Model, Inputs, and Calculations within Each HAA

Change in Discharge On a Monthly Basis

Figure 14 shows how average flow below Peck Road will vary from existing conditions on a monthly basis. For clarity only two operational scenarios are shown, but these bracket the range of results for the different scenarios. The figure shows how flows during the period October through March remain relatively high and are only slightly affected by the Project in percentage terms, but that during the period from April through September the proportional effect is larger.

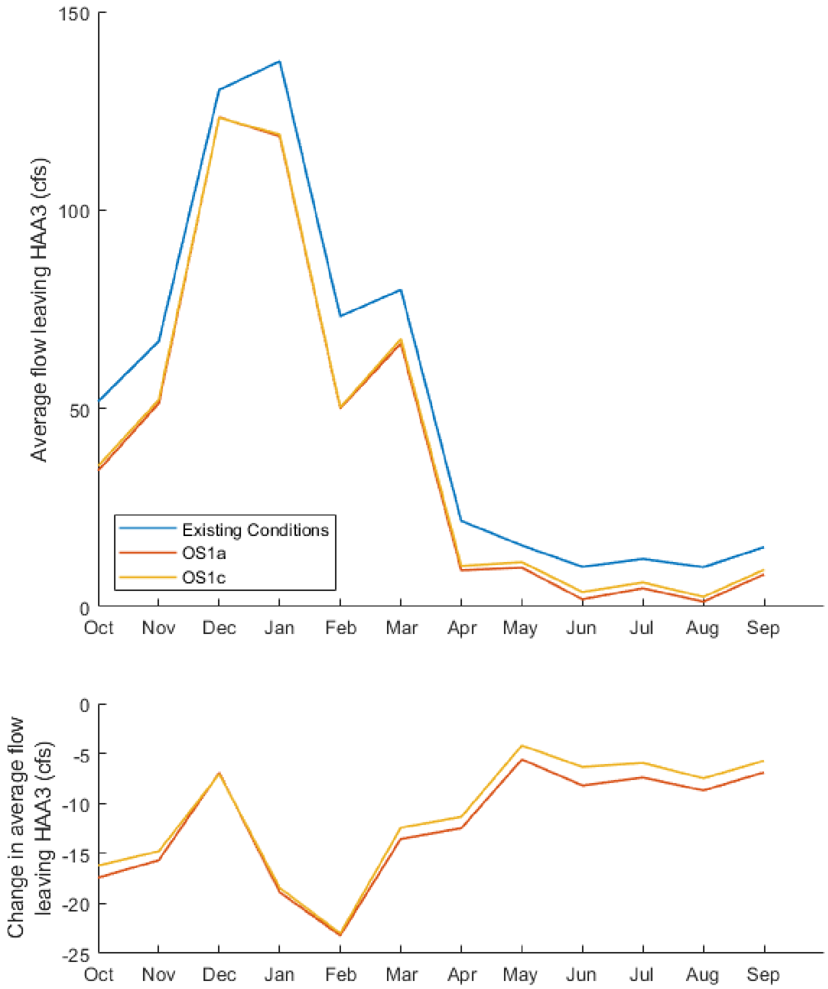


Figure 14
Average monthly flow during the 5 year baseline period under existing conditions and two bookend project Operational Scenarios

Change in Stage-Elevation Exceedance Curve

The stage-elevation exceedance curve describes the number of days a given stage (elevation above the lowest point in the reach) is exceeded over the dry period, and the total volume of water reaching a given point. As such it is a good metric to describe the range of conditions and the average conditions, but it ignores the periodicity of flows (i.e. it ignores the length of dry periods between flows). By overlaying stage-elevation exceedance curves for different operational scenarios it is possible to see the elevations (and by relating that to root length, area of different vegetation species) that are potentially affected by the Project.

Using Figure 12 as an example, the stage-elevation exceedance curve under Project conditions shows drier conditions for the lowest 4 feet of the area, above which the curves for the different operational scenarios converge with the existing conditions curve, meaning that above 4 feet there is no change in the volume or frequency with which soil is wetted. Almost all the black willows in the area are found within their root distance of 4 feet elevation, meaning that they can likely obtain water from the frequently wetted areas around the channel). Therefore, we would consider almost the entire acreage (all black willows between elevation 4 and 11 feet) to be potentially affected by changes in water delivery. By contrast, only blue elderberry below elevation 17 feet are able to ‘feel’ changes in hydroperiod (4 feet of changed hydroperiod plus a maximum root length of 13 feet). Blue elderberry below elevation 17 feet would also be considered potentially affected by changed water delivery, while elderberry above elevation 17 feet would be considered dependent on other water sources not affected by the project. In Table 5 below we report the acreage of each species within the area potentially affected by the project using this approach, along with the change in volume of water delivered during the dry season. Note that this does not imply acreage of habitat impacted: Project effects could be beneficial, neutral or adverse. It simply indicates the acreage of each species that is expected to obtain some of its water supply from the channel of the San Gabriel River within an elevation range that will experience hydroperiod changes as a result of the Project.

TABLE 5
AREA OF HABITAT WITHIN ROOT-REACH OF SAN GABRIEL RIVER CHANNEL SUBJECT TO CHANGES IN HYDROPERIOD

Assessment Area (HAA)	**Vegetation with access to water within the root zone (acres)**									
	Arroyo willow thickets	**Black willow thickets**	**Blue elderberry stands**	**Box-elder forest**	**California sycamore woodlands**	**California walnut groves**	**Cattail marshes**	**Mulefat thickets**	**Sandbar willow thickets**	**Total**
1	8.3	9.7	0.0	0.0	0.0	0.0	0.9	1.1	0.8	20.8
2	0.6	2.3	0.0	0.0	0.0	0.0	0.1	0.1	0.4	3.4
3	0.2	3.8	0.0	0.0	0.0	0.0	0.4	2.6	0.0	6.9
4	0.1	3.9	0.0	0.0	0.0	0.0	0.2	0.9	0.0	5.1
5	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9
6	0.0	1.6	0.0	0.1	0.0	0.0	0.0	0.0	0.0	1.7
7	0.0	1.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	1.6
8	0.0	1.3	0.1	0.0	0.0	0.0	0.0	0.2	0.0	1.6
9	0.0	0.9	0.1	0.0	0.0	0.0	0.1	0.0	0.0	1.1
10	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	4.1
Total										48.1

TABLE 6
CHANGE IN WATER VOLUME TO ASSESSMENT AREAS UNDER DIFFERENT OPERATIONAL SCENARIOS, AND ACREAGE OF HABITAT SUBJECT TO CHANGE

		Operational Scenario					
		1a	**1b**	**1c**	**2a**	**2b**	**2c**
Hydrology Assessment Area	**Acres of habitat in root range**	**Change in water supplied during dry season**					
HAA1	20.8	-26%	-25%	-26%	-41%	-41%	-45%
HAA2	3.4	-36%	-35%	-36%	-36%	-34%	-35%
HAA3	6.9	-48%	-41%	-38%	-47%	-39%	-36%
HAA4	5.1	-59%	-47%	-41%	-59%	-45%	-39%
HAA5	1.9	-63%	-55%	-46%	-64%	-54%	-43%
HAA6	1.7	-62%	-59%	-49%	-62%	-59%	-46%
HAA7	1.6	-58%	-58%	-51%	-58%	-58%	-48%
HAA8	1.6	-53%	-54%	-51%	-54%	-54%	-51%
HAA9	1.1	-36%	-36%	-35%	-36%	-36%	-35%
HAA10	4.1	-35%	-36%	-35%	-36%	-36%	-35%
Weighted flow reduction (flow reduction x acreage)		-19	-17	-16	-22	-20	-20

Note: color indicates degree of water reduction (green lowest to red highest)

The following patterns can be seen from the analysis:

- Most of the riparian habitat that is within root-range of the San Gabriel River (~50%) is within HAA1, with the acreage diminishing downstream until picking up again in HAA10. (Note areas are not the same size.)
- In general, the areas with the most vegetation are also the areas where the least change in flow will occur, and where conditions are least likely to be flow-limited based on the number of flow days per dry season (discussed below). HAA1 and 2 generally see the smallest reductions in flow, and the number of flow days per dry season remains relatively high (around 60-70 days per dry season under most scenarios). HAA9 and 10 receive relatively little water from SJCWRP and PWRP currently, and receive some water from WNWRP and groundwater, so are somewhat buffered from the proposed Project effects.
- HAA3 and 4 are transitional, with some operational scenarios having relatively less effect (e.g. OS1c and 2c) and others having more (1a and 2a).
- HAA5-8 have the least vegetation, but are most affected by the proposed flow reduction. Some pulsed operational scenarios (e.g. 1c and 2c) have a smaller reduction in flow by concentrating water past the percolation ponds, while 1a and 2a have the largest reduction because the proposed flow rates are largely absorbed by the upstream percolation ponds.

- Swapping flow releases from SJC002and SJC003 has some effect (pushing more water downstream) but at a certain level of concentration (e.g. OS 2c with 14 MGD being concentrated and alternated) it may displace impacts from downstream to upstream, where there is more vegetation. If the flow reduction is weighted by the acreage of habitat within root-range, operational scenario 2c appears to offer the best response (most area of vegetation exposed to the smallest reduction in flow).

Changes in the Length of Dry Periods

The stage exceedance analysis is very helpful in identifying *where* and *how much* habitat is potentially affected by changes in the duration and volume of channel flow, and the relative magnitude of those flow changes. However, it ignores the *periodicity* in water delivery and the stress caused by dry periods. For example, it would not distinguish between a scenario in which all the dry season channel flows occurred on consecutive days in May followed by a four-month period of no flow, and a scenario in which channel flows occurred once a week throughout the dry season, which we would assume to be a more favorable pattern for riparian habitat. To analyze the effects of periodicity, we looked at the number of dry days under existing and Project conditions. In this approach we looked at the longest period of zero flow duration in each of the five baseline years and calculated the average. The results are shown in Table 7.

Table 7 clearly shows the increasingly dry conditions downstream from San Jose Creek until the WNWRP under existing conditions. HAA1 and 2 are both very wet, with the average longest dry period less than the shortest recommended watering interval for establishing native plants (14 days). Downstream of HAA2, the duration of dry periods increases, peaking with an average 65-day period of no flow at HAA8 before becoming wetter again due to WNWRP discharges. Based on this table, we would expect the vegetation in HAA3-10 to be under some degree of stress most dry seasons under existing conditions, with a reach-averaged longest drought of 39 days each year.

All the operational scenarios show a reduction in the duration of dry periods in the upstream part of the study reach, with some increase in dry periods downstream (lower part of Table 7). In some operational scenarios there is a net increase in dry periods (as shown by the mean column in the upper table). For example, operational scenarios 1a, 1b, 2a, and 2b all cause a net increase in the number of dry days. However, operational scenarios 1c and 2c show a net reduction in dry days, and thus potentially offer a benefit over existing conditions. The potential benefit occurs because water is released in a more regular pattern, as well as being concentrated to overcome the percolation areas upstream and deliver water downstream.

TABLE 7
DURATION OF DRY PERIODS (PERIODS WITHOUT CHANNEL WETTING) UNDER EXISTING AND PROJECT CONDITIONS

Duration of longest dry period in dry season (average of 5 years) - days											
Operational Scenario	**HAA 1**	**HAA 2**	**HAA 3**	**HAA 4**	**HAA 5**	**HAA 6**	**HAA 7**	**HAA 8**	**HAA 9**	**HAA 10**	**Mean**
Existing Conditions	4	13	25	35	49	58	64	65	35	37	39
OS1a	0	3	21	61	97	109	118	120	66	66	66
OS1b	1	6	8	20	59	105	112	112	66	66	56
OC1c	2	8	9	10	15	33	50	81	65	65	34
OS2a	2	3	6	73	109	122	129	132	66	66	71
OS2b	3	6	7	9	86	105	112	112	66	66	57
OS2c	4	9	9	10	11	12	70	88	65	65	34

>21	Longer than recommended watering interval for establishing plants
14-21	Within range of recommended watering interval
<14	More frequent than recommended watering interval

Change in longest dry period in dry season compared with existing conditions										
Operational Scenario	**HAA1**	**HAA2**	**HAA3**	**HAA4**	**HAA5**	**HAA6**	**HAA7**	**HAA8**	**HAA9**	**HAA10**
OS1a	-4	-11	-4	26	48	50	54	55	31	29
OS1b	-3	-7	-17	-15	10	47	49	47	31	29
OC1c	-2	-5	-16	-25	-34	-25	-14	16	30	28
OS2a	-2	-10	-19	38	60	64	66	67	31	29
OS2b	-1	-7	-17	-26	37	47	49	47	31	29
OS2c	0	-5	-16	-25	-38	-46	6	23	30	28

-45	-30	-20	-5	0	5	20	30	40	50	65
Decrease in length of dry periods			Little change in length of dry periods			Increase in length of dry periods				

Summary of Results and Conclusions

The analysis and modeling has shown that different species of vegetation along the San Gabriel River have unique spatial patterns that closely correspond to elevation above water sources and root zone depth. Species such as black willow are clearly dependent on areas within about 7 feet (a typical maximum root length) of the channel, and as such are sensitive to changes in the frequency and volume of flow down the San Gabriel River which could be affected by the Project flow regime. Other species such as blue elderberry and sycamore occupy higher elevations where the water source appears to be rainfall and infrequent floodplain flows that are not affected by the Project flow regime.

The existing hydrologic regime of the San Gabriel River is highly erratic, for reasons that are both natural (Mediterranean climate) and human-caused (water diversions, percolation pond operation, WRP discharges). While some of the human uses of the river benefit vegetation by providing a dry season water source, they are not currently coordinated to benefit riparian ecology. The proposed Project hydrologic regime, while smaller in volume than existing conditions, can be managed in a more coordinated way.

The stage exceedance analysis and the dry period analysis can be viewed collectively as providing slightly different but complementary insights into how the Project may affect riparian habitat, with several converging lines of evidence. Key conclusions are:

- The upstream percolation areas (HAA1-2) are so well watered that they are unlikely to be impacted by the Project flow reduction (except for operational scenario 2c, which diverts a large enough volume of water downstream of HAA1 to potentially impact habitat).
- Percolation areas HAA3-4 are shown by the stage exceedance analysis as potentially impacted under the uniform 5 MGD flow release operations scenarios (OS 1a and 2a) but generally remain well watered by the concentrated 9 and 14 MGD flow releases (OS 1b and c and 2b and c). The dry period analysis shows the same trend, with OS 1a and 2a creating longer dry periods but the other operational scenarios reducing the length of dry periods.
- Areas HAA5-8 appear to be the most sensitive to Project effects, as shown by both the stage exceedance and dry period analyses. The stage exceedance analysis shows relatively large reductions in flow under all scenarios, with the greatest effect from OS 1a and 2a and a lower impact from more concentrated flow releases. While the dry period analysis supports the finding of potential impact under the 5 MGD and 9 MGD scenarios (OS 1a and b, 2a and b), it shows a net benefit from scenarios OS 1c and 2c, with a net reduction in dry periods. The results are a little ambiguous, with potential for both impact and improvement but a clear support for the most concentrated flow regimes (OS 1c and 2c).
- Areas HAA9-10 may at limited times receive water from Pomona and San Jose Creek WRPs and the Whittier Narrows WRP. The stage exceedance analysis doesn’t show a project impact because the total volume of water reaching this area from upstream is small, but the dry period analysis does show a potential impact, because reducing flows from the upstream WRPs tends to cause drying out from downstream to upstream. These reaches do not appear sensitive to the different operational scenarios.

Synthesizing the results across models and project areas:

- Operational scenarios 1a and 2a (uniform 5 MGD releases, either from SJC002 or alternating between 002 and 003) do not appear to be favorable, and show potential impacts under both the stage exceedance and dry period assessments. This is because a 5 MGD release is mostly percolated in HAA1 and 2 (which are already wet under existing conditions) and does not push water downstream as effectively as the existing flow regime.
- Operational scenarios 1b and 2b (9 MGD released four days out of seven from either SJC002 or alternating between 002 and 003) appear to offset some of the impact potential in the mid reach areas and perform better than OS 1a and 1b, but don’t appear to offer a net benefit in terms of reduced dry periods.
- Operational scenario 1c (14 MGD released for five days every two weeks from SJC002) has the best metrics for both stage exceedance analysis and dry period analysis. This scenario appears to be a good starting point for an adaptive management plan in which flows are controlled and vegetation response monitored.

- Operational scenario 2c (14 MGD released for five days every two weeks alternating between SJC002 and SJC003) has some of the positive traits of OS 1c (slight improvement in length of dry periods over existing conditions) but reduces flow in HAA1 where around 50% of the habitat within root-range of the river is located, potentially creating a risk of habitat impacts. This scenario does not appear as favorable as OS 1c but may be a suitable adaptation to OS 1c if monitoring shows the need to move more water downstream while upstream habitat is performing well.
- HAA1-4 and HAA9-10 appear to be least vulnerable to Project effects provided one of the more concentrated operational scenarios is employed. HAA5-8 appears to be the most vulnerable area, though use of operational scenario 1c appears to have the potential to improve habitat over existing conditions.

Detailed Results

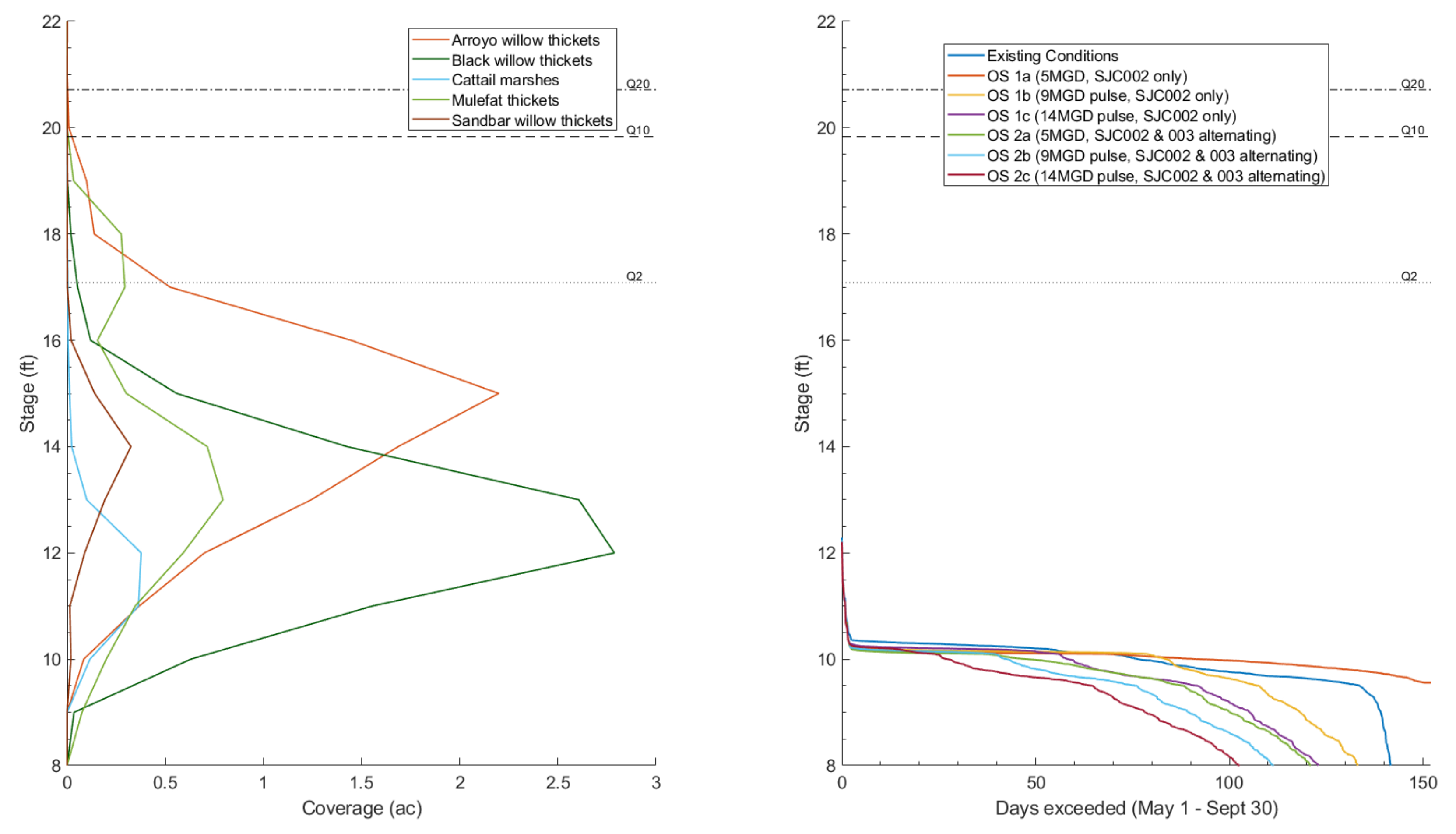


Figure 15
HAA1 Habitat Elevation and Flow Duration

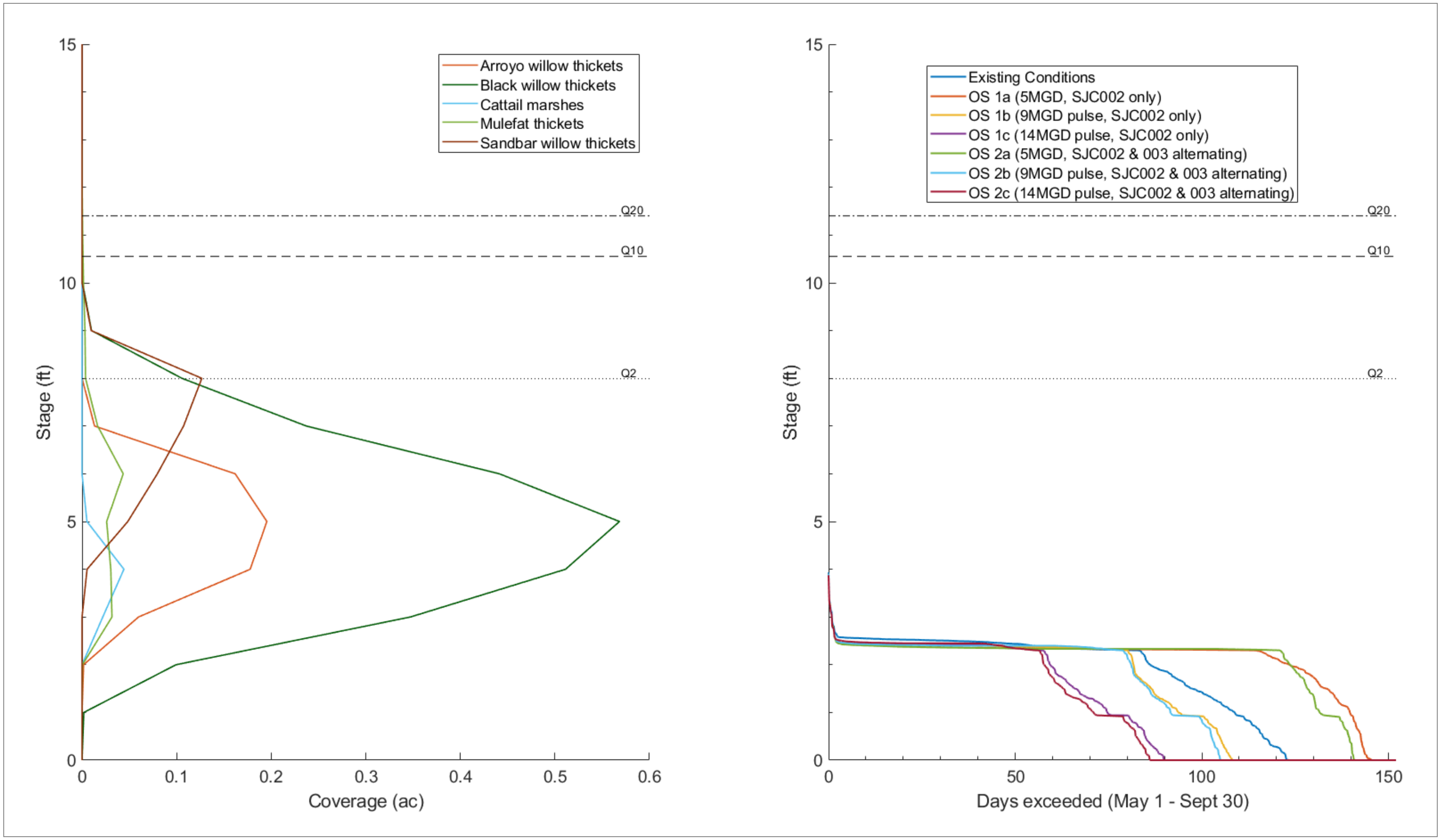


Figure 16
HAA2 Habitat Elevation and Flow Duration

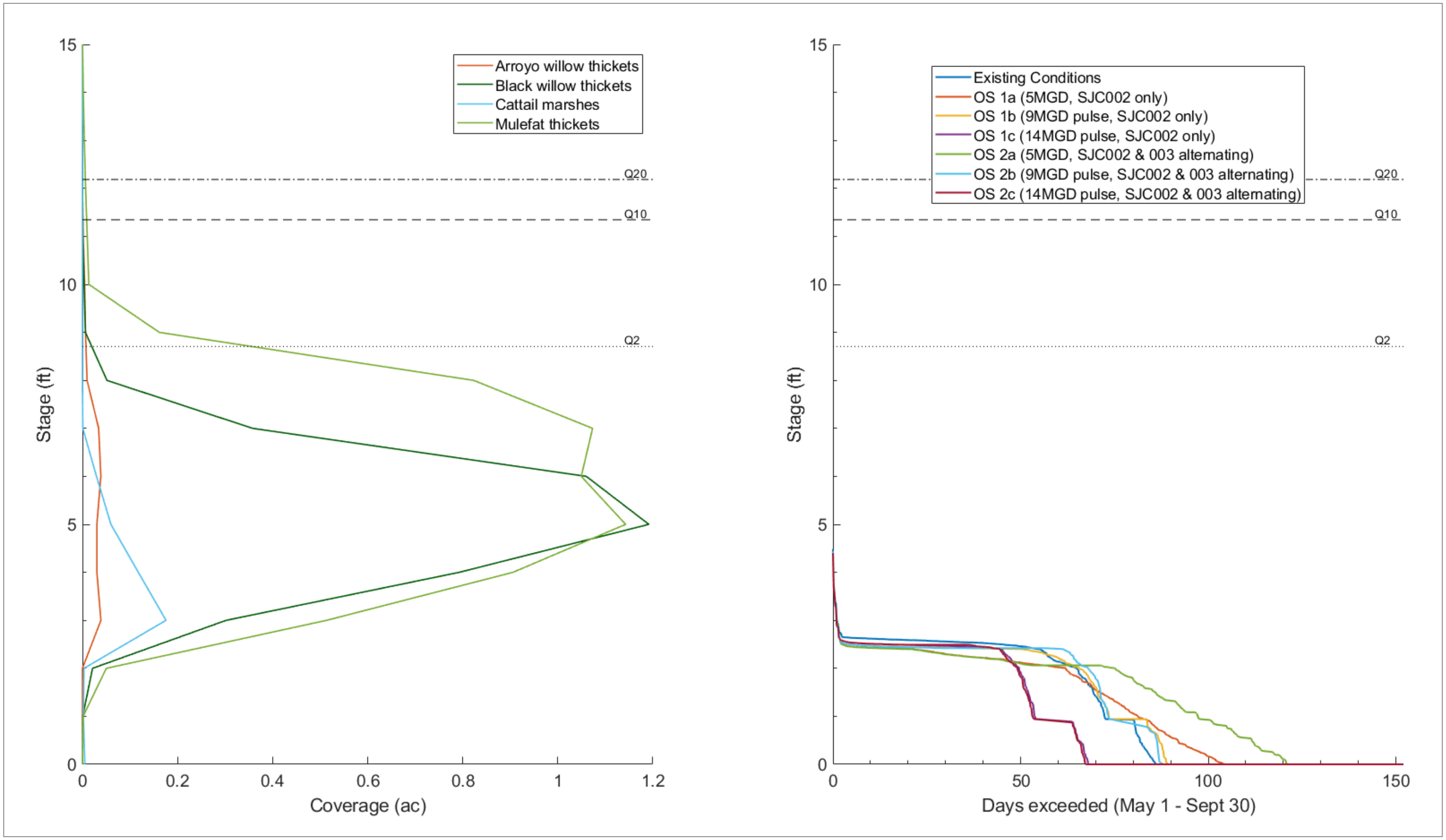


Figure 17
HAA3 Habitat Elevation and Flow Duration

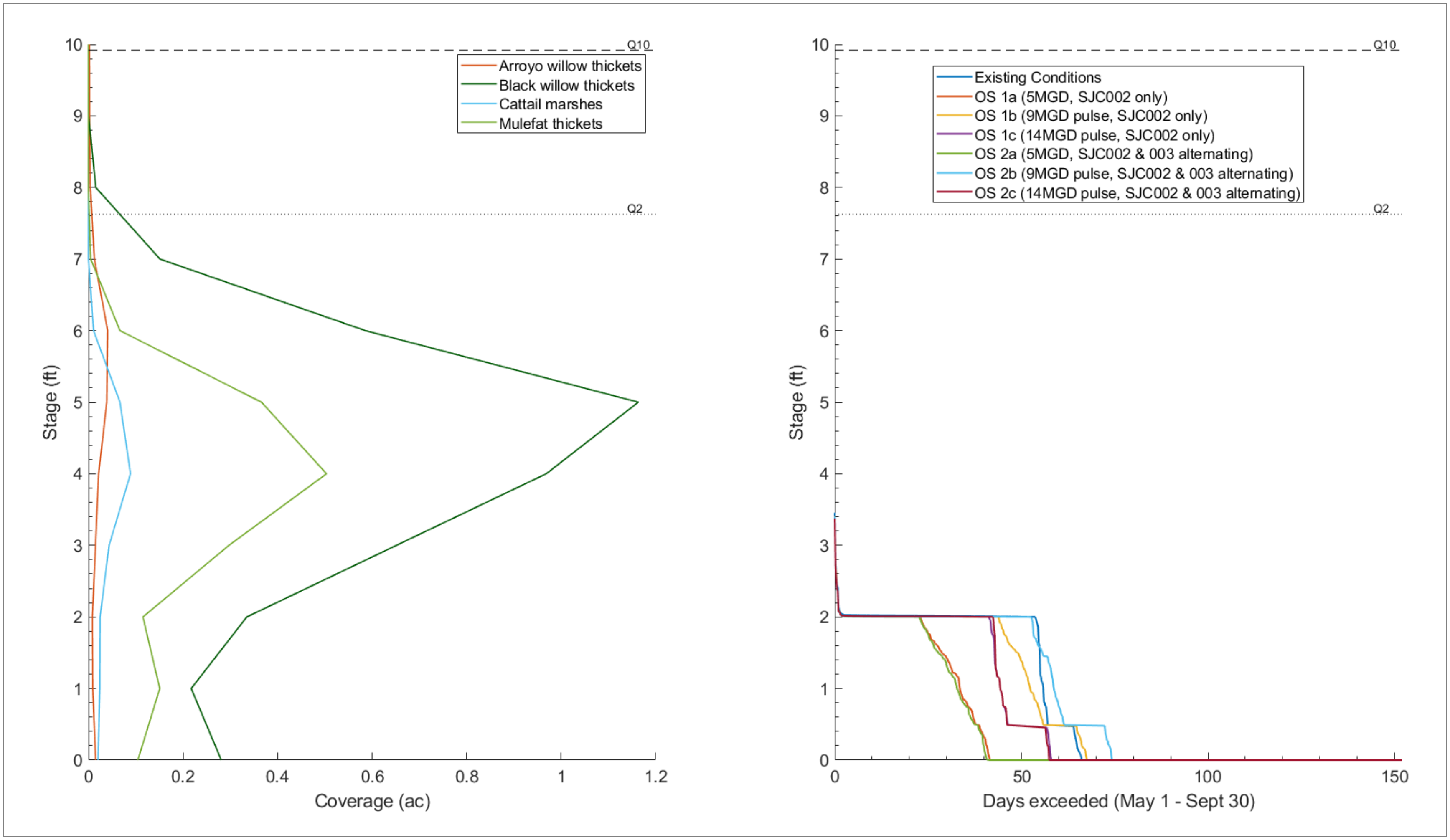


Figure 18
HAA4 Habitat Elevation and Flow Duration

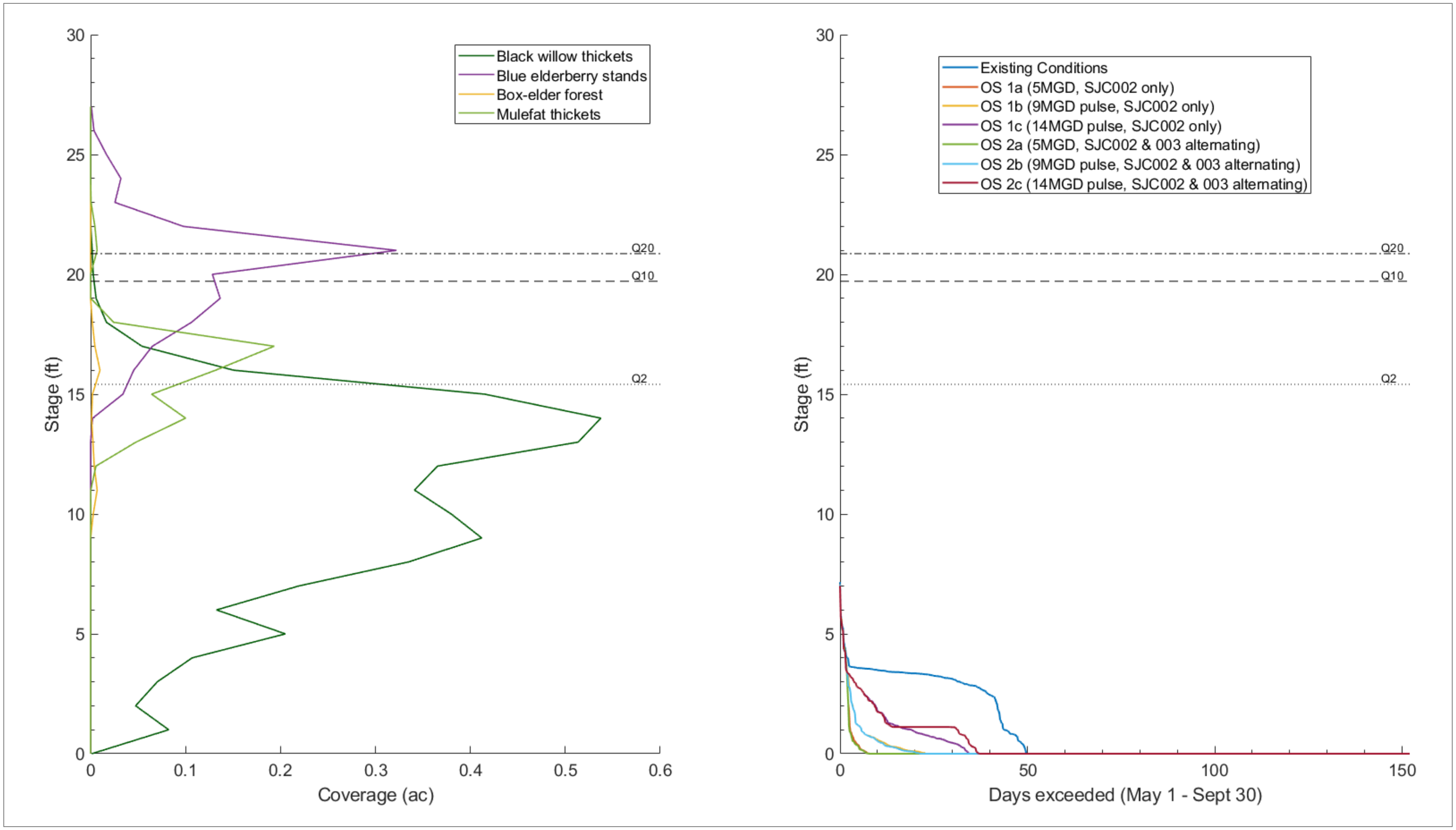


Figure 19

HAA5 Habitat Elevation and Flow Duration

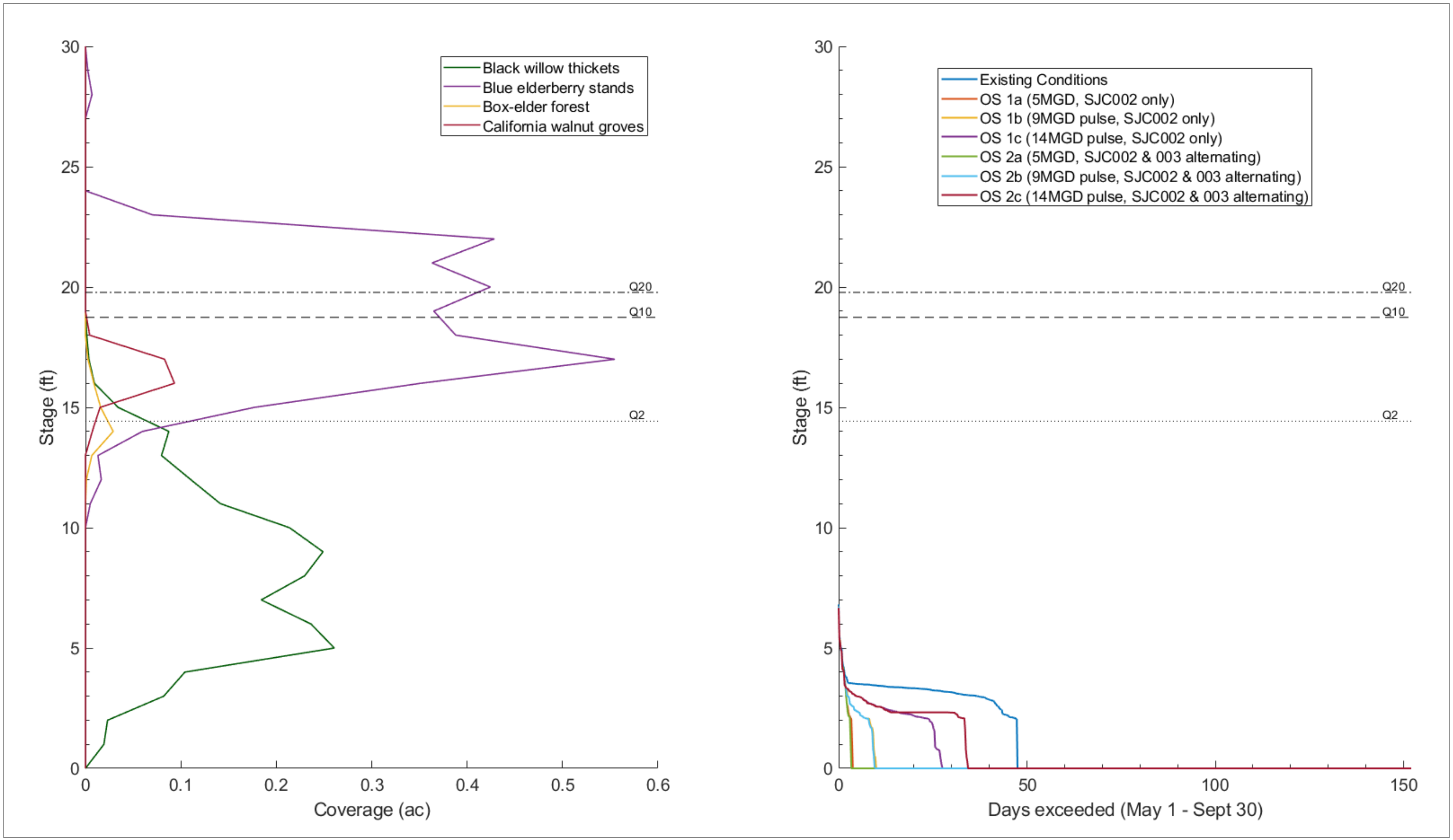


Figure 20

HAA6 Habitat Elevation and Flow Duration

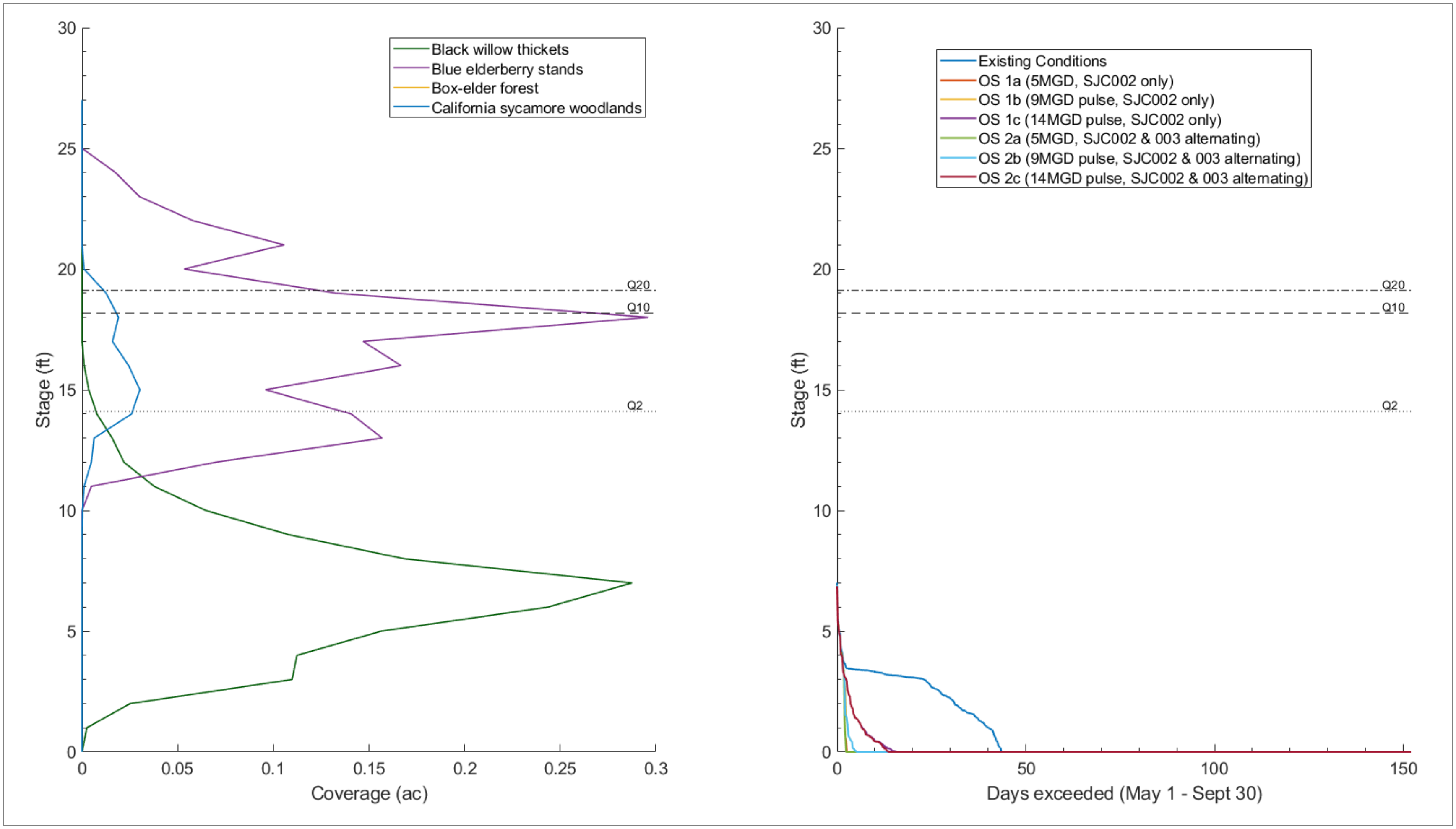


Figure 21
HAA7 Habitat Elevation and Flow Duration

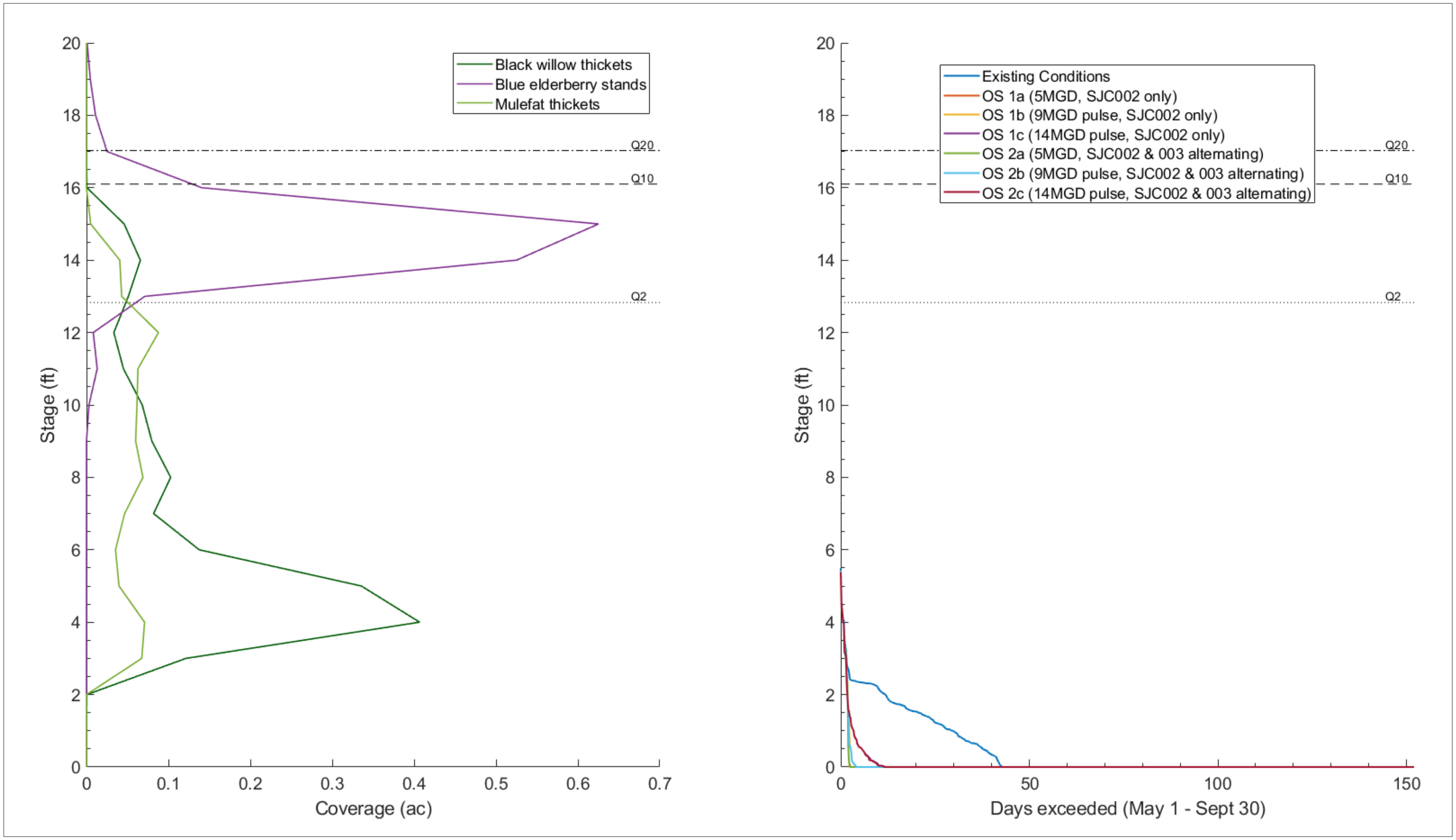


Figure 22
HAA8 Habitat Elevation and Flow Duration

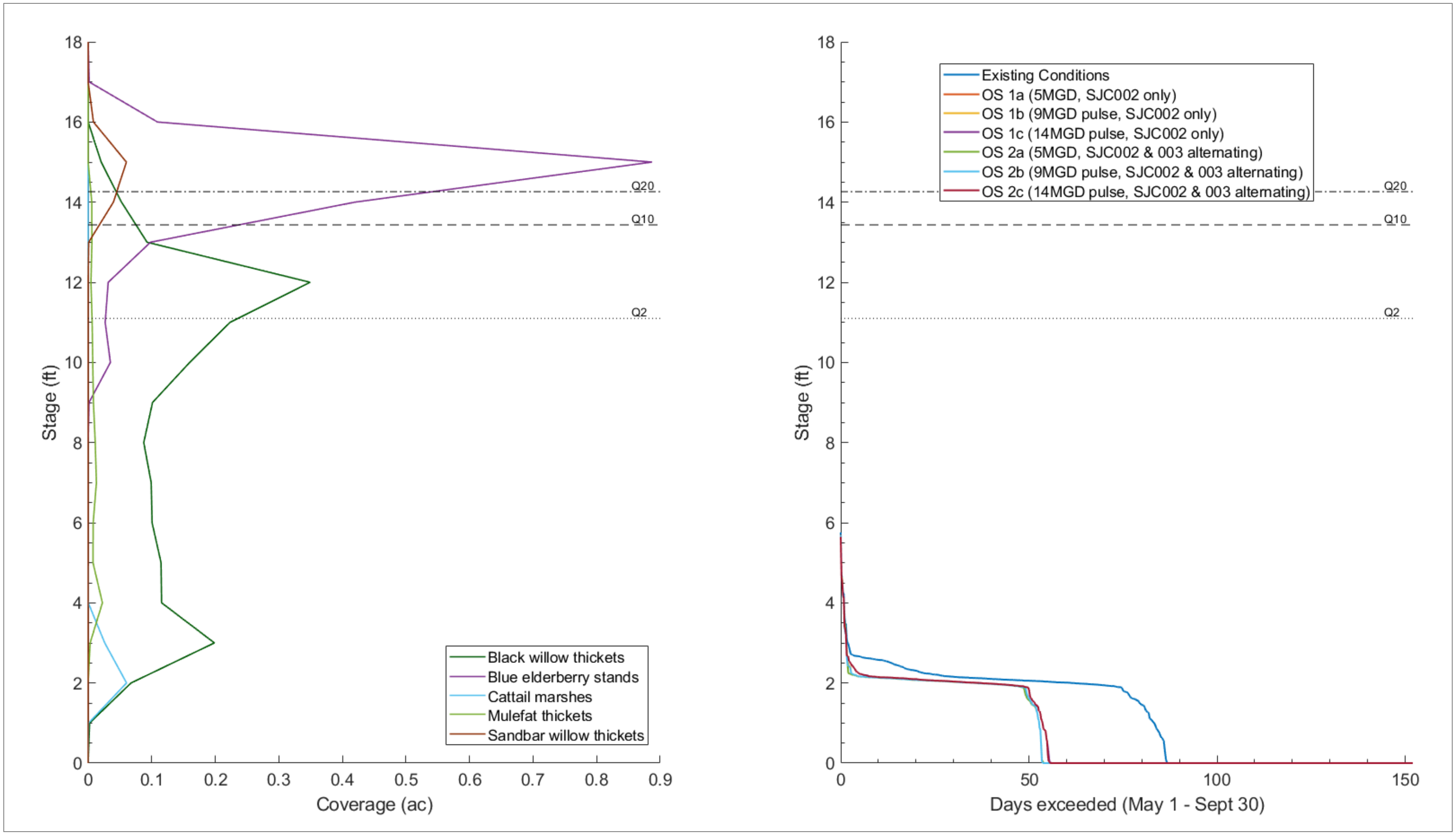


Figure 23
HAA9 Habitat Elevation and Flow Duration

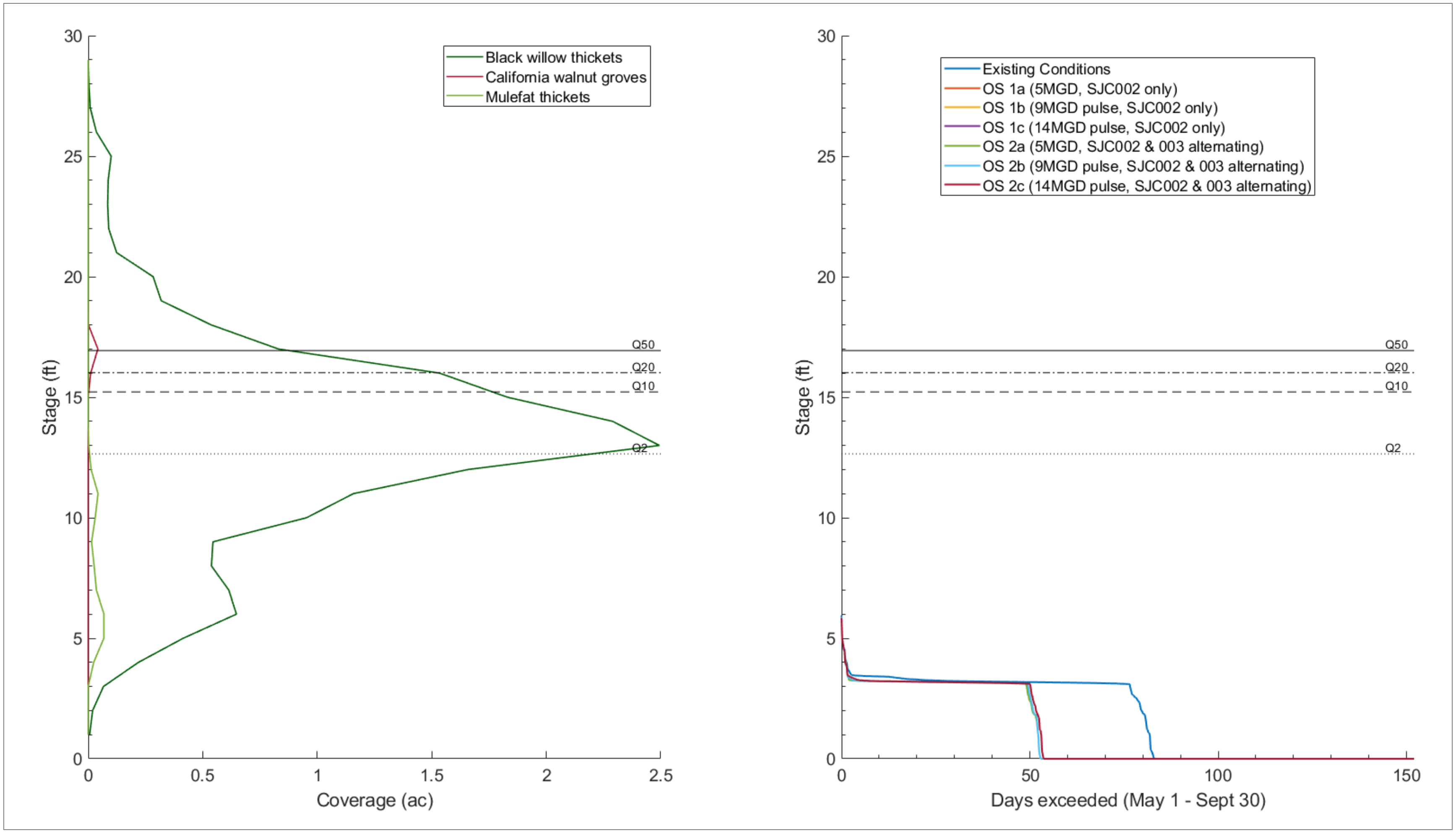


Figure 24
HAA10 Habitat Elevation and Flow Duration

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Appendix E2

Assessing the Effects of the San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse on Downstream Hydrology, Hydrology Report, July 2018

Final

ASSESSING THE EFFECTS OF THE SAN GABRIEL RIVER WATERSHED PROJECT TO REDUCE RIVER DISCHARGE IN SUPPORT OF INCREASED RECYCLED WATER REUSE ON DOWNSTREAM HYDROLOGY

Hydrology Report

Prepared for

Sanitation Districts of Los Angeles County

July 2018

Final

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Hydrology Report

Prepared for

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CHAPTER 1

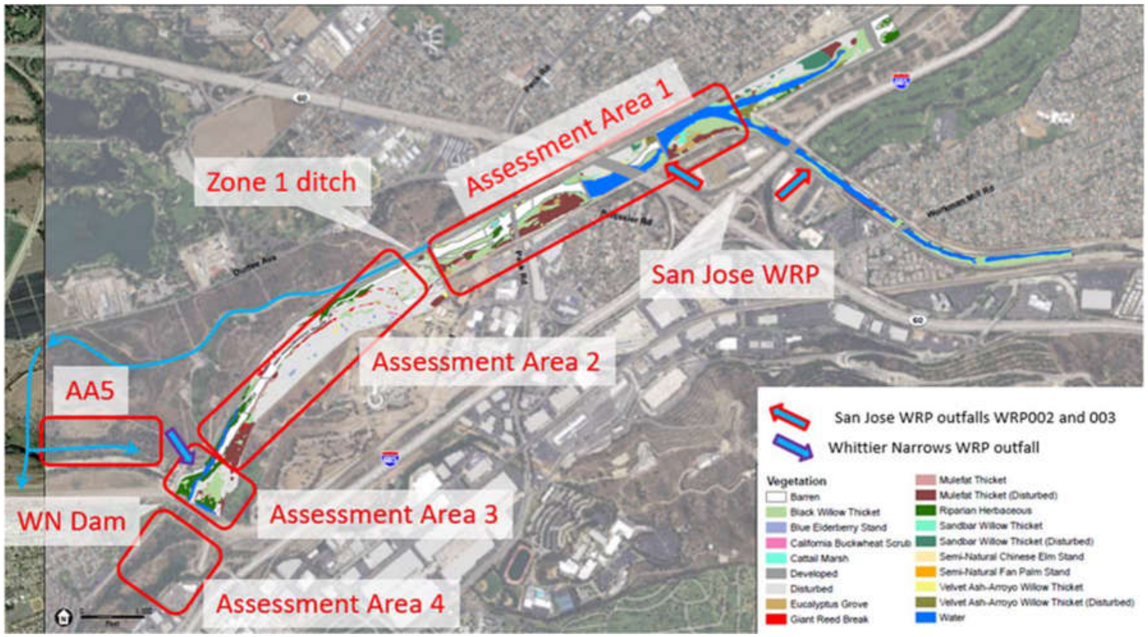
Project Background

Introduction

Environmental Science Associates (ESA) has prepared this report to evaluate a planned Section 1211 Wastewater Change Petition to be submitted by the Sanitation Districts of Los Angeles County (District) for proposed reductions in the rate and volume of recycled water discharged to surface flow from the San Jose Creek, Pomona, Whittier Narrows, Los Coyotes and Long Beach Water Reclamation Plants (WRPs). The District's project is the San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse (Project). This memorandum focuses on hydrologic conditions within five distinct Habitat Assessment Areas within 2.5 miles of San Jose Creek WRP where potential riparian habitat that supports least Bell's vireo has been mapped, and on the concrete channel reach that extends from the San Gabriel Coastal Basin Spreading Grounds to the San Gabriel River estuary. The five Habitat Assessment Areas are: 1) San Jose Creek WRP Outfalls to San Gabriel River at Zone 1 ditch; 2) San Gabriel River at Zone 1 ditch to Whittier Narrows WRP Outfall; 3) Whittier Narrows WRP outfall area; 4) San Gabriel River below Whittier Narrows Dam; and 5) Zone 1 ditch (Rio Hondo Diversion) from San Gabriel River to Rio Hondo (Figure 1). The existing and proposed operation of the relevant WRPs is provided in the Initial Study Project Description, and briefly summarized below, followed by a discussion of existing conditions related to surface hydrology and groundwater in the five Assessment Areas identified above.

To support water reuse projects planned by water supply agencies, the District is planning for a reduction of recycled water discharged into San Jose Creek and San Gabriel River to an approximate monthly average of 5 Million Gallons per Day (MGD) or 5,604 Acre-Feet per Year (AFY) or 7.7 cubic feet per second (cfs) at the San Jose Creek WRPs, with the remaining treated wastewater being conveyed for recharge in support of the Water Replenishment District of Southern California's (WRD) Groundwater Reliability Improvement Project (GRIP). In addition, flow reductions to support recycling are proposed from Pomona WRP (assessed as a separate cumulative impact to the San Jose Creek WRP reductions in the assessment of the five Habitat Assessment Areas). Finally, flow reductions to support recycling are proposed for Los Coyotes WRP and Long Beach WRP. These WRPs discharge water to concrete reaches of the San Gabriel River and Coyote Creek (a tributary of the San Gabriel River).

This report characterizes the existing conditions of the San Gabriel River watershed and groundwater basin and is intended to provide the California Department of Fish and Wildlife (CDFW) and other interested parties with context for evaluating potential effects associated with the proposed discharge reductions. Note that while wastewater plant operations and water rights applications typically use MGD or AFY, instream flow studies typically use cubic feet per second (cfs). In this report all water balance analyses are described in cfs, where 1 MGD equals 1,125 AFY and 1.55 cfs.



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 1
Habitat Assessment Areas and WRP Discharge Locations

Because riparian habitat in the Assessment Areas is influenced by a wide range of naturally varying factors (e.g. flooding, droughts) as well as human factors that are outside the District's control (e.g. water diversions, recharge operations, channel maintenance) the District has developed an Adaptive Managing Plan (AMP), which is described in detail (Amec Foster Wheeler 2018) and summarized below. Under the AMP the District will release sufficient water from San Jose Creek WRP into the upper boundary of Assessment Area 1 to supply the evapotranspiration needs of the habitat. This has been initially set to be a monthly average of 5 MGD (5,604 AFY) at the confluence of San Jose Creek with the San Gabriel River, but will be subject to riparian health monitoring triggers (described in the AMP) and, if needed, modified to sustain habitat.

Three potential future conditions were analyzed and water budgets for the Habitat Assessment Areas developed:

- Project Condition 1 (San Jose Creek WRP reduction only) assessed the water budget assuming that discharges from San Jose Creek WRP were reduced to a monthly average of 5 MGD (5,604 AFY, 7.7 cfs) (flows may be increased and decreased around this average, for example to send "pulses" of water to inundate selected habitat areas).
- Project Condition 2 (All WRPs) assessed a water budget that included the San Jose Creek WRP reduction and the effects of additional discharge reductions at Whittier Narrows WRP (subject to Wastewater Change Petition WW0098) and Pomona WRP (for which a Wastewater Change Petition is being prepared but has not yet been submitted). A Wastewater Change Petition is filed to the Division of Water Rights by wastewater treatment plant

owners seeking to reduce the volume or change the location of their treated discharge. The Petition describes the existing and proposed monthly discharge volume. Wastewater Change Petition WW0098 is the petition for Whittier Narrows WRP.

- Cumulative Condition which included all the above project effects, plus removal of imported water (to show the effects of the projects if water imports are discontinued in future).

Estimated Water Needs of Riparian Habitat

The water budget below has been assessed in the context of the water needs to support existing biological resources within and adjacent to the channel of the San Gabriel River. Biological resources within the Assessment Areas have recently been evaluated (Chambers Group 2016). This section provides a summary of the existing biological resources within the Assessment Areas, with a focus on the status of the federally and state listed endangered least Bell's vireo (*Vireo bellii pusillus*) and its habitat. The least Bell's vireo has been documented as recently as 2015 in the Assessment Areas.

The San Jose Creek and San Gabriel River channels within the Assessment Areas have concrete walls and "soft" (i.e., soil) bottoms. Weirs spanning the San Gabriel River channel are also present within the Assessment Areas. Vegetation communities present within the Assessment Areas include the following associations, as defined by Sawyer et al. (2009):

- Black Willow/Mule Fat
- Disturbed Black Willow/Mule Fat
- Cattail Marsh
- Giant Reed Break

The District's plan to discharge sufficient water to support existing riparian vegetation in the Assessment Areas as described in the AMP. To provide data for the AMP, the water needed to maintain evapotranspiration for the mapped riparian habitat has been calculated (Amec Foster Wheeler 2018). Water demand ranges from a high of 0.907 MGD (1.4 cfs) in the dry season to a low of 0.21 MGD (0.3 cfs) in the wet season (**Table 1**). It has been estimated that in order to supply the required water to the root zones of the riparian habitat, approximately five to ten times this volume should be discharged near San Jose Creek WRP, to allow for percolation and evaporation losses downstream. Based on this analysis, the District's plan to release an average monthly flow of 5 MGD (5,604 AFY, 7.7 cfs) from the two San Jose Creek WRP outfalls near the confluence of San Jose Creek and the San Gabriel River. As described in the AMP, the health of riparian vegetation in the Assessment Areas will be monitored and, if vegetation appears to become more moisture-stressed than under existing conditions as a result of flow reductions by the District, flows will be increased adaptively.

TABLE 1
RIPARIAN WATER DEMANDS

Month	ET (in)	%	gal/mo	gal per day	MGD	AF/d
Jan	1.75	4%	7,689,840	248,059	0.248	0.762
Feb	1.76	4%	7,733,782	249,477	0.249	0.766
Mar	4.28	9%	18,807,151	606,682	0.607	1.863
Apr	5.55	12%	24,387,777	786,702	0.787	2.415
May	5.31	11%	23,333,171	752,683	0.753	2.311
Jun	5.22	11%	22,937,693	739,926	0.740	2.272
Jul	6.4	13%	28,122,842	907,188	0.907	2.785
Aug	5.98	12%	26,277,281	847,654	0.848	2.602
Sept	4.63	10%	20,345,119	656,294	0.656	2.015
Oct	3.26	7%	14,325,073	462,099	0.462	1.419
Nov	2.34	5%	10,282,414	331,691	0.332	1.018
Dec	1.48	3%	6,503,407	209,787	0.210	0.644
Total	**47.96**	**100%**	**210,745,550**	**0.567**	**1.739**	

SOURCE: Amec Foster Wheeler, 2018

Treated Wastewater Discharge Practices

The Sanitation Districts are a public agency created under state law to manage wastewater and solid waste on a regional scale and consist of 24 independent special districts serving approximately 5.6 million people in Los Angeles County (County). The Sanitation Districts' service area covers approximately 850 square miles and encompasses 78 cities and unincorporated territory within the County. The Sanitation Districts operate 10 WRPs and the Joint Water Pollution Control Plant. Seventeen sanitation districts provide sewerage services in the metropolitan Los Angeles area are signatory to a Joint Outfall Agreement that provides for the regional, interconnected systems of facilities known as the Joint Outfall System (JOS). The service area of the JOS encompasses 73 cities and unincorporated territory, providing sewage treatment, reuse, and ocean disposal for residential, commercial, and industrial wastewater. Under the Joint Outfall Agreement, Sanitation District No. 2 of Los Angeles County (District) has been appointed managing authority over the JOS. This report focuses on discharge practices that affect the Assessment Areas depicted on Figure 1. WRPs operated by the District and located in the general vicinity of the Assessment Areas include: Pomona, San Jose Creek, and Whittier Narrows, which are described below.

San Jose Creek WRP

The San Jose Creek WRP, located at the San Jose Creek/San Gabriel River confluence, consists of two, independently operated treatment units, one on the east side of I-605 (i.e., SJCE) and one on the west side of I-605 (i.e., SJCW). The San Jose Creek WRP has a combined treatment capacity of 100 MGD (112,089 AFY, 155 cfs).

The San Jose Creek WRP has five total surface water discharge points. SJCE can discharge directly into San Jose Creek via an outfall near the northeast portion of the plant (SJC002), while SJCW can discharge directly into San Gabriel River via an outfall near the southwest portion of the plant (SJC003). In addition, both SJCE and SJCW can contribute flow to the San Jose Creek Outfall pipeline and discharge to the San Gabriel River via three downstream outfalls (SJC001A, SJC001B, and SJC001). These downstream outfalls are beyond the scope of the hydrological analyses presented herein as SJC001A and SCJ001B discharge to managed reaches of the river that are cleared and SJC001 discharges to the concrete lined channel upstream of the Los Coyotes WRP, which is mostly dry; therefore, discharge at these locations is referenced for general operational context only.

The San Jose Creek WRP has been providing recycled water for groundwater recharge at the Montebello Forebay Groundwater Recharge Project (MFGRP) since the plant began operating. Recycled water from the San Jose Creek WRP is recharged at the following locations: San Gabriel Coastal Spreading Grounds (SGSG), Rio Hondo Spreading Grounds (RHSG), and in the San Gabriel River through the use of inflatable rubber dams located in unlined portions of the river. Recycled water that is used for recharge in the MFGRP can be delivered at six different locations: (1) flow into San Jose Creek at Discharge Point SJC002; (2) flow into the San Gabriel River at Discharge Point SJC003; (3) flow diverted into the SGSG from the San Jose Creek Outfall pipeline (at diversion points SGSG B1 and SGSG B2); flow from both Discharge Point SJC001A (4) and SJC001B (5) can percolate in the unlined San Gabriel River behind existing rubber dams; and (6) flow from Discharge Points SJC002 and SJC003 can be diverted from the San Gabriel River through the Zone 1 Ditch to the RHSG. Flow discharged into the San Gabriel River at Discharge Point SJC001 is not recharged and ultimately flows to the ocean since this is a lined channel. Recycled water flowing down the unlined channels that does not infiltrate into the subsurface or otherwise get diverted into the recharge basins will reach the lined portion of the river and ultimately flow into the ocean.

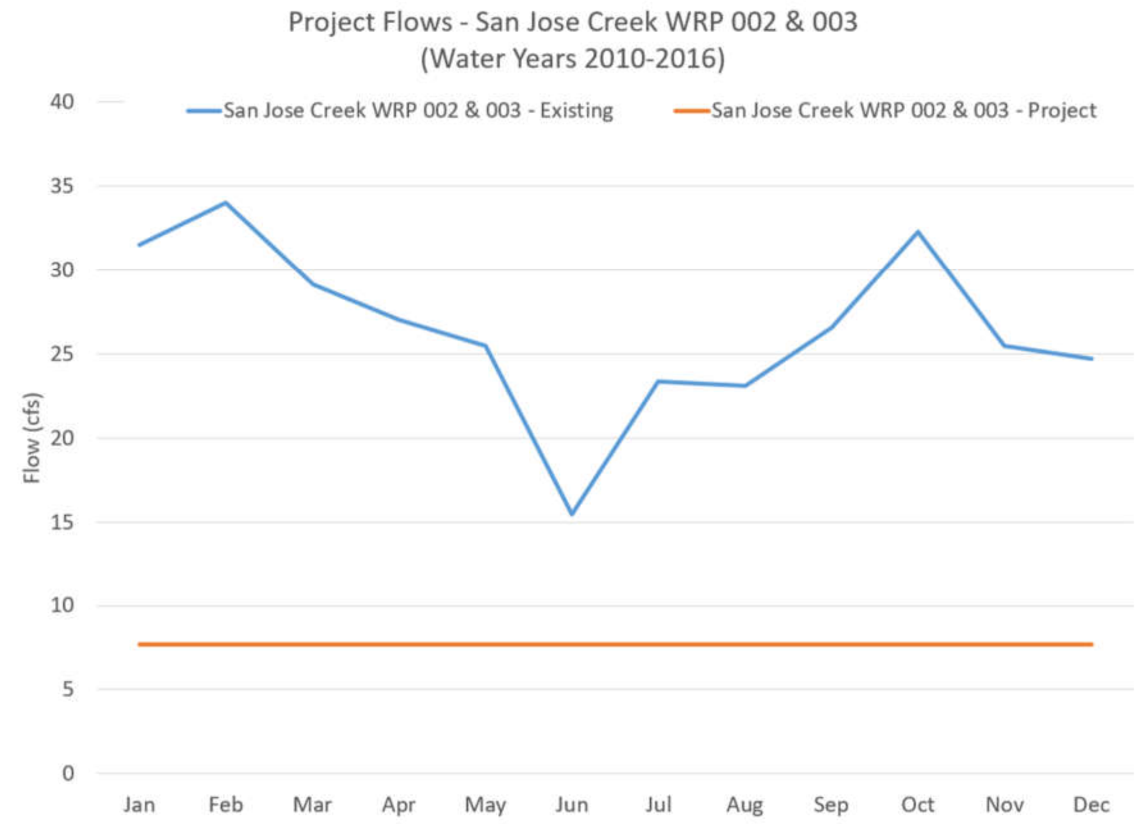
Recycled water for non-potable purposes is conveyed from the San Jose Creek WRP. There are three recycled water user connections off SJCE: City of Industry Pump Station; California Country Club; and internal San Jose Creek WRP facility use. At the SJCW, there is a single direct connection to a neighboring nursery. Additionally, there are two connections off of the San Jose Creek Outfall pipeline: District's Puente Hills Pump Station and the Central Basin Municipal Water District's Rio Hondo Pump Station.

Generally, discharge and diversion points are used interchangeably throughout the year, and only one discharge point for the SJCW and one discharge point for SJCE is used at any one time. In determining which discharge or diversion point to use, several factors must be considered, including, but not limited to: current flows in the river channels or spreading grounds, maintenance activities planned or occurring in the river channels and spreading grounds, water quality compliance, storm conditions, and the San Jose Creek WRP or spreading grounds operational needs.

Since June 2009, surface water discharges from SJC003 (associated with SJCW) have been highly intermittent and generally minimal (i.e., annual daily average of approximately 0.9 MGD (1009

AFY, 1.4 cfs) between 2009 and 2016). This is because a minimum continuous flow (20 MGD, 22,418 AFY, 31 cfs) must be maintained within the San Jose Creek Outfall pipeline to ensure pump stations have sufficient supply, and SJCW has primarily provided this minimum flow. **Figure 2** presents monthly average discharge data from SJC002 and SJC003 combined over the last seven years for which data on all Assessment Areas are available.

The District is considering reducing discharge from Discharge Point SJC002 and Discharge Point SJC003 to a monthly average of approximately 5 MGD (5,604 AFY, 7.7 cfs).



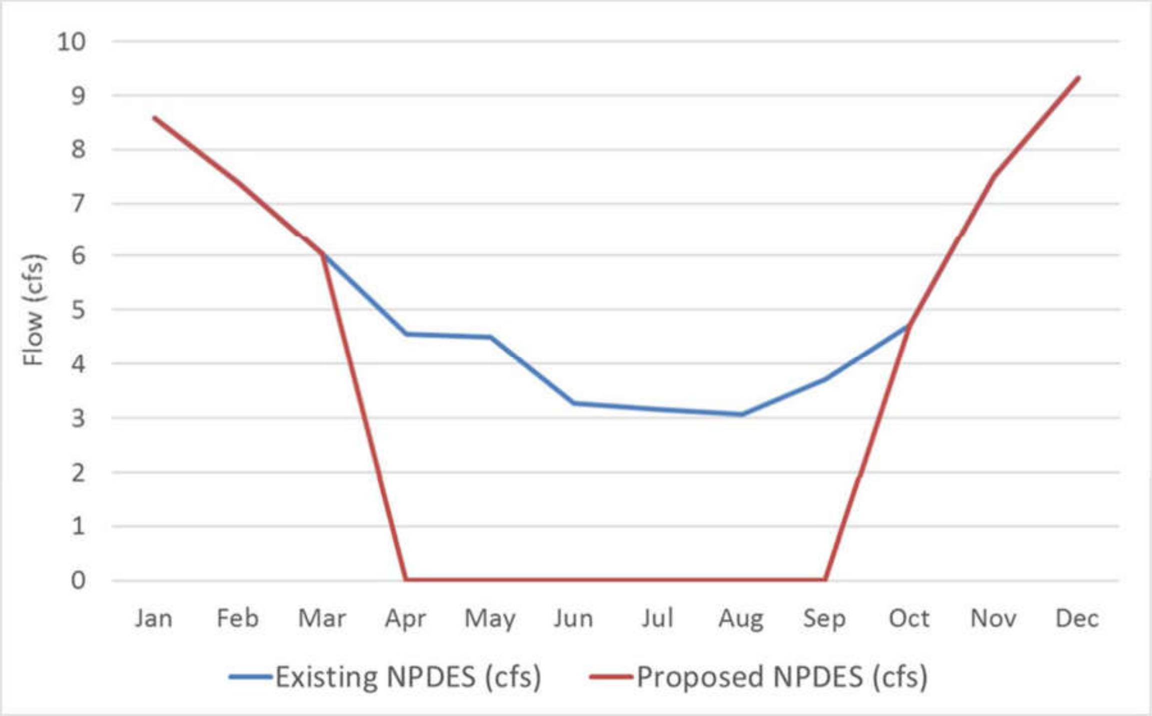
San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 2
Average monthly San Jose Creek WRP combined SJC002 and SJC003 discharge under Existing and Project Conditions, WY 2010-2016

Pomona WRP

The Pomona WRP is located upstream of San Jose Creek WRP adjacent to a concrete-lined portion of the south fork of San Jose Creek, northeast of the intersection of State Route- (SR-) 60 and SR-57 in the City of Pomona. The facility has a treatment capacity of 15 MGD (16,813 AFY, 23 cfs) and has a single point of discharge into the south fork of San Jose Creek. Total plant effluent between 2015 and 2016 was 6,102 acre-feet, of which 3,300 acre-feet were delivered to the City of Pomona for resale and 2,802 acre-feet were discharged into San Jose Creek (San Gabriel River Watermaster 2017). Of the 2,802 acre-feet delivered to San Jose Creek, it was determined that no Reclaimed Water was bypassed to the ocean; 1,833 acre-feet was replenished in the San Gabriel Valley, and 969 acre-feet was replenished in the MFGRP. The District is currently developing plans to recycle more treated water from Pomona WRP, reducing discharges to San Jose Creek. For the full Project Conditions Analysis of this study, a hypothetical scenario was considered in which discharge from Pomona WRP was reduced to zero between April 1 and September 30, as shown in **Figure 3**.



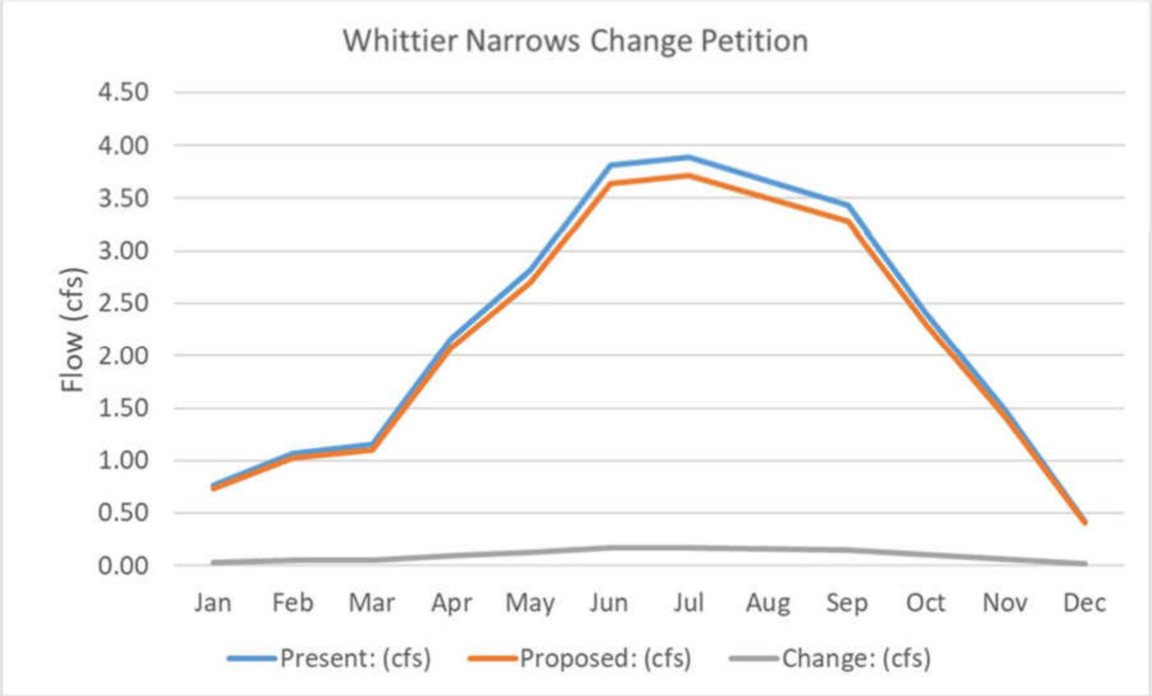
San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 3
Existing (WY 2016) and Proposed Discharges to San Jose Creek from Pomona WRP

Whittier Narrows WRP

The Whittier Narrows WRP is located adjacent to an unlined portion of the Rio Hondo in the City of El Monte, south of SR-60 and just west of Legg Lake. The facility has a treatment capacity of 15 MGD (16,813 AFY, 23 cfs). The facility uses three points of discharge: one into the Rio Hondo, one into the San Gabriel River (located approximately 600 feet upstream of the Whittier Narrows Dam), and one into the Zone 1 Ditch (also known as the Rio Hondo Bypass). Discharge into the Zone 1 Ditch flows to the Rio Hondo and can be diverted into the Rio Hondo Spreading Grounds. The District has submitted a Wastewater Change Petition (WW0098) to recycle treated water from Whittier Narrows WRP, reducing discharges to the San Gabriel River (as shown in **Figure 4**). For the full Project Conditions Analysis of this study, the proposed discharge reduction was applied to the water budget for the relevant habitat areas.



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 4
Existing (WY 2016) and Proposed Discharges to San Jose Creek from Whittier Narrows WRP as Shown in Wastewater Change Petition WW0098

Imported Water

There are two sources of imported water from the State Water Project that sometimes reach the Assessment Areas: CENB-28 discharges to Thompson Creek, from where it flows into San Jose Creek and the San Gabriel River near the San Jose Creek WRP, and CENB-48, which discharges to Dalton Wash where some water infiltrates, while the excess can reach the San Gabriel River upstream of the San Jose Creek confluence. For the Cumulative Project condition, the volume of imported water reaching the Assessment Areas was calculated by tracing imported water pulses from their source into the San Gabriel River, and deducting this volume from the water budget.

Diverted Water

Water is sometimes diverted out of the San Gabriel River watershed and into the Rio Hondo watershed via the Zone 1 Ditch, located 5,800 feet upstream of the Whittier Narrows Dam. Transfers are used for recharge further downstream in the Rio Hondo. On average between WY 2010 and 2016, 14 MGD (15,692 AFY, 22 cfs) of water was transferred out of the San Gabriel River watershed via this connection.

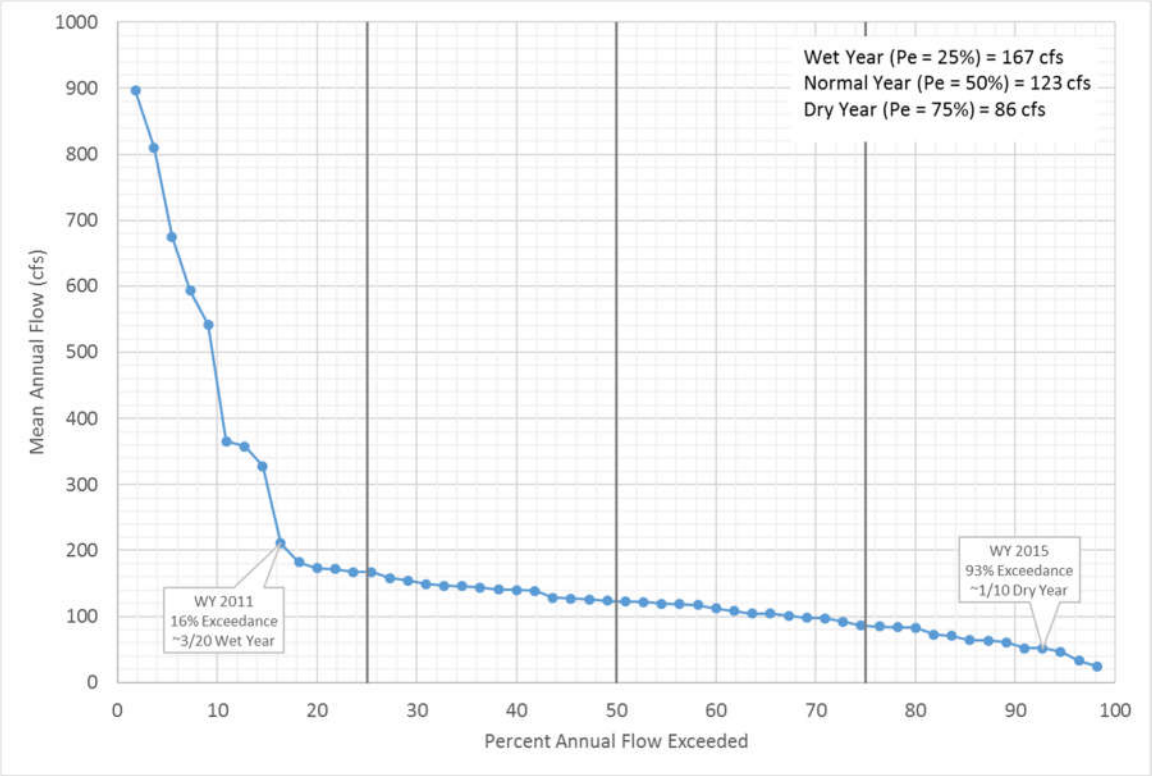
Percolation Areas

Four weirs in the San Gabriel River between San Jose Creek and the Zone 1 Ditch diversion exert a significant influence on surface flows and groundwater. These weirs function passively : flows from the watershed or the WRPs fill the channel upstream of the weirs until the crest of the weir is reached, at which point water flows downstream to the next weir. Water passing the last weir can flow to Whittier Narrows Dam, but during the dry season most flows do not reach the dam, percolating or evaporating along the way. In addition to percolating a large volume of water, the percolation areas act as a reservoir for Zone 1 Ditch; examining the flow gage records shows that large volumes of flow are sometimes pulled off the downstream impoundment even when no water has passed USGS Gage 11087020, located at Peck Road in the San Gabriel River above Whitter Narrows Dam, for several weeks.

Variability in San Gabriel River Flow Conditions

Annual Variability

USGS gage 11087020 - San Gabriel above Whitter Narrows Dam (at Peck Road) is located within Assessment Area 1 (most upstream), providing a good indicator of how flows vary from year to year. Flows at this gage for water years 1964 to 2017 were analyzed using a percent exceedance curve shown in **Figure 5**.



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 5
Percent Exceedance Curve for San Gabriel River above Whittier Narrows Dam (USGS gage 11087020), Water Years 1964-2017

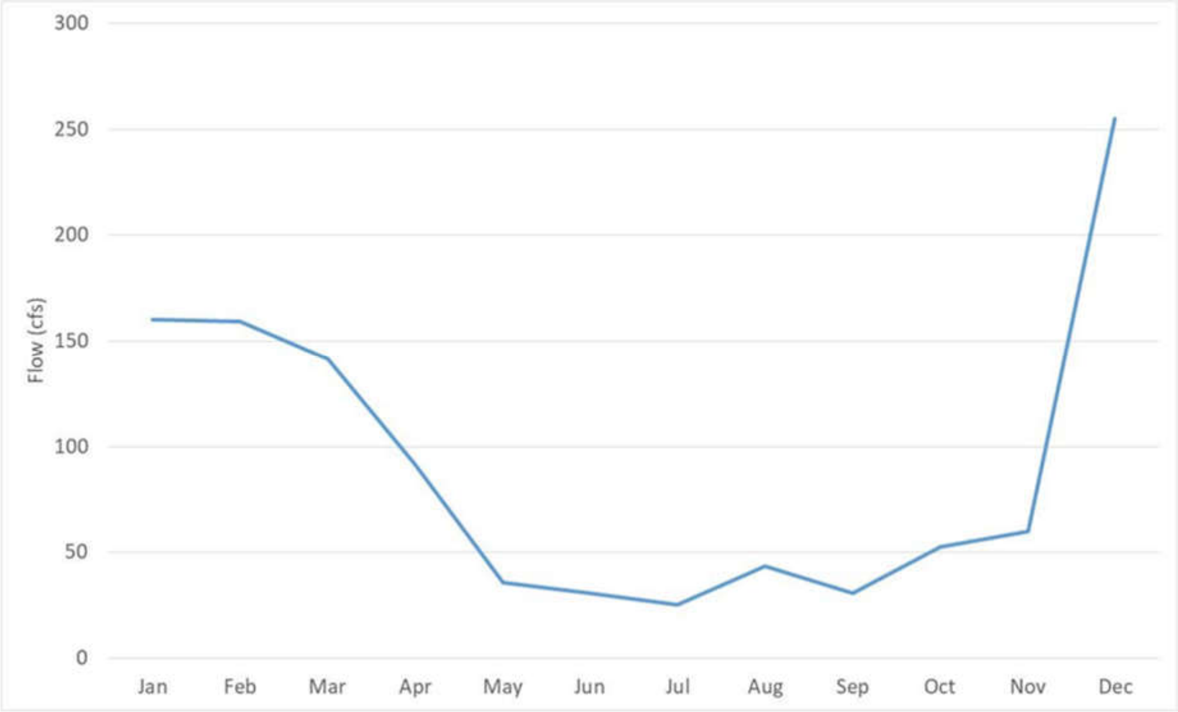
This figure shows that 25% of the time (13 years out of the 53 years analyzed) mean annual flow was greater than 167 cfs, 50% of the time (26 years) mean annual flow was greater than 123 cfs, and 75% of the time (39 years) mean annual flow was greater than 86 cfs. WYs 2011 and 2015, which were used as the wet year and dry year Baseline Conditions for this study, are indicated on the plot. As shown, WY 2015 was a very dry year, with flows that are exceed almost nine years out of ten, while 2011 was a relatively high flow year, with flows that are only exceeded three years out of twenty. Because there was no average year within the last ten years, we analyzed average project effects by modeling a five-year period (WY 2011-2015) that contained a mix of wet and dry years. The seven-year period of available gage data for the water balance model (WY 2010-2016) is shown in **Table 2**.

TABLE 2
PERCENT ANNUAL FLOW EXCEEDANCE FOR WATER YEARS 2010-2016, EVALUATED AT USGS GAGE 11087020

Water Year	Percent of Years Flow Exceeded	Year Type
2010	24	Wet
2011	16	Very wet
2012	87	Very dry
2013	95	Very dry
2014	96	Extremely dry
2015	93	Very dry
2016	89	Very dry

Seasonal Variability

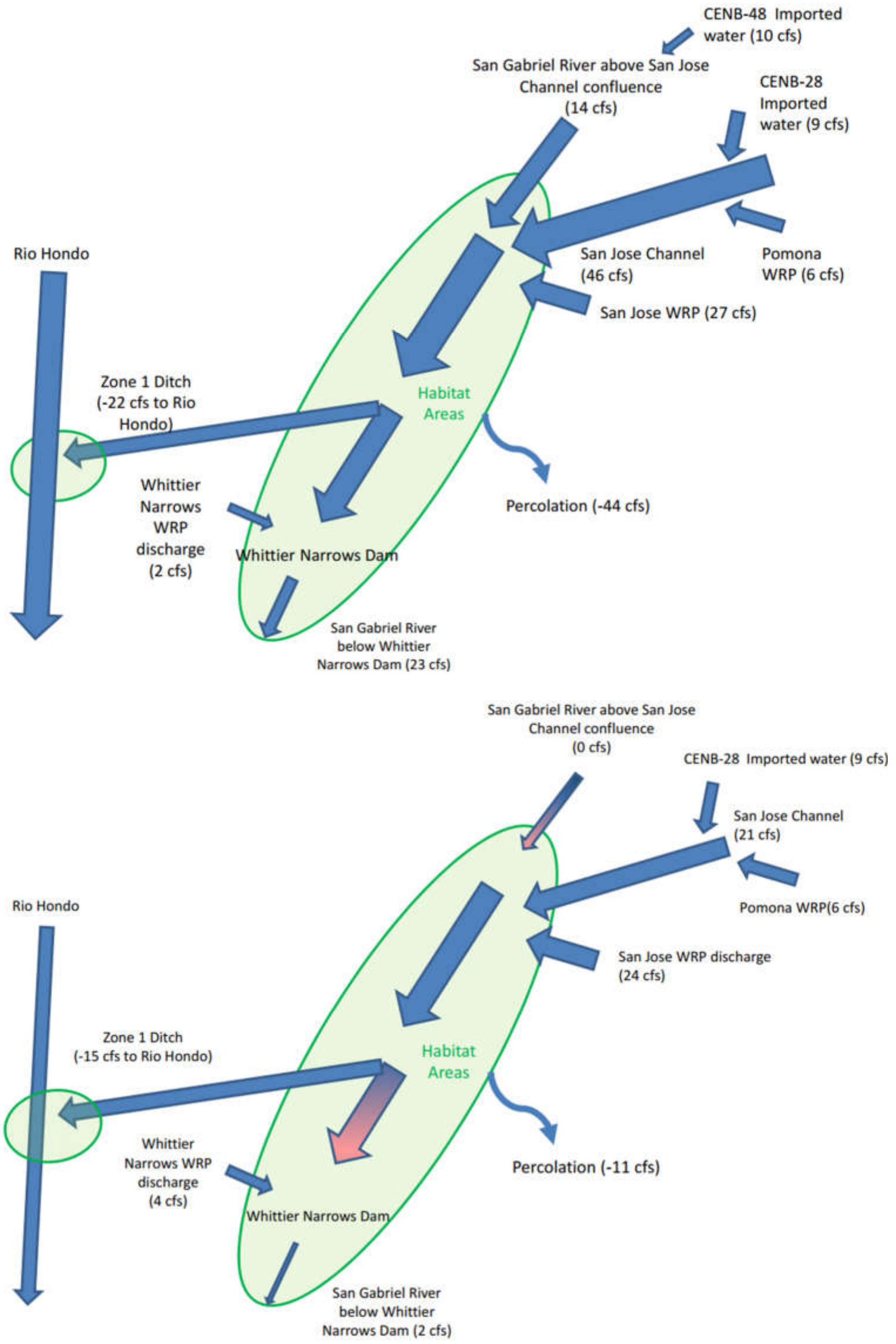
Flow in the San Gabriel River is strongly seasonal, reflecting the Mediterranean climate of the watershed with rainfall occurring in the winter and summer typically seeing almost no rainfall (**Figure 6**). During the wet season (assumed to be October 1 – March 31) surface flows in the Assessment Areas consist generally of stormwater and urban runoff from rainfall events, imported water deliveries, WRP discharges, and groundwater upwelling from San Jose Creek and the confluence of San Jose Creek and the San Gabriel River. During the dry season (assumed to be April 1 – September 30), the water balance is more heavily influenced by WRP discharges, imported water and urban dry season runoff. An average annual water budget and an average dry season budget for the project area is shown in **Figure 7** based on flow gage data between 2010 and 2016.



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 6
Average Monthly Flow in the San Gabriel River at USGS Gage 1187020, Water Years 2010-2016



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 7

Average Annual Water Budget (Upper) and Average Dry Season Water Budget (Lower) for Habitat Assessment Areas, Water Years 2010-2016

CHAPTER 2

Project Conditions for Wastewater Treatment Plants

ESA evaluated the effect reductions in discharges from the WRPs (San Jose Creek, Pomona, and Whittier Narrows) on surface flow by developing daily water budgets for five Assessment Areas. These analyses were aggregated as Existing, Project 1 (San Jose Creek WRP), Project 2 (all WRPs), and Cumulative Conditions (all WRPs and reduction in imported water). The water budgets were developed using ten flow gages (**Table 3**).

TABLE 3
GAGES USED IN WATER BUDGET ANALYSIS

Operator	Gage ID and Location	Purpose in Analysis
LACDPW	CENB-28 (discharges to Thompson Creek - San Jose Creek – San Gabriel River)	Imported Water
LACDPW	CENB-48 (discharges to San Dimas Wash – Dalton Wash – San Gabriel River)	Imported Water
LACDPW	F274B Dalton Wash	Identify and adjust for imported water pulses from CENB-48 under cumulative conditions
District	POM001(Pomona WRP- discharges to San Jose Creek – San Gabriel River)	Identify and adjust for discharge from Pomona WRP under cumulative conditions
LACDPW	F312B San Jose Channel Above Workman Mill Road	Identify and adjust for imported water pulses from CENB-48 under cumulative conditions Identify and adjust for discharge from Pomona WRP under cumulative conditions
District	SJC 002 (Discharges to San Jose Creek) SJC003 (Discharges to San Gabriel River)	Existing and proposed San Jose Creek WRP discharge
USGS	USGS Gage 11087020 San Gabriel River above Whittier Narrows Dam (Peck Road)	Flow reaching upstream Assessment Areas
LACDPW	F313B Rio Hondo Bypass (Zone One Ditch)	Flow diverted out of San Gabriel River to Rio Hondo
District	WN001 Whittier Narrows WRP discharge to San Gabriel River	Flow input into Assessment Areas upstream and downstream of Whittier Narrows Dam under existing conditions' removed for cumulative conditions
LACDPW	G44B San Gabriel River Above Whittier Narrows Dam	Flow input into Assessment Area around Whittier Narrows Dam

For the detailed analysis presented below, two individual years and a five-year period were analyzed:

- WY 2011, which is the year that flows in the San Gabriel River were highest in the last ten years,
- WY 2015, which is the second lowest flow year in the last ten years

- The average of WY 2011-2015

Note that WY 2016 was the lowest flow year of the last decade and was initially assessed as the dry baseline year. However, San Jose Creek WRP was operated in a very atypical way during water year 2016 (much less recycled water was discharged into the San Gabriel River near the WRP during the dry season than usual) that makes it unrepresentative as a baseline condition; therefore, water year 2015 was chosen as the baseline year. Note also that although the water balance calculations were carried out using daily data, the results are presented as monthly averages.

The flows used for the Existing, Project 1 (San Jose Creek WRP only), Project 2 (all WRPs), and Cumulative Conditions (all WRPs and no imported water) are described in **Table 4**. The annual average value for each water source is provided to show the magnitude of the water source for context only.

TABLE 4
EXISTING, PROJECT, AND CUMULATIVE CONDITIONS FOR EACH WATER SOURCE

Water Source	**Existing Conditions**	**Project Conditions 1 (San Jose Creek WRP reduction only)**	**Project Conditions 2 (San Jose Creek and Pomona WRP reductions)**	**Cumulative Conditions (Project conditions 2, Whittier Narrows WRP reduction, and no Imported Water)**
San Jose Creek WRP	Measured discharge	Measured discharge	Measured discharge	Measured discharge
Pomona WRP	Measured discharge	Measured discharge	Measured discharge in wet season, zero flow in dry season	Measured discharge in wet season, zero flow in dry season
Whittier Narrows WRP	Existing average monthly flow per wastewater change petition	Existing average monthly flow per wastewater change petition	Existing average monthly flow per wastewater change petition	Proposed average monthly flow per wastewater change petition
Imported water CENB28 and CENB48	Measured discharge	Measured discharge	Measured discharge	No imported water

Surface water budgets were calculated for each Assessment Area as shown in **Table 5**:

TABLE 5
EXISTING, PROJECT, AND CUMULATIVE CONDITIONS FOR EACH WATER SOURCE

Assessment Area	Existing Conditions (WY 2016)	Project Conditions (1 and 2)	Cumulative Conditions
1. San Jose Creek Confluence to Zone 1 Ditch Diversion	USGS Gage 11087020 (Peck Road)	USGS Gage 11087020 (Peck Road) -Plus or minus flow change from San Jose Creek WRP -Minus flow change from Pomona WRP -Minus flow change from Whittier Narrows WRP	USGS Gage 11087020 (Peck Road) -Plus or minus flow change from San Jose Creek WRP -Minus flow change from Pomona WRP -Minus imported water
2. Zone 1 Ditch Diversion to Whittier Narrows WRP Outfall in San Gabriel River	USGS Gage 11087020 (Peck Road) -Minus flow to Zone 1 Ditch Diversion -Minus 50% of the percolation losses measured between Peck Road and Whittier Narrows Dam[a]	USGS Gage 11087020 (Peck Road) -Plus or minus the flow change from San Jose Creek WRP (weighted for percolation losses[b]) -Minus flow to Zone 1 Ditch Diversion -Minus 50% of the percolation losses measured between Peck Road and Whittier Narrows Dam[a] -Minus flow change from Pomona WRP (weighted for percolation losses[b])	USGS Gage 11087020 (Peck Road) -Plus or minus the flow change from San Jose Creek WRP (weighted for percolation losses[b]) -Minus flow to Zone 1 Ditch Diversion -Minus 50% of the percolation losses measured between Peck Road and Whittier Narrows Dam[a] -Minus flow change from Pomona WRP (weighted for percolation losses[b]) -Minus imported water[c]
3. Around Whittier Narrows WRP outfall	WN001 discharge to San Gabriel River	WN001 discharge to San Gabriel River (existing)	-WN001 discharge to San Gabriel River (proposed)
4. Below Whittier Narrows Dam	LACPWD flow gage at Whittier Narrows Dam	LACPWD flow gage at Whittier Narrows Dam -Minus flow change from Whittier Narrows WRP -Plus or minus the flow change from San Jose Creek WRP (weighted for percolation losses[b]) -Minus flow change from Pomona WRP (weighted for percolation losses[b])	LACPWD flow gage at Whittier Narrows Dam -Minus flow change from Whittier Narrows WRP -Plus or minus the flow change from San Jose Creek WRP (weighted for percolation losses[b]) -Minus flow change from Pomona WRP (weighted for percolation losses[b]) -Minus imported water[c]
5. Zone 1 Ditch Diversion	LACPWD flow gage at Zone 1 Ditch Diversion	LACPWD flow gage at Zone 1 Ditch Diversion -If existing Zone 1 Ditch Diversion would cause Assessment Area 2 to fall below 5 MGD (5,604 AFY) under Project Conditions, then reduce Zone 1 Ditch Diversion to leave 5 MGD in San Gabriel River if possible. If not possible to meet entire 5 MGD requirement, then eliminate all flows down Zone 1 Ditch to leave as much flow as possible in San Gabriel River.	LACPWD flow gage at Zone 1 Ditch Diversion -If existing Zone 1 Ditch Diversion would cause Assessment Area 2 to fall below 5MGD under Project Conditions, then reduce Zone 1 Ditch Diversion to leave 5 MGD (5,604 AFY) in San Gabriel River if possible. If not possible to meet entire 5 MGD requirement, then eliminate all flows down Zone 1 Ditch to leave as much flow as possible in San Gabriel River.

NOTES:

[a] 50% of the measured percolation loss between Peck Road and Whittier Narrows Dam was applied to Assessment Area 2 since its' center is approximately half way between the two gages.

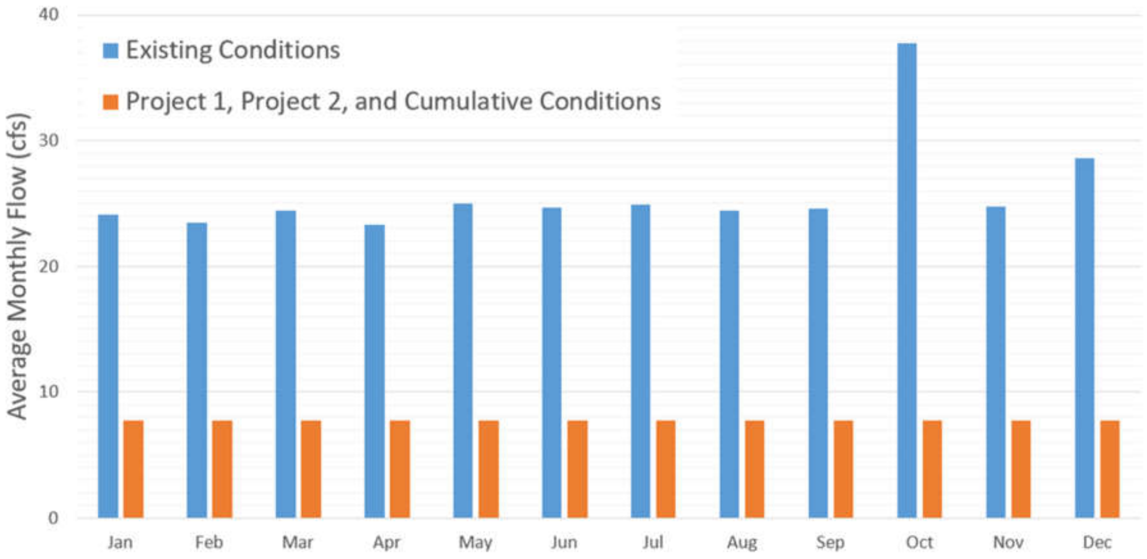
[b] During the dry season flow increases from San Jose Creek WRP and Pomona WRP were reduced in Assessment Area 2 based on measured daily flow losses between San Jose Creek and Whittier Narrows during April, to account for percolation and evaporation losses downstream. April was selected since it is the month closes to the dry season in which all losses appear to be due to either percolation or evaporation, rather than losses could be due to storage in the percolation area.

c No water was imported during WY 2016

San Jose Creek WRP

Proposed changes in discharge from San Jose Creek WRP are shown in **Figure 8** through **Figure 10** for WY 2011 (representative wet year), WY 2015 (representative dry year), and WY 2011-2015 (5-year average).

Wet Year (WY2011)



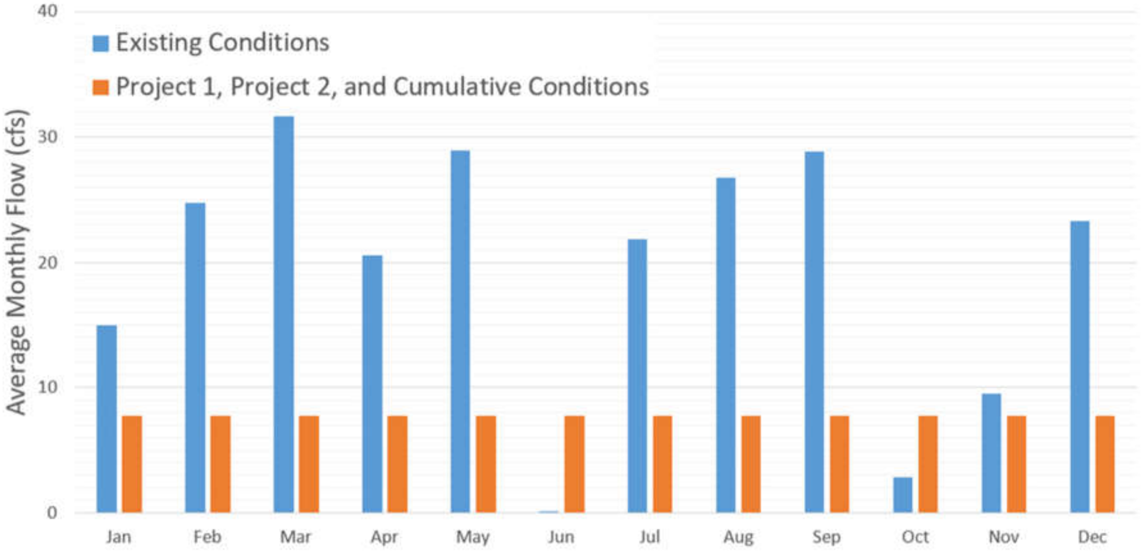
San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 8
Discharges from San Jose Creek WRP under Existing, Project 1, Project 2, and Cumulative Conditions for Wet Year (WY2011)

Under WY 2011 (representative wet year) existing conditions, more than 20 cfs was released to the project area for all months. For Project 1 and 2 conditions, flows from San Jose Creek WRP would be reduced from an average monthly discharge of 26 to 7.7 cfs.

Dry Year (WY2015)



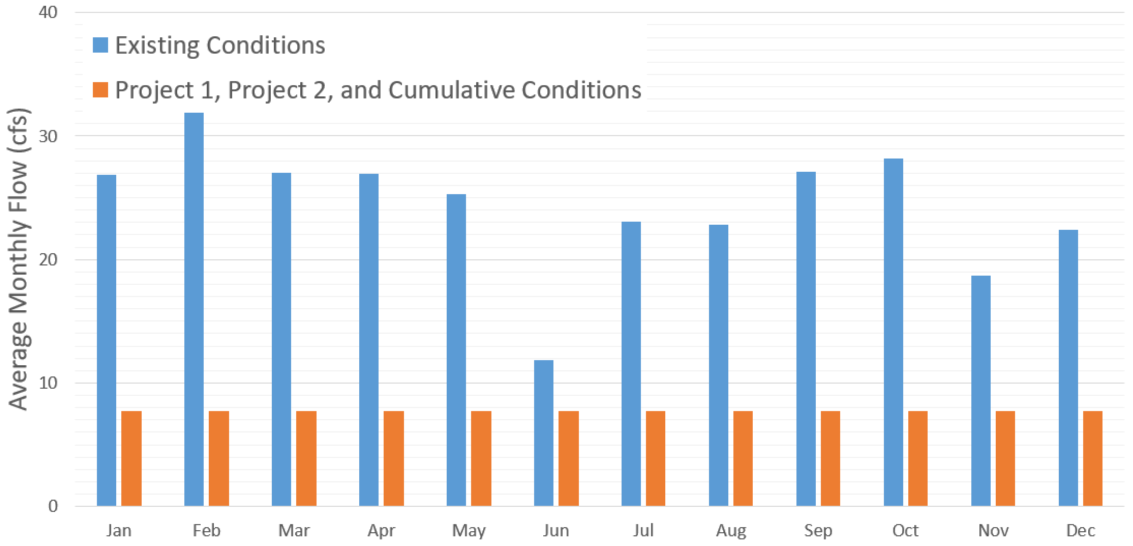
San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 9
Discharge from San Jose Creek WRP under Existing, Project 1, Project 2, and Cumulative Conditions for Dry Year (WY2015)

Under WY 2015 (representative dry year) existing conditions, flow releases from the San Jose Creek WRP to the project area varied between less than 5 cfs in June and July to over 20 cfs in the majority of months. For the project condition, flows from San Jose Creek WRP would be reduced in the wet season from an average discharge of 18 to 7.7 cfs, and in the dry season from 21 to 7.7 cfs.

5-Year Average (WY2011-2015)



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

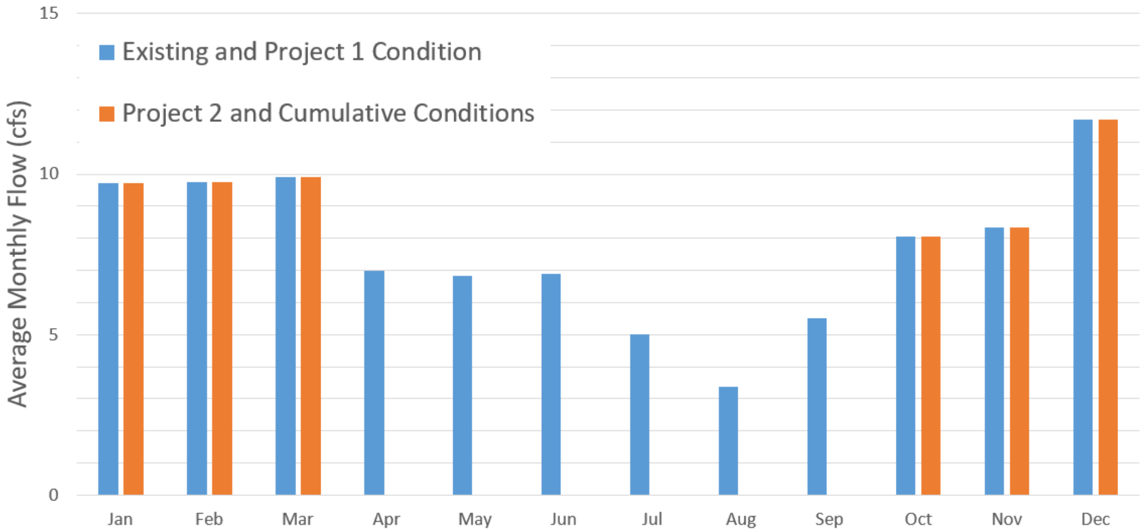
Figure 10
Discharge from San Jose Creek WRP under Existing, Project 1, Project 2, and Cumulative Conditions for 5-Year Average (WY2011-2015)

Under WY 2011-2015 (5-year average) existing conditions, more than 10 cfs was released from San Jose Creek WRP to the project area all months. For Projects 1 and 2, flows from San Jose Creek WRP would be reduced in the wet season from an average discharge of 26 to 7.7 cfs, and in the dry season from 23 to 7.7 cfs.

Pomona WRP

Proposed changes in discharge for Pomona WRP are shown in **Figure 11** through **Figure 13** for WY 2011 (representative wet year), WY 2015 (representative dry year), and WY 2011-2015 (5-year average).

Wet Year (WY2011)



San Jose Creek WRP Change Petition / D170647

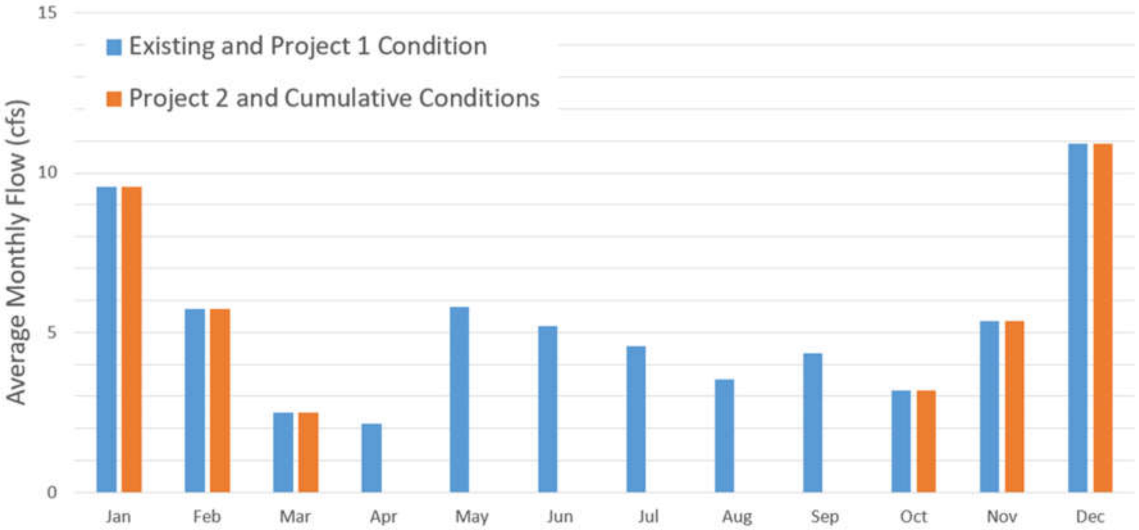
SOURCE: ESA

Figure 11
Discharge from Pomona WRP under Existing, Project 1, Project 2, and Cumulative Conditions Wet Year (WY2011)

For WY2011 (representative wet year) baseline condition flows from Pomona WRP would be unchanged in the wet season with an average discharge of 9.6 cfs, and reduced in the dry season from 5.8 to 0 cfs.

Dry Year (WY2015)

San Jose Creek WRP Change Petition / D170647

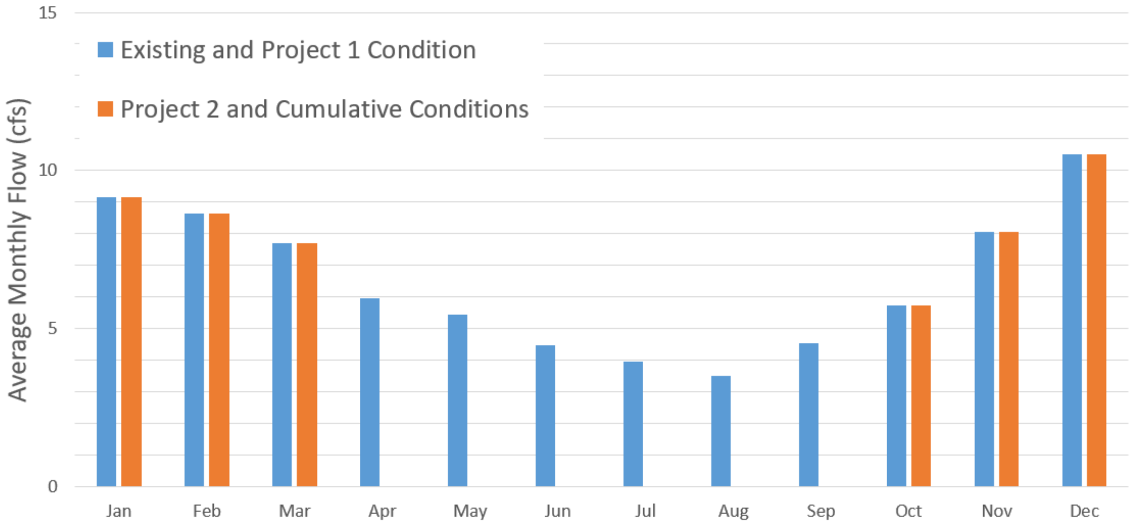


SOURCE: ESA

Figure 12
Discharge from Pomona WRP under Existing, Project 1, Project 2, and Cumulative Conditions Dry Year (WY2015)

For the WY2015 (representative dry year) baseline condition, flows from Pomona WRP would be unchanged in the wet season with an average discharge of 9.6 cfs, and reduced in the dry season from 5.8 to 0 cfs.

5-Year Average (WY2011-2015)



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

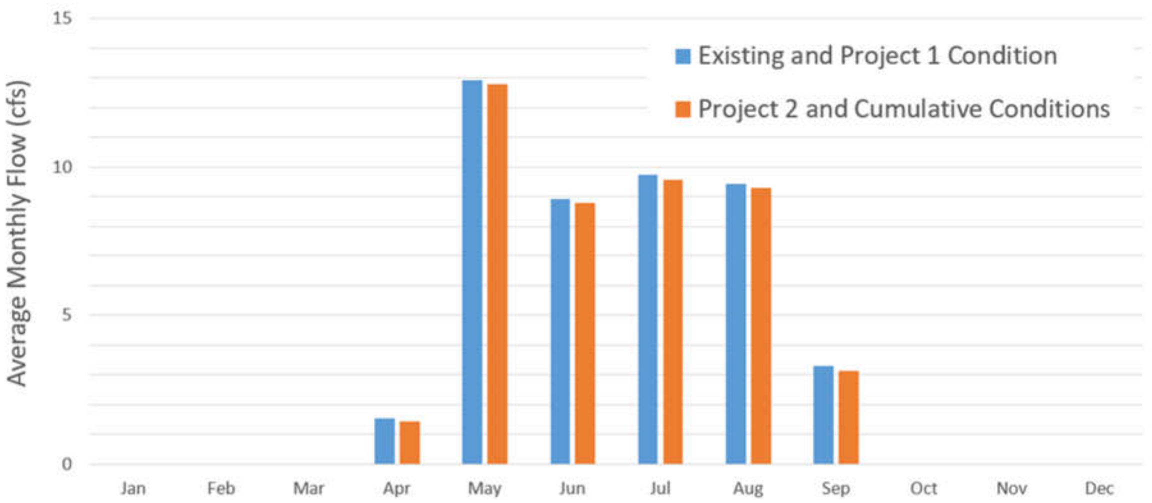
Figure 13
Discharge from Pomona WRP under Existing, Project 1, Project 2, and Cumulative Conditions 5-Year Average (WY2011-2015)

For the WY2011-2015 (5-year average) baseline condition, flows from Pomona WRP would be unchanged in the wet season with an average discharge of 8.3 cfs, and reduced in the dry season from 4.6 to 0 cfs.

Whittier Narrows WRP

Proposed changes in discharge for Whittier Narrows WRP are shown in **Figure 14** and **Figure 15** for WY 2011 (representative wet year) and WY 2011-2015 (5-year average). 2015 (representative dry year) is not shows as flows would be zero under all conditions, as described below.

Wet Year (WY2011)



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

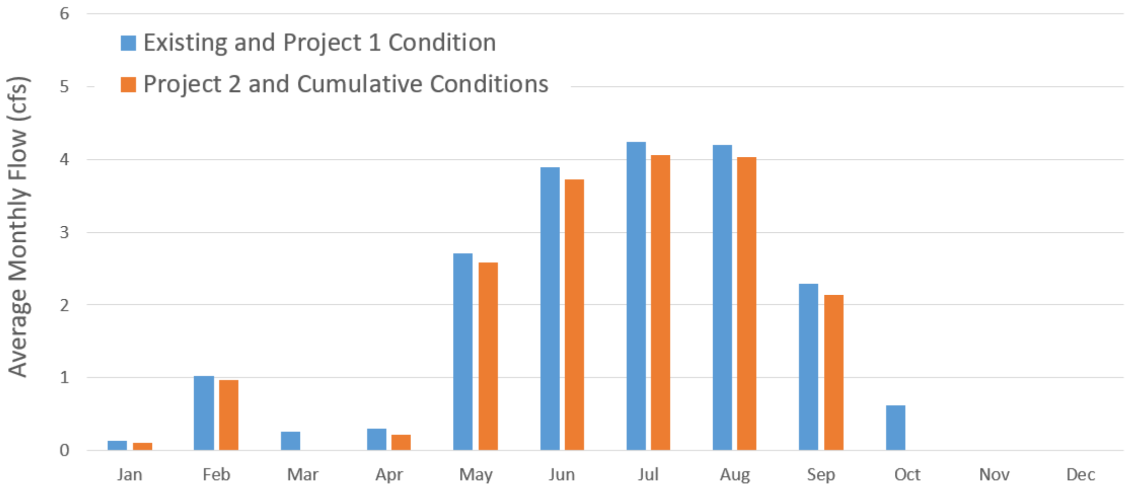
Figure 14
Discharge from Whittier Narrows WRP under Existing, Project 1, Project 2, and Cumulative Conditions Wet Year (WY2011)

For the WY2011 (representative wet year) baseline condition, flows from Whittier Narrows WRP would be unchanged in the wet season with an average discharge of 0 cfs, and reduced in the dry season from 7.6 to 7.5 cfs.

Dry Year (WY2015)

For the WY2015 (representative dry year) baseline condition, flows from Whittier Narrows WRP would be unchanged in year round with an average discharge of 0 cfs (Not shown in a figure).

5-Year Average (WY2011-2015)



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 15
Discharge from Whittier Narrows WRP under Existing, Project 1, Project 2, and Cumulative Conditions 5-Year Average (WY2011-2015)

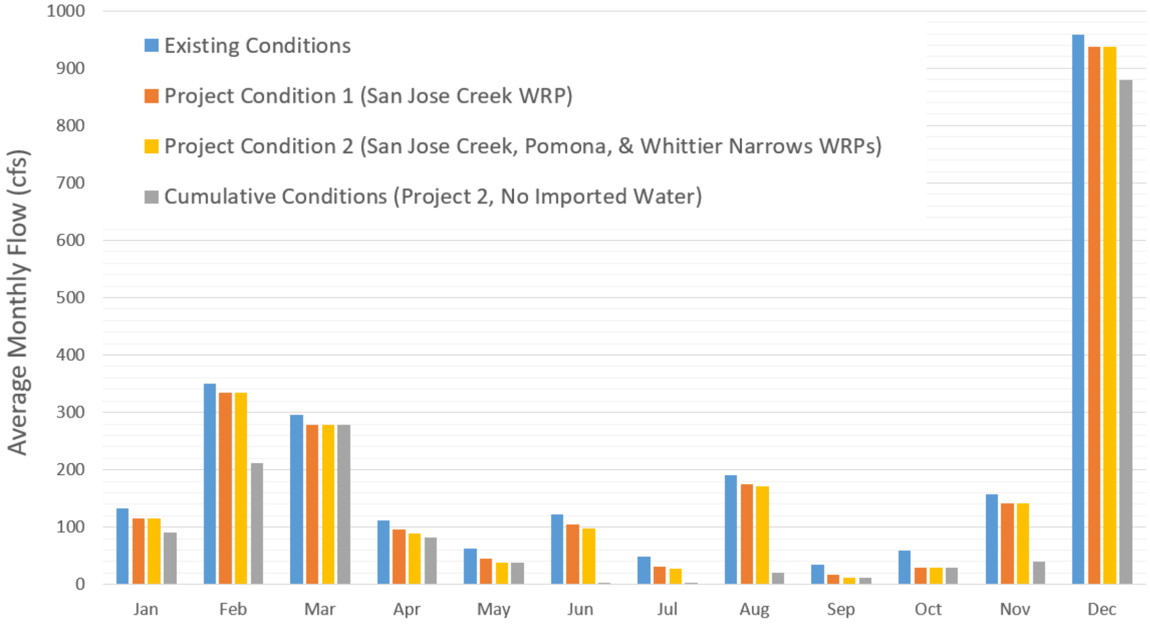
For the WY2011-2015 (5-year average) baseline condition, flows from Whittier Narrows WRP would be reduced in the wet season from 0.3 to 0.2 cfs, and in the dry season from 2.9 to 2.8 cfs.

CHAPTER 3

Estimating Project and Cumulative Effects on Surface Water Hydrology in the Habitat Assessment Areas

Assessment Area 1: San Jose Creek WRP Outfalls to San Gabriel River at Zone 1 Ditch Diversion

Wet Year (WY2011)



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 16
Surface Water Inflows for Assessment Area 1 under Existing, Project 1, Project 2, and Cumulative Conditions Wet Year (WY2011)

Existing Conditions

Under Existing Conditions for WY 2011 (representative wet year), Assessment Area 1 is dominated by storm runoff events during the wet season, with an average monthly flow of 326 cfs and monthly flows exceeding 60 cfs. During the dry season, less flow reaches Assessment Area 1, with an average monthly flow of 95 cfs and monthly flows exceeding 34 cfs.

Project Condition 1 (San Jose Creek WRP)

Project Condition 1 (San Jose Creek WRP) for WY 2011 (representative wet year) shows an average 6% reduction in flows during the wet season (306 cfs monthly average) and an average

18% reduction in flows during the dry season (78 cfs monthly average) as compared to Existing Conditions. Flows during all months exceed 16 cfs.

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs)

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs) for WY 2011 (representative wet year) shows an average 6% reduction in flows during the wet season (306 cfs monthly average) and an average 24% reduction in flows during the dry season (73 cfs monthly average) as compared to Existing Conditions. Flows during all months exceed 12 cfs.

Cumulative Conditions (San Jose Creek WRP, No Imported Water)

Cumulative Conditions (Project 2, No Imported Water) for WY 2011 (representative wet year) show an average 22% reduction during the wet season (255 cfs monthly average) and an average 72% reduction during the dry season (27 cfs monthly average) as compared to under Existing Conditions. Flows exceed 12 cfs all months, except June and July, with 3.9 cfs and 3.7 cfs inflow respectively.

Dry Year (WY2015)

SOURCE: ESA

San Jose Creek WRP Change Petition / D170647

Figure 17
Surface Water Inflows for Assessment Area 1 under Existing, Project 1, Project 2, and Cumulative Conditions Dry Year (WY2015)

Existing Conditions

Under Existing Conditions for WY 2015 (representative dry year), Assessment Area 1 is dominated by storm runoff events during the wet season, with an average monthly flow of 66 cfs. During October, Assessment Area 1 receives 0.4 cfs due to the small volume being discharged from San Jose and Pomona WRPs, as well as percolation and other losses downstream of San Jose Creek and San Gabriel River confluence. During the dry season, less flow reaches Assessment Area 1, with an average monthly flow of 37 cfs and monthly flows exceeding 24 cfs.

Project Condition 1 (San Jose Creek WRP)

Project Condition 1 (San Jose Creek WRP) for WY 2015 (representative dry year) shows an average 14% reduction in flows during the wet season (57 cfs monthly average) and an average 35% reduction in flows during the dry season (24 cfs monthly average) as compared to Existing Conditions. During August, flow decreases to 5.9 cfs and during October, flow *increases* to 6.7 cfs.

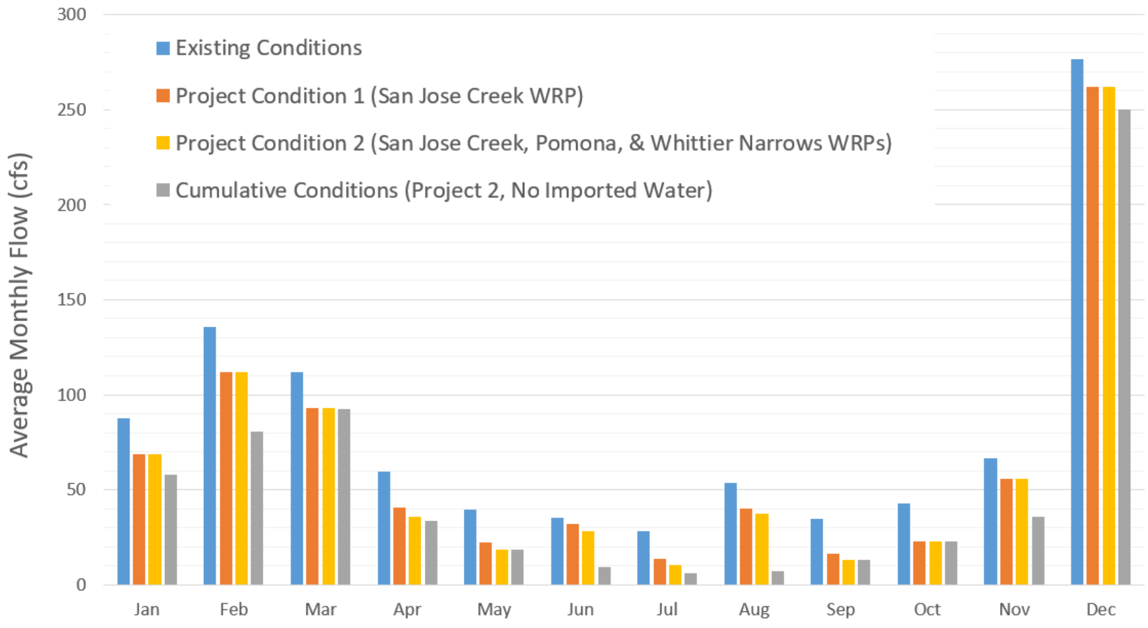
Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs)

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs) for WY 2011 (representative wet year) shows an average 14% reduction in flows during the wet season (57 cfs monthly average) and an average 42% reduction in flows during the dry season (21 cfs monthly average) as compared to Existing Conditions. During August, flow decreases to 3.9 cfs and during October, flow *increases* to 6.7 cfs.

Cumulative Conditions (San Jose Creek WRP, No Imported Water)

Cumulative Conditions (Project 2, No Imported Water) for WY 2015 (representative dry year) show an average 30% reduction during the wet season (46 cfs monthly average) and an average 44% reduction during the dry season (21 cfs monthly average) as compared to under Existing Conditions. During August, flow decreases to 3.9 cfs and during October, flow *increases* to 6.7 cfs.

5-Year Average (WY2011-2015)



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 18
Surface Water Inflows for Assessment Area 1 under Existing, Project 1, Project 2, and Cumulative Conditions 5-Year Average (WY2011-2015)

Existing Conditions

Under Existing Conditions for WY 2011-2015 (5-year average), Assessment Area 1 is dominated by storm runoff events during the wet season, with an average monthly flow of 120 cfs. During the dry season, less flow reaches Assessment Area 1, with an average monthly flow of 42 cfs and monthly flows exceeding 28 cfs.

Project Condition 1 (San Jose Creek WRP)

Project Conditions (San Jose Creek WRP) for WY 2011-2015 (5-year average) show an average 15% reduction in flows during the wet season (102 cfs monthly average) and an average 34% reduction in flows during the dry season (27 cfs monthly average) as compared to Existing Conditions. Flows during all months exceed 14 cfs.

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs)

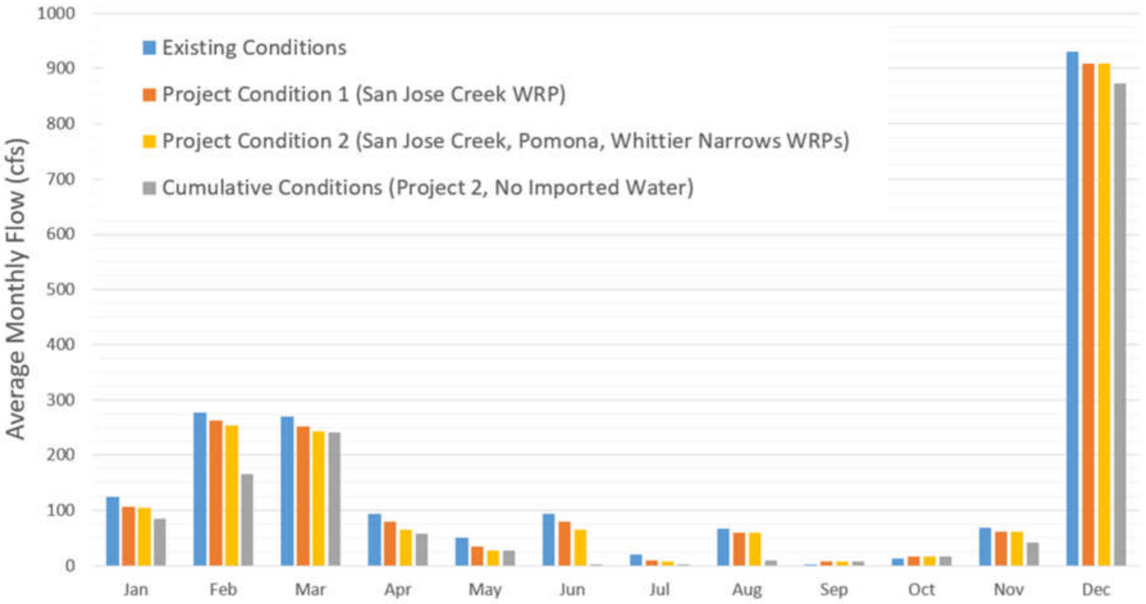
Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs) for WY 2011-2015 (5-year average) shows an average 15% reduction in flows during the wet season (102 cfs monthly average) and an average 43% reduction in flows during the dry season (24 cfs monthly average) as compared to Existing Conditions. Flows during all months exceed 11 cfs.

Cumulative Conditions (San Jose Creek WRP, No Imported Water)

Cumulative Conditions (Project 2, No Imported Water) for WY 2011-2015 (5-year average) show an average 25% reduction in flows during the wet season (90 cfs monthly average) and an average 65% reduction in flows during the dry season (14 cfs monthly average) as compared to Existing Conditions. Flows during all months exceed 5.9 cfs.

Assessment Area 2: San Gabriel River from Zone 1 Ditch Diversion to Whittier Narrow WRP Outfall

Wet Year (WY2011)



SOURCE: ESA

Figure 19
Surface Water Inflows for Assessment Area 2 under Existing, Project 1, Project 2, and Cumulative Conditions Wet Year (WY2011)

Existing Conditions

Under Existing Conditions for WY 2011 (representative wet year), Assessment Area 2 is dominated by storm runoff events during the wet season, with an average monthly flow of 281 cfs. During the dry season, less flow reaches Assessment Area 2, with an average monthly flow of 55 cfs and monthly flows exceeding 20 cfs, except during September, when it receives an inflow of 0.7 cfs. This is likely due to the small volume being discharged from San Jose Creek and Pomona WRPs, as well as percolation and other losses downstream of the San Jose Creek and San Gabriel River confluence.

Project Condition 1 (San Jose Creek WRP)

Project Conditions (San Jose Creek WRP) for WY 2011-2015 (5-year average) show an average 4% reduction in flows during the wet season (269 cfs monthly average) and an average 17% reduction in flows during the dry season (45 cfs monthly average) as compared to Existing Conditions. During September, inflow *increases* to 7.4 cfs. This increase is in part dependent on the assumption that Zone 1 Ditch would be operated to only divert water from the San Gabriel River when flows exceeding the Project minimum are met. All other monthly flows exceed 10 cfs.

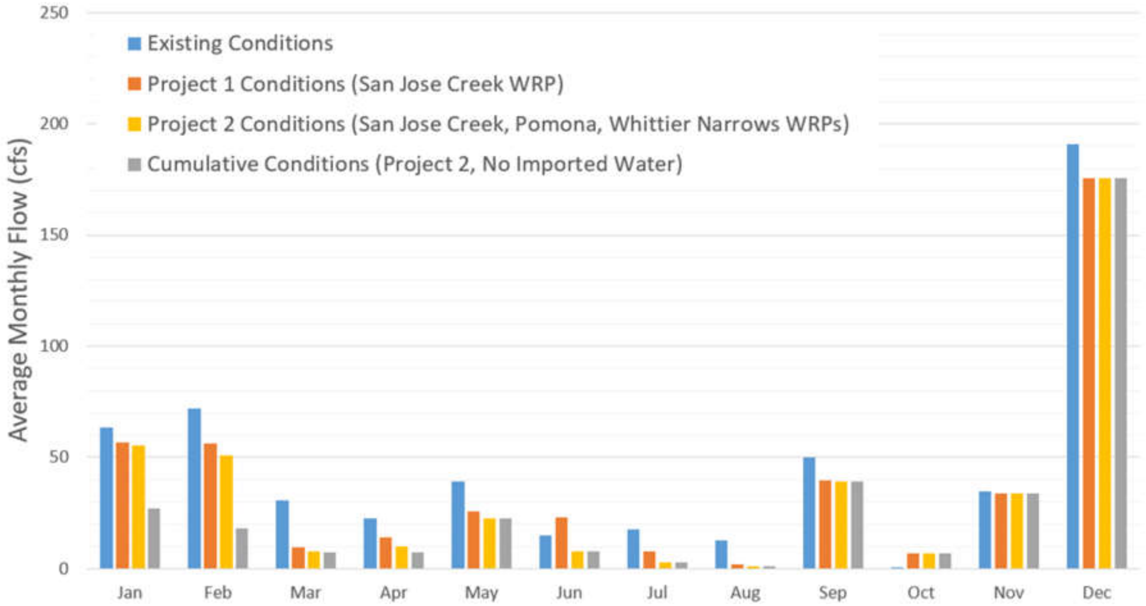
Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs)

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs) for WY 2011 (representative wet year) shows an average 6% reduction in flows during the wet season (265 cfs monthly average) and an average 29% reduction in flows during the dry season (39 cfs monthly average) as compared to Existing Conditions. During September, inflow *increases* to 7.4 cfs. This increase is in part dependent on the assumption that Zone 1 Ditch would be operated to only divert water from the San Gabriel River when flows exceeding the Project minimum are met. All other monthly flows exceed 7.7 cfs.

Cumulative Conditions (San Jose Creek WRP, No Imported Water)

Cumulative Conditions (Project 2, No Imported Water) for WY 2011 (representative wet year) show an average 15% reduction in flows during the wet season (237 cfs monthly average) and an average 68% reduction in flows during the dry season (18 cfs monthly average) as compared to Existing Conditions. During September, inflow *increases* to 7.4 cfs. This increase is in part dependent on the assumption that Zone 1 Ditch would be operated to only divert water from the San Gabriel River when flows exceeding the Project minimum are met. Inflows for the months of June and July are 1.9 and 2.5 cfs respectively. All other monthly flows exceed 8.8 cfs.

Dry Year (WY2015)



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 20
Surface Water Inflows for Assessment Area 2 under Existing, Project 1, Project 2, and Cumulative Conditions Dry Year (WY2015)

Existing Conditions

Under Existing Conditions for WY 2015 (representative dry year), Assessment Area 2 is dominated by storm runoff events during the wet season, with an average monthly flow of 65 cfs. During the dry season, less flow reaches Assessment Area 2, with an average monthly flow of 26 cfs and monthly flows exceeding 20 cfs, except October, which receives an inflow of 0.4 cfs. This is likely due to the small volume being discharged from San Jose Creek and Pomona WRPs, as well as percolation and other losses downstream of San Jose Creek confluence.

Project Condition 1 (San Jose Creek WRP)

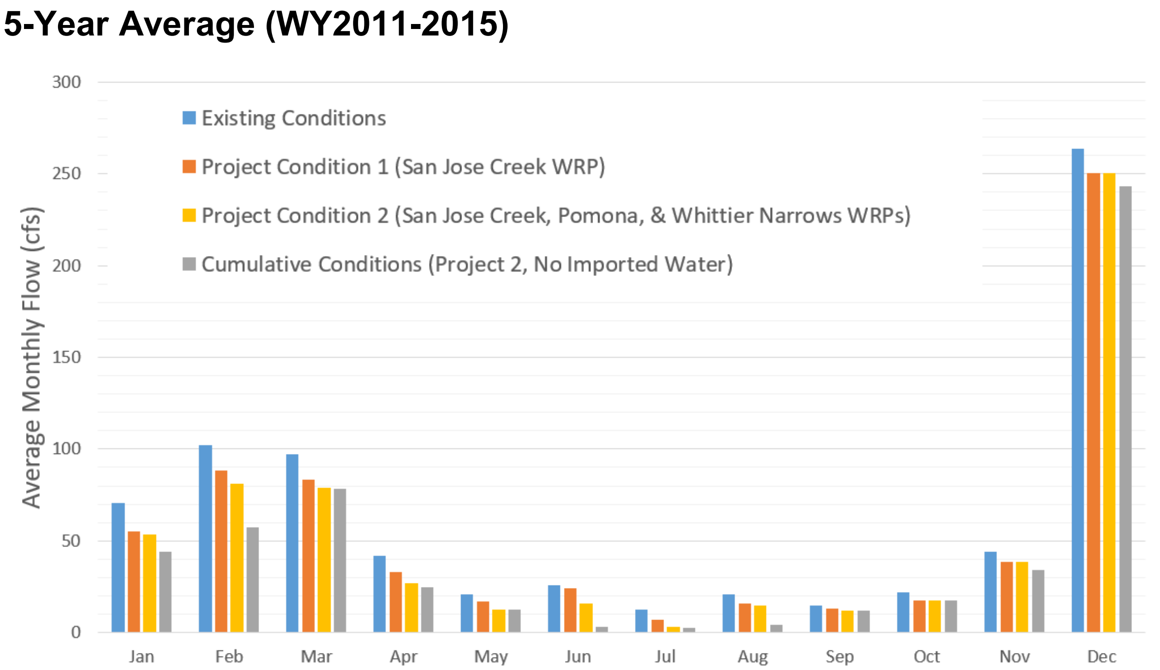
Project Condition 1 (San Jose Creek WRP) for WY 2015 (representative dry year) shows an average 13% reduction in flows during the wet season (57 cfs monthly average) and an average 29% reduction in flows during the dry season (19 cfs monthly average) as compared to Existing Conditions. During October, inflow *increases* to 6.7 cfs. This increase is in part dependent on the assumption that Zone 1 Ditch would be operated to only divert water from the San Gabriel River when flows exceeding the Project minimum are met. Flow in August is reduced to 1.8 cfs. All other monthly flows exceed 7.9 cfs.

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs)

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs) for WY 2015 (representative dry year) shows an average 16% reduction in flows during the wet season (55 cfs monthly average) and an average 47% reduction in flows during the dry season (14 cfs monthly average) as compared to Existing Conditions. During October, inflow *increases* to 6.7 cfs. This increase is in part dependent on the assumption that Zone 1 Ditch would be operated to only divert water from the San Gabriel River when flows exceeding the Project minimum are met. Flow in July and August is reduced to 2.9 cfs and 1.8 cfs respectively. All other monthly flows exceed 7.6 cfs.

Cumulative Conditions (San Jose Creek WRP, No Imported Water)

Cumulative Conditions (Project 2, No Imported Water) for WY 2015 (representative dry year) show an average 31% reduction in flows during the wet season (45 cfs monthly average) and an average 49% reduction in flows during the dry season (14 cfs monthly average) as compared to Existing Conditions. During October, inflow *increases* to 6.7 cfs. This increase is in part dependent on the assumption that Zone 1 Ditch would be operated to only divert water from the San Gabriel River when flows exceeding the Project minimum are met. Flow in July and August is reduced to 2.9 cfs and 1.8 cfs respectively. All other monthly flows exceed 7.2 cfs.


5-Year Average (WY2011-2015)

San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 21
Surface Water Inflows for Assessment Area 2 under Existing, Project 1, Project 2, and Cumulative Conditions 5-Year Average (WY2011-2015)

Existing Conditions

Under Existing Conditions for WY 2011-2015 (5-year average), Assessment Area 2 is dominated by storm runoff events during the wet season, with an average monthly flow of 100 cfs. During the dry season, less flow reaches Assessment Area 2, with an average monthly flow of 23 cfs and monthly flows exceeding 12 cfs for all months.

Project Condition 1 (San Jose Creek WRP)

Project Condition 1 (San Jose Creek WRP) for WY 2011-2015 (5-year average) shows an average 11% reduction in flows during the wet season (86 cfs monthly average) and an average 11% reduction in flows during the dry season (18 cfs monthly average) as compared to Existing Conditions. All monthly flows exceed 7.0 cfs.

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs)

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs) for WY 2011-2015 (5-year average) shows an average 13% reduction in flows during the wet season (84 cfs monthly average) and an average 37% reduction in flows during the dry season (14 cfs monthly average) as compared to Existing Conditions. During July, inflow is reduced to 3.9 cfs. This is due to lack of flows to divert from Zone 1 Ditch. All other monthly flows exceed 12 cfs.

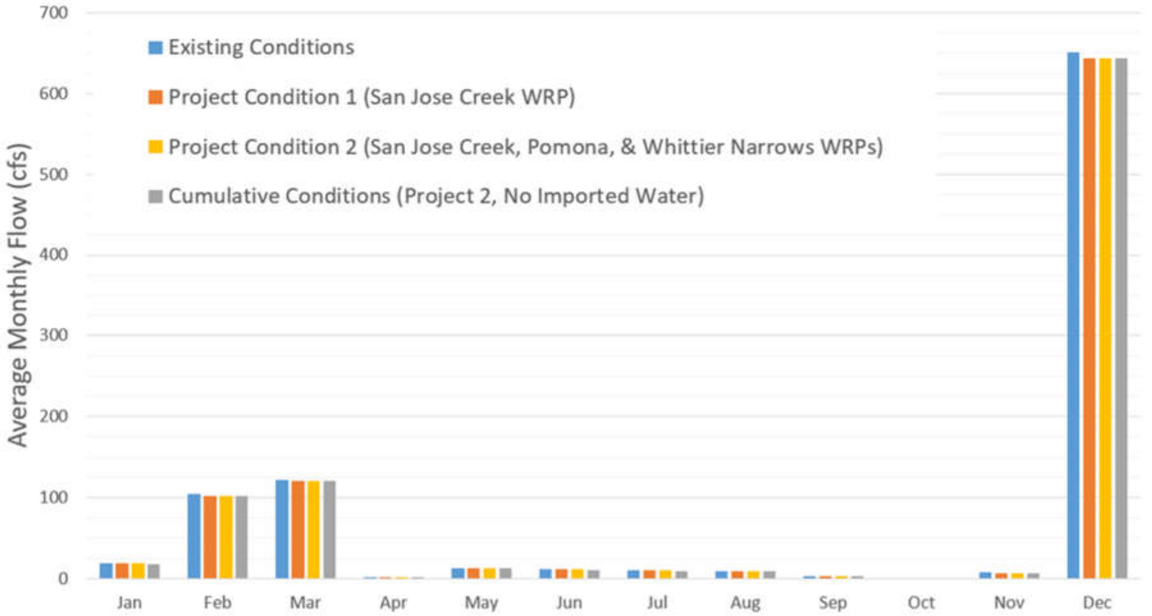
Cumulative Conditions (San Jose Creek WRP, No Imported Water)

Cumulative Conditions (Project 2, No Imported Water) for WY 2011-2015 (5-year average) show an average 21% reduction in flows during the wet season (79 cfs monthly average) and an average 56% reduction in flows during the dry season (10 cfs monthly average) as compared to Existing Conditions. Flows in June, July, and August drop to 3.2 cfs, 2.3 cfs, and 4.4 cfs respectively. All other monthly flows exceed 12 cfs.

Assessment Area 3: San Gabriel River around Whittier Narrows WRP Outfall

Wet Year (WY2011)

San Jose Creek WRP Change Petition / D170647



SOURCE: ESA

Figure 22
Surface Water Inflows for Assessment Area 3 under Existing, Project 1, Project 2, and Cumulative Conditions Wet Year (WY2011)

Existing Conditions

Under Existing Conditions for WY 2011 (representative wet year), Assessment Area 3 is dominated by storm runoff events during the wet season months, with an average monthly flow of 151 cfs. During October, no water reaches Assessment Area 3. During the dry season, less flow reaches Assessment Area 3, with an average monthly flow of 8 cfs. In April and September flows are 1.5 and 3.3 respectively. All other monthly flows exceed 7.0 cfs.

Project Condition 1 (San Jose Creek WRP)

Project Condition 1 (San Jose Creek WRP) for WY 2011 (representative wet year) shows an average 1% reduction in flows during the wet season (149 cfs monthly average), but flows are unchanged during the dry season (8 cfs monthly average) as compared to Existing Conditions. In April and September flows are 1.5 and 3.3 respectively. In October, inflow remains at 0 cfs. All other monthly flows exceed 7.0 cfs.

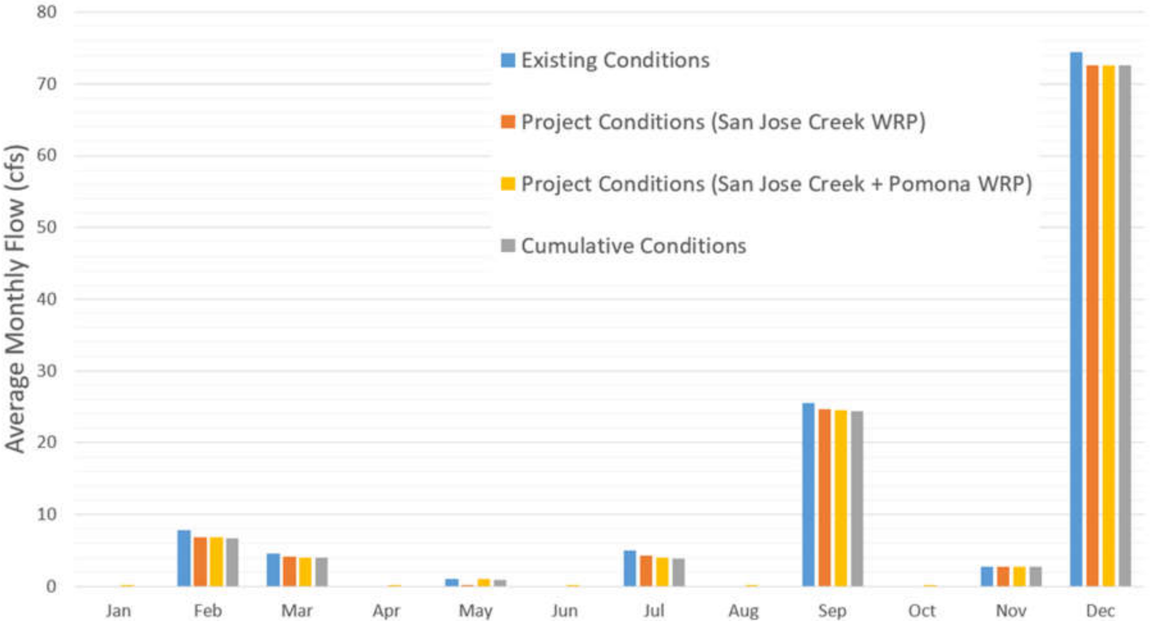
Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs)

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs) for WY 2011 (representative wet year) shows an average 1% reduction in flows during the wet season (149 cfs monthly average) and an average 1% reduction during the dry season (8 cfs monthly average) as compared to Existing Conditions. In April and September flows are 1.5 and 3.3 respectively. In October, inflow remains at 0 cfs. All other monthly flows exceed 7.0 cfs.

Cumulative Conditions (San Jose Creek WRP, No Imported Water)

Cumulative Conditions (Project 2, No Imported Water) for WY 2011 (representative wet year) show an average 1% reduction in flows during the wet season (149 cfs monthly average) and an average 4% reduction during the dry season (8 cfs monthly average) as compared to Existing Conditions. In April and September flows are 1.4 and 3.1 respectively. In October, inflow remains at 0 cfs. All other monthly flows exceed 7.0 cfs.

Dry Year (WY2015)



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 23
Surface Water Inflows for Assessment Area 3 under Existing, Project 1, Project 2, and Cumulative Conditions Dry Year (WY2015)

Existing Conditions

Under Existing Conditions for WY 2015 (representative dry year), Assessment Area 3 is dominated by storm runoff events during September and December. No flow was discharged from Whittier Narrows WRP outfall for WY 2015 (representative dry year). Less than 10 cfs flows to Assessment Area 3 during all other months. During January, April, June, August and October, there is no inflow to Assessment Area 3. During May and November, 1.0 cfs and 2.8 reach Assessment Area 3 respectively.

Project Condition 1 (San Jose Creek WRP)

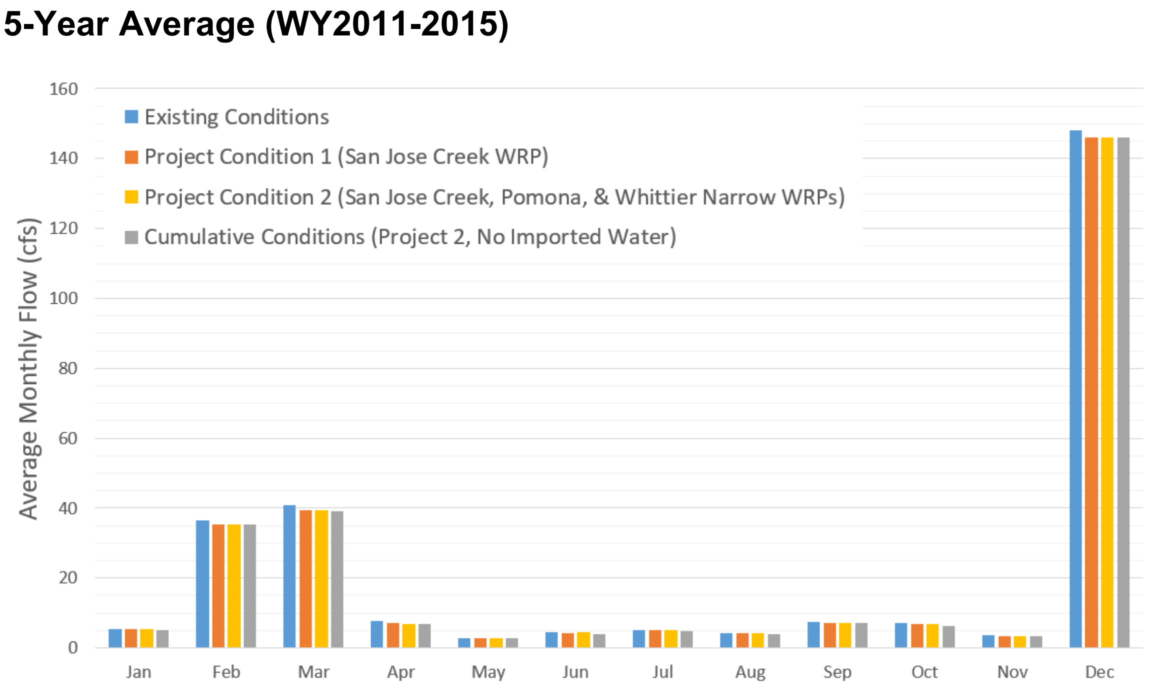
Project Condition 1 (San Jose Creek WRP) for WY 2015 (representative dry year) shows an average 4% reduction in flows during the wet season (14 cfs monthly average) and a 7% reduction in flows during the dry season (5 cfs monthly average) as compared to Existing Conditions. During January, April, June, August and October, inflow remains at 0 cfs. Flows in May and November decrease to 0.2 cfs and 2.7 cfs respectively.

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs)

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs) for WY 2015 (representative dry year) shows an average 4% reduction in flows during the wet season (14 cfs monthly average) and a 6% reduction in flows during the dry season (5 cfs monthly average) as compared to Existing Conditions. During January, April, June, August and October, inflow remains at 0 cfs. Flows in May and November decrease to 0.2 cfs and 2.6 cfs respectively.

Cumulative Conditions (San Jose Creek WRP, No Imported Water)

Cumulative Conditions (Project 2, No Imported Water) for WY 2015 (representative dry year) show an average 4% reduction in flows during the wet season (14 cfs monthly average) and a 9% reduction in flows during the dry season (5 cfs monthly average) as compared to Existing Conditions. During January, April, June, August and October, inflow remains at 0 cfs. Flows in May and November decrease to 0.2 cfs and 2.7 cfs respectively.



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 24
Surface Water Inflows for Assessment Area 3 under Existing, Project 1, Project 2, and Cumulative Conditions 5-Year Average (WY2011-2015)

Existing Conditions

Under Existing Conditions for WY 2011-2015 (5-year average), Assessment Area 3 is dominated by storm runoff events during the wet season months, with an average monthly flow of 40 cfs. During the dry season, less flow reaches Assessment Area 3, with an average monthly flow of 5 cfs. All other monthly flows exceed 2.9 cfs. During the dry season, the majority of flow is received from the Whittier Narrows outfall.

Project Condition 1 (San Jose Creek WRP)

Project Condition 1 (San Jose Creek WRP) for WY 2011-2015 (5-year average) shows an average 2% reduction in flows during the wet season (39 cfs monthly average) and an average 3% reduction during the dry season (5 cfs monthly average) as compared to Existing Conditions. All flows exceed 2.8 cfs. During the dry season, the majority of flow is received from the Whittier Narrows outfall.

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs)

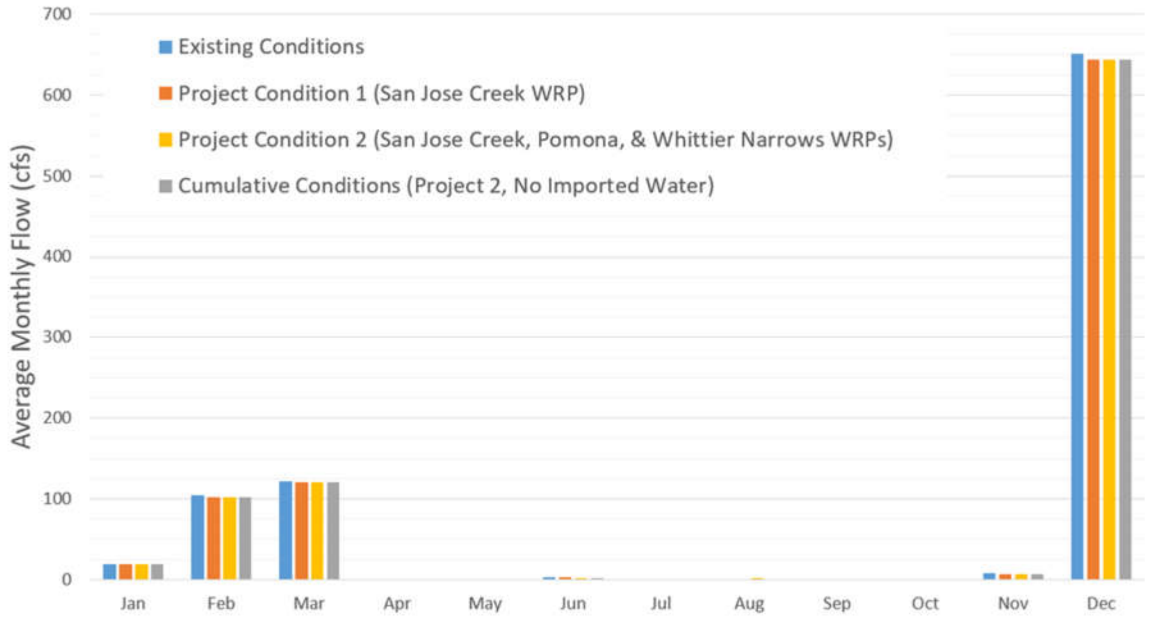
Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs) for WY 2011-2015 (5-year average) shows an average 2% reduction in flows during the wet season (39 cfs monthly average) and an average 2% reduction during the dry season (5 cfs monthly average) as compared to Existing Conditions. All flows exceed 2.9 cfs. During the dry season, the majority of flow is received from the Whittier Narrows outfall. The Whittier Narrows wastewater change petition has no effect on average monthly reductions in flow.

Cumulative Conditions (San Jose Creek WRP, No Imported Water)

Cumulative Conditions (Project 2, No Imported Water) for WY 2011-2015 (5-year average) show an average 3% reduction in flows during the wet season (39 cfs monthly average) and an average 7% reduction during the dry season (5 cfs monthly average) as compared to Existing Conditions. All flows exceed 2.8 cfs. During the dry season, the majority of flow is received from the Whittier Narrows outfall. The Whittier Narrows wastewater change petition has no effect on average monthly reductions in flow.

Assessment Area 4: San Gabriel River at Whittier Narrows Dam to 1,500 Feet Downstream

Wet Year (WY2011)



SOURCE: ESA

Figure 25
Surface Water Inflows for Assessment Area 4 under Existing, Project 1, Project 2, and Cumulative Conditions Wet Year (WY2011)

Existing Conditions

Under Existing Conditions for WY 2011 (representative wet year), Assessment Area 4 is dominated by storm runoff events during the wet season months, with an average monthly flow of 151 cfs. During October, no water reaches Assessment Area 4. During the dry season, June is the only month with flow (2.6 cfs). Little to no flow reaches Assessment Area 4 from upstream due to percolation and other losses downstream of Peck Road.

Project Condition 1 (San Jose Creek WRP)

Project Condition 1 (San Jose Creek WRP) for WY 2011 (representative wet year) shows an average 1% reduction in flows during the wet season (149 cfs monthly average) and an average 7% reduction during the dry season (0.4 cfs monthly average) as compared to Existing Conditions. Flow in June decreases to 2.4 cfs. All other dry season months have an inflow of 0 cfs.

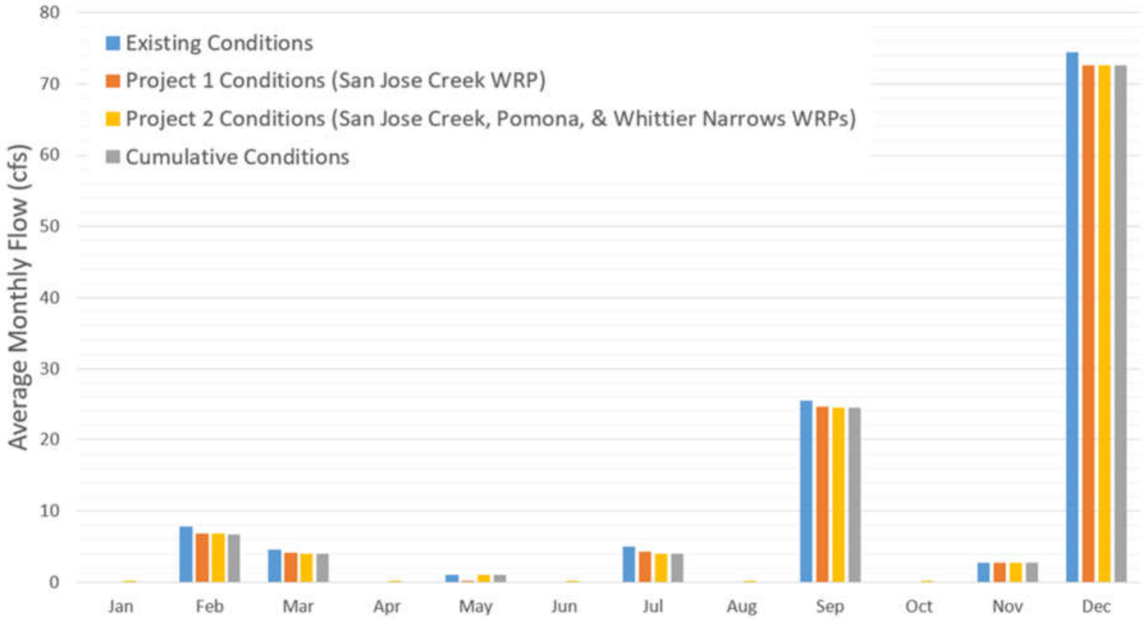
Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs)

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs) for WY 2011 (representative wet year) shows an average 1% reduction in flows during the wet season (149 cfs monthly average) and an average 11% reduction during the dry season (0.4 cfs monthly average) as compared to Existing Conditions. Flow in June decreases to 2.3 cfs. All other dry season months have an inflow of 0 cfs.

Cumulative Conditions (San Jose Creek WRP, No Imported Water)

Cumulative Conditions (Project 2, No Imported Water) for WY 2011 (representative wet year) show an average 1% reduction in flows during the wet season (149 cfs monthly average) and an average 32% reduction during the dry season (0.3 cfs monthly average) as compared to Existing Conditions. Flow in June decreases to 1.7 cfs. All other dry season months have an inflow of 0 cfs.

Dry Year (WY2015)



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 26
Surface Water Inflows for Assessment Area 4 under Existing, Project 1, Project 2, and Cumulative Conditions Dry Year (WY2015)

Existing Conditions

Under Existing Conditions for WY 2015 (representative dry year), Assessment Area 4 is dominated by storm runoff events during the wet season months, with an average monthly flow of 15 cfs. During January and October, no water reaches Assessment Area 4. During the dry season, May, July, and September are the only months with flow (1.0, 5.0, and 25 cfs average monthly flow respectively). Little to no flow reaches Assessment Area 4 from upstream due to percolation and other losses downstream of Peck Road.

Project Condition 1 (San Jose Creek WRP)

Project Condition 1 (San Jose Creek WRP) for WY 2015 (representative dry year) shows an average 4% reduction in flows during the wet season (14 cfs monthly average) and an average 7%

reduction during the dry season (5 cfs monthly average) as compared to Existing Conditions. Flow in May and July decreases to 0.2 cfs and 4.3 cfs respectively.

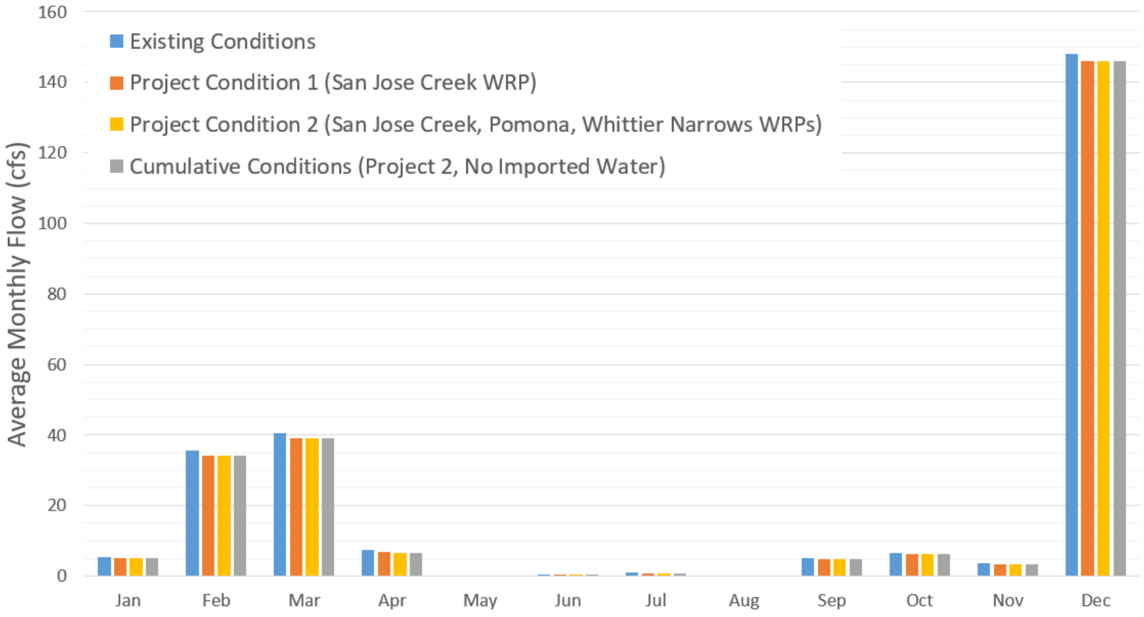
Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs)

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs) for WY 2015 (representative dry year) shows an average 4% reduction in flows during the wet season (14 cfs monthly average) and an average 6% reduction during the dry season (5 cfs monthly average) as compared to Existing Conditions. Flow in May and July decreases to 1.0 cfs and 4.0 cfs respectively.

Cumulative Conditions (San Jose Creek WRP, No Imported Water)

Cumulative Conditions (Project 2, No Imported Water) for WY 2015 (representative dry year) show an average 4% reduction in flows during the wet season (14 cfs monthly average) and an average 6% reduction during the dry season (5 cfs monthly average) than Existing Conditions. Flow in May and July decreases to 1.0 cfs and 4.0 cfs respectively.

5-Year Average (WY2011-2015)



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 27
Surface Water Inflows for Assessment Area 4 under Existing, Project 1, Project 2, and Cumulative Conditions 5-Year Average (WY2011-2015)

Existing Conditions

Under Existing Conditions for WY 2011-2015 (5-year average), Assessment Area 4 is dominated by storm runoff events during the wet season months, with an average monthly flow of 40 cfs. During the dry season, an average 2.4 cfs reaches Assessment Area 4. August average inflow is 0 cfs. Little to no flow reaches Assessment Area 4 from upstream due to percolation and other losses downstream of Peck Road.

Project Condition 1 (San Jose Creek WRP)

Project Condition 1 (San Jose Creek WRP) for WY 2011-2015 (5-year average) shows an average 2% reduction in flows during the wet season (39 cfs monthly average) and an average 7% reduction during the dry season (2.2 cfs monthly average) as compared to Existing Conditions. Flow in May is reduced to 0 cfs and flow in August remains at 0 cfs.

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs)

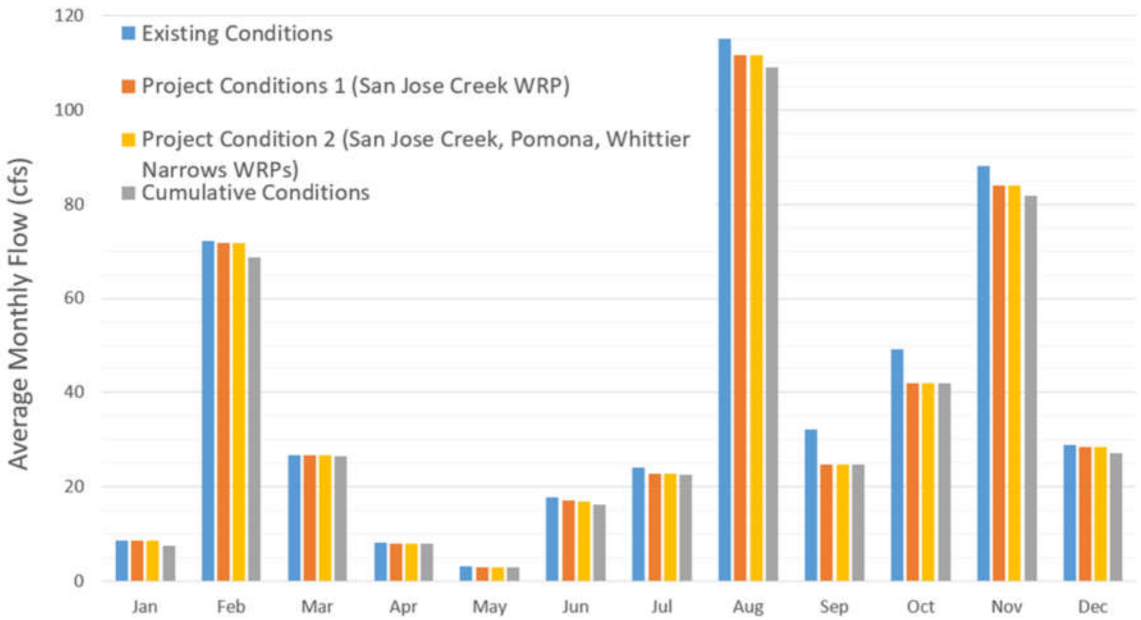
Project Conditions 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs) for WY 2011-2015 (5-year average) shows an average 2% reduction in flows during the wet season (39 cfs monthly average) and an average 7% reduction during the dry season (2.2 cfs monthly average) as compared to Existing Conditions. Flow in August remains at 0 cfs.

Cumulative Conditions (San Jose Creek WRP, No Imported Water)

Cumulative Conditions (Project 2, No Imported Water) for WY 2011-2015 (5-year average) show an average 2% reduction in flows during the wet season (39 cfs monthly average) and an average 9% reduction during the dry season (2.2 cfs monthly average) as compared to Existing Conditions. Flow in August remains at 0 cfs.

Assessment Area 5: Zone 1 Ditch Diversion / Backwater from Rio Hondo

Wet Year (WY2011)



SOURCE: ESA

Figure 28
Surface Water Inflows for Assessment Area 4 under Existing, Project 1, Project 2, and Cumulative Conditions Wet Year (WY2011)

Existing Conditions

Under Existing Conditions for WY 2011 (representative wet year), Assessment Area 5 inflows are dominated by diversions from Peck Road percolation areas. During the wet season, when percolation areas at Peck Road have sufficient head, water is diverted. Diversions often lagged rainfall events by several months. During the dry season, as the ponded areas dried up, less flow was diverted. Assessment Area 5 had an average monthly inflow during the wet season of 46 cfs and during the dry season 33 cfs. Flow in May was 3.1 cfs.

Project Condition 1 (San Jose Creek WRP)

Under Project Condition 1 (San Jose Creek WRP) for WY 2011 (representative wet year), we assumed that if flows were not passing Peck Road, no flows could be diverted down Zone 1 Ditch. Based on this assumption, the model results show an average 5% reduction in flows during the wet season (44 cfs monthly average) and an average 7% reduction during the dry season (31 cfs monthly average) as compared to Existing Conditions. Flow in May reduced to 2.9 cfs. More detailed modeling of Zone 1 Ditch operations would be needed to optimize water management.

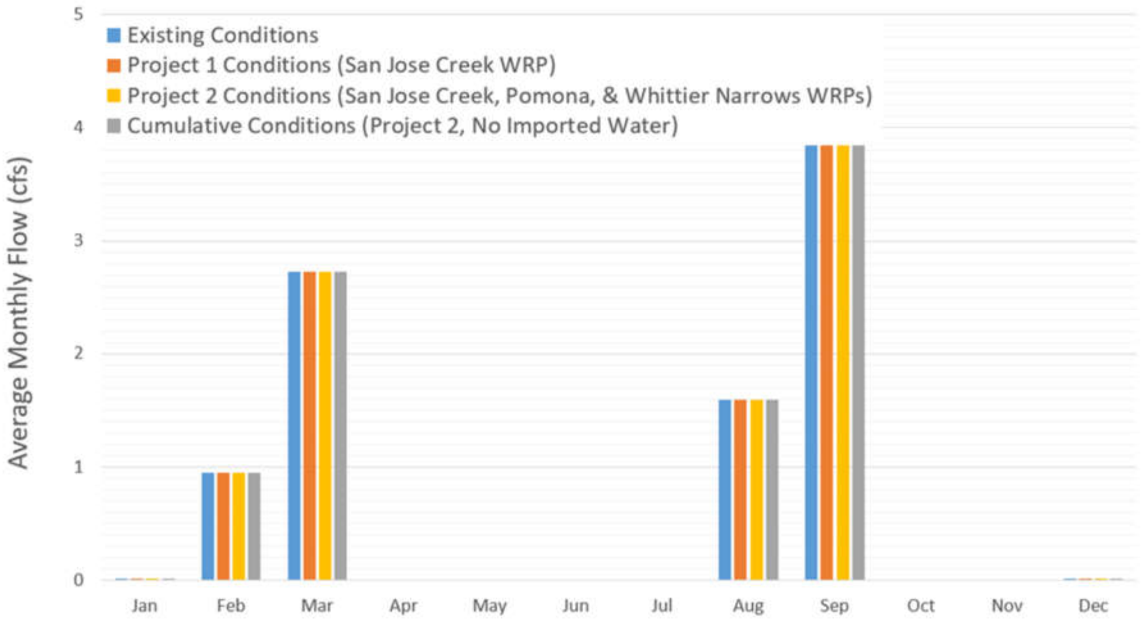
Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs)

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs) for WY 2011 (representative wet year) is almost identical to Project Condition 1 because Zone 1 Ditch diversions are "turned off" when flows on the San Gabriel River fall below the AMP recommended level.

Cumulative Conditions (San Jose Creek WRP, No Imported Water)

Cumulative Conditions (Project 2, No Imported Water) for WY 2011 (representative wet year) are almost identical to Project Condition 1 and Project Condition 2 because Zone 1 Ditch diversions are "turned off" when flows on the San Gabriel River fall below the AMP recommended level.

Dry Year (WY2015)



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 29
Surface Water Inflows for Assessment Area 4 under Existing, Project 1, Project 2, and Cumulative Conditions Dry Year (WY2015)

Existing Conditions

Under Existing Conditions for WY 2015 (representative dry year), Assessment Area 5 inflows are dominated by diversions from Peck Road percolation areas. During the wet season, when percolation areas at Peck Road have sufficient head, water is diverted. Diversions often lagged rainfall events by several months. During the dry season, as the ponded areas dried up, less flow was diverted. Assessment Area 5 had an average monthly inflow during the wet season of 0.6 cfs and during the dry season it was 0.9 cfs. There was no inflow for the majority of months, with all monthly inflows less than 3.8 cfs.

Project Condition 1 (San Jose Creek WRP)

Project Condition 1 (San Jose Creek WRP) for WY 2011 (representative wet year) remains unchanged from Existing Conditions. This is because Zone 1 Ditch diversions are "turned off" when flows on the San Gabriel River fall below the AMP recommended level.

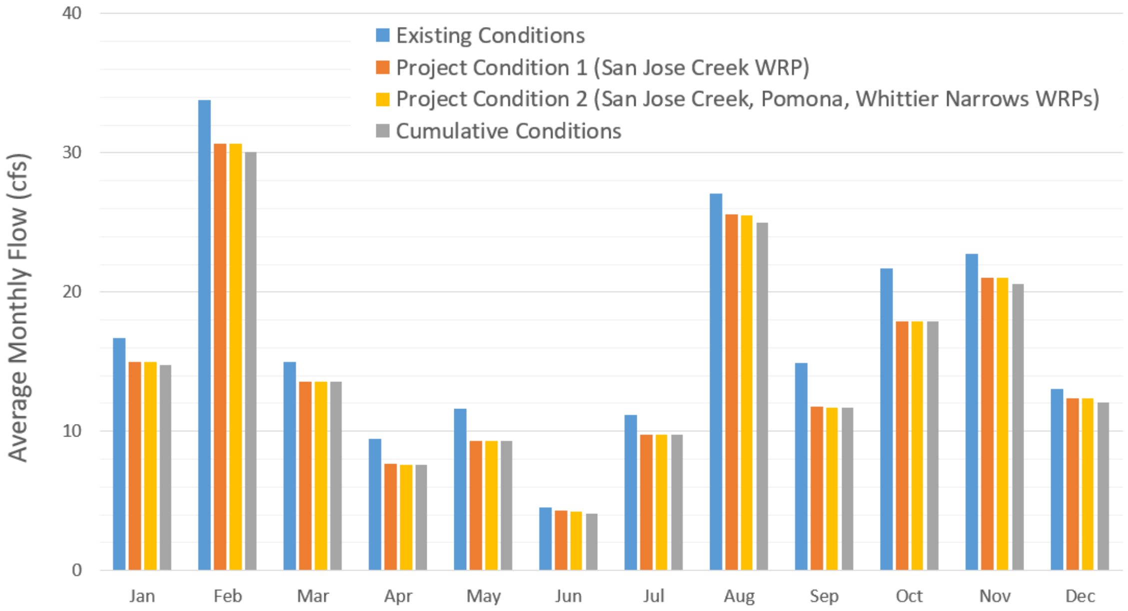
Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs)

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs) for WY 2015 (representative dry year) remains unchanged from Existing Conditions.

Cumulative Conditions (San Jose Creek WRP, No Imported Water)

Cumulative Conditions (Project 2, No Imported Water) for WY 2015 (representative dry year) remain unchanged from Existing Conditions.

5-Year Average (WY2011-2015)



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 30
Surface Water Inflows for Assessment Area 4 under Existing, Project 1, Project 2, and Cumulative Conditions 5-Year Average (WY2011-2015)

Existing Conditions

Under Existing Conditions Assessment for WY 2011-2015 (5-year average), Assessment Area 5 inflows are dominated by diversions from Peck Road percolation areas. During the wet season, when percolation areas at Peck Road have sufficient head, water is diverted. Diversions often lagged rainfall events by several months. During the dry season, as the ponded areas dried up, less flow was diverted. Assessment Area 5 had an average monthly inflow during the wet season of 20 cfs and during the dry season it was 13 cfs. Flow in June was 4.6 cfs.

Project Condition 1 (San Jose Creek WRP)

Under Project Condition 1 (San Jose Creek WRP) for WY 2011-2015 (5-year average), we assumed that if flows were not passing Peck Road, no flows could be diverted down Zone 1 Ditch. Based on this assumption, the model results show an average 10% reduction in flows during the wet season (18 cfs monthly average) and an average 13% reduction during the dry season (11 cfs monthly average) as compared to Existing Conditions. Flow in June reduced to 4.3 cfs. More detailed modeling of Zone 1 Ditch operations would be needed to optimize water management.

Project Condition 2 (San Jose Creek, Pomona, & Whittier Narrows WRPs)

Project Condition 2 (San Jose Creek, Pomona, and Whittier Narrows WRPs) for WY 2011-2015 (5-year average) is almost identical to Project Condition 1 because Zone 1 Ditch diversions are "turned off" when flows on the San Gabriel River fall below the AMP recommended level.

Cumulative Conditions (San Jose Creek WRP, No Imported Water)

Cumulative Conditions (Project 2, No Imported Water) for WY 2011-2015 (5-year average) are almost identical to Project Condition 1 and Project Condition 2 because Zone 1 Ditch diversions are "turned off" when flows on the San Gabriel River fall below the AMP recommended level.

CHAPTER 4
Groundwater

Background and Summary of Groundwater Basin Adjudication

The Assessment Areas are located within the southern portion of the Main San Gabriel Basin. The Main San Gabriel Basin occupies most of San Gabriel Valley and is bounded on the north by the San Gabriel Mountains, on the east by the San Jose Hills, on the south by the Puente Hills, and the Raymond Fault on the west. San Gabriel River and Rio Hondo, a distributary of the San Gabriel River, drain the San Gabriel River watershed. The aquifers are located inland (saltwater intrusion is not a risk) and are unconfined (shallower aquifers) or semiconfined (deeper aquifers) (Appendix L in Kennedy/Jenks 2008). The major sources of natural recharge to Main San Gabriel Basin are infiltration of rainfall on the valley floor and runoff from the nearby mountains (San Gabriel River Watermaster 2017). The Main San Gabriel Basin is the first of a series of basins (including the adjacent Puente Basin, and the downstream Central and West Coast Basins) to receive mountain runoff, and the Basin interacts hydrogeologically and institutionally with adjoining basins, including the Puente, Central, and West Coast Basins. Most of the local communities depend almost entirely on Main San Gabriel Basin groundwater for their water supply with indirect access to untreated imported water to replenish groundwater in the Basin.

The Main San Gabriel Basin groundwater and surface water rights were adjudicated in 1973 in response to overdraft of the groundwater supply that was affecting groundwater users within the Main San Gabriel Basin and downstream users in the Central and West Coast Basins (San Gabriel River Watermaster 2017). The adjudication defined water rights, created the Main San Gabriel Watermaster as the governing body, and described a Physical Solution for water management. The Physical Solution provides for Watermaster control of Basin management, and flexibility in initiating cooperative agreements, regulating and controlling pumping, purchasing replacement water, authorizing groundwater recharge facilities, and determining the natural and operational safe yields. Pumpers whose production exceeds their water rights pay an assessment to finance the purchase of replenishment water. The adjudication placed injunctions against unauthorized production, non-consumptive uses (not including spreading), unauthorized recharge, and exporting native water from the Main San Gabriel Basin. The adjudication guarantees the downstream Central and West Coast Basins an average annual water supply of about 98,000 acre- feet per year through the Whittier Narrows.

Monitoring of flow during wet and dry conditions has shown that San Jose Creek between Pomona WRP and San Jose Creek WRP is mostly a gaining creek (groundwater upwells and contributed to flow). The area around the confluence of San Jose Creek and the San Gabriel River has also been shown to gain flow at some times, but lose it to groundwater recharge at others. Downstream of the confluence the San Gabriel River is a losing reach and is specifically managed for groundwater recharge in Assessment Areas 1 and 2.

Groundwater Level Data

To assess the potential effects of the project on groundwater, existing groundwater observation wells were analyzed to determine whether riparian habitat in the Assessment Areas was likely dependent on groundwater, and the effects of the proposed surface water changes were qualitatively overlain on these patterns. Three pairs of groundwater wells were located that span the San Gabriel River near the Assessment Areas, as shown in **Figure 31**. Some of the wells do not have recent data, so in some cases we have relied on data from 1980 onwards that may not represent recent dry conditions. Topographic cross sections were cut across the San Gabriel River using LA County LiDAR data, and the elevation of the groundwater surface added. For each cross section we show the average groundwater elevation during the period analyzed as well as the 90th and 10th percent exceeded elevation, which gives an indication of typical summer and winter levels, as well as accounting for longer term fluctuations. The cross sections and associated time series are shown in **Figures 31** through **39**. Note that the groundwater levels shown are linear interpolations between two well points: in reality percolation from the river would create local mounding of the water table beneath and some distance away from the channel bed during months when surface water was flowing, as shown schematically in Figure 32. When assessing how groundwater may support riparian vegetation we assumed that most riparian tree roots would be found in the upper 3-6 feet of the soil profile.

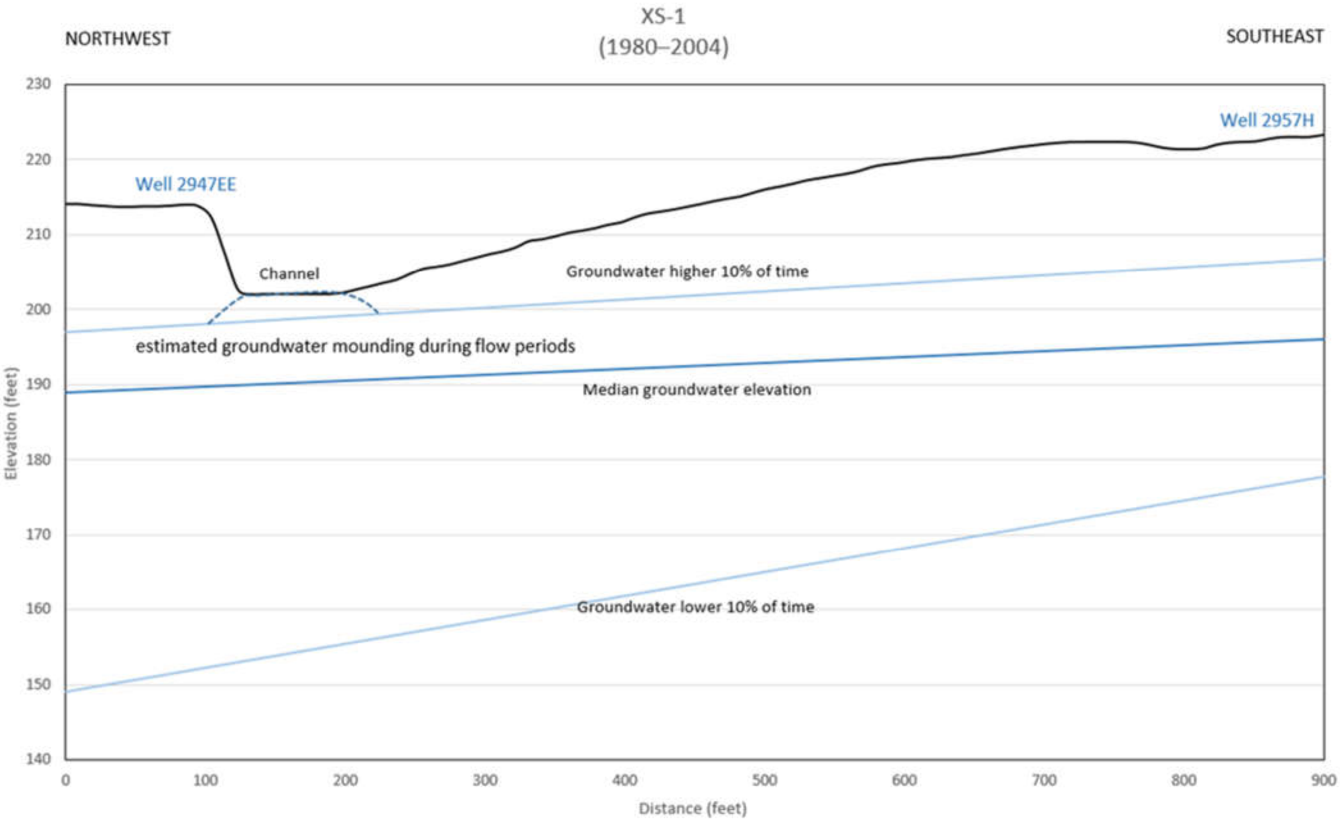
San Jose Creek WRP Change Petition / D170647

SOURCE: Text, text, text

Figure 31
Groundwater Cross Sections within and below the Project Site

Cross Section 1

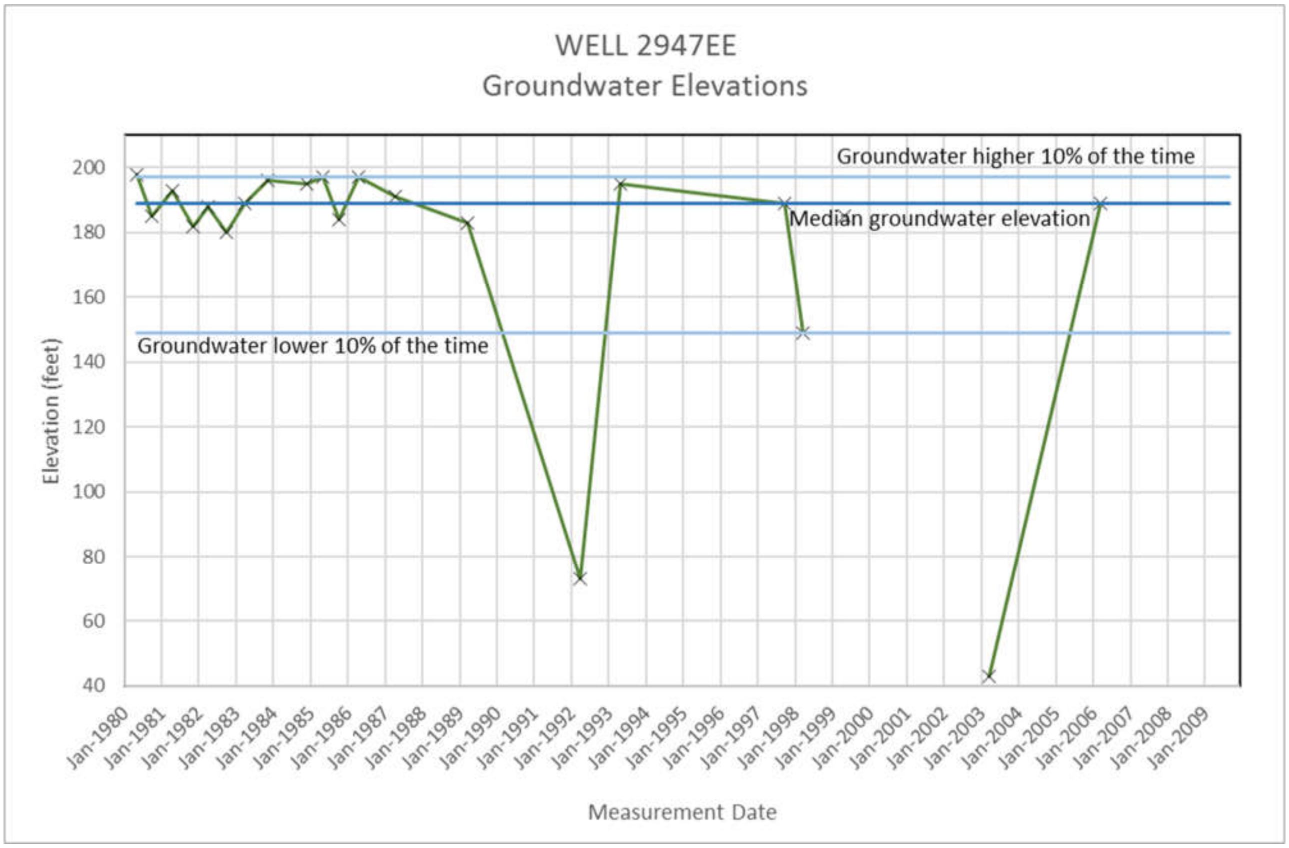
Cross section 1 corresponds to the boundary between Assessment Areas 2 and 3 (just upstream of the Whittier Narrows WRP outfall). The data suggest that during the wet season of wetter than average years, groundwater is likely high enough to be reached by the roots of riparian vegetation growing in and around the channel bed (especially when groundwater mounding is added to the interpolated line), but that during the dry season and dry years the water level likely drops below the typical root zone for riparian trees except for short periods after flow events.



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

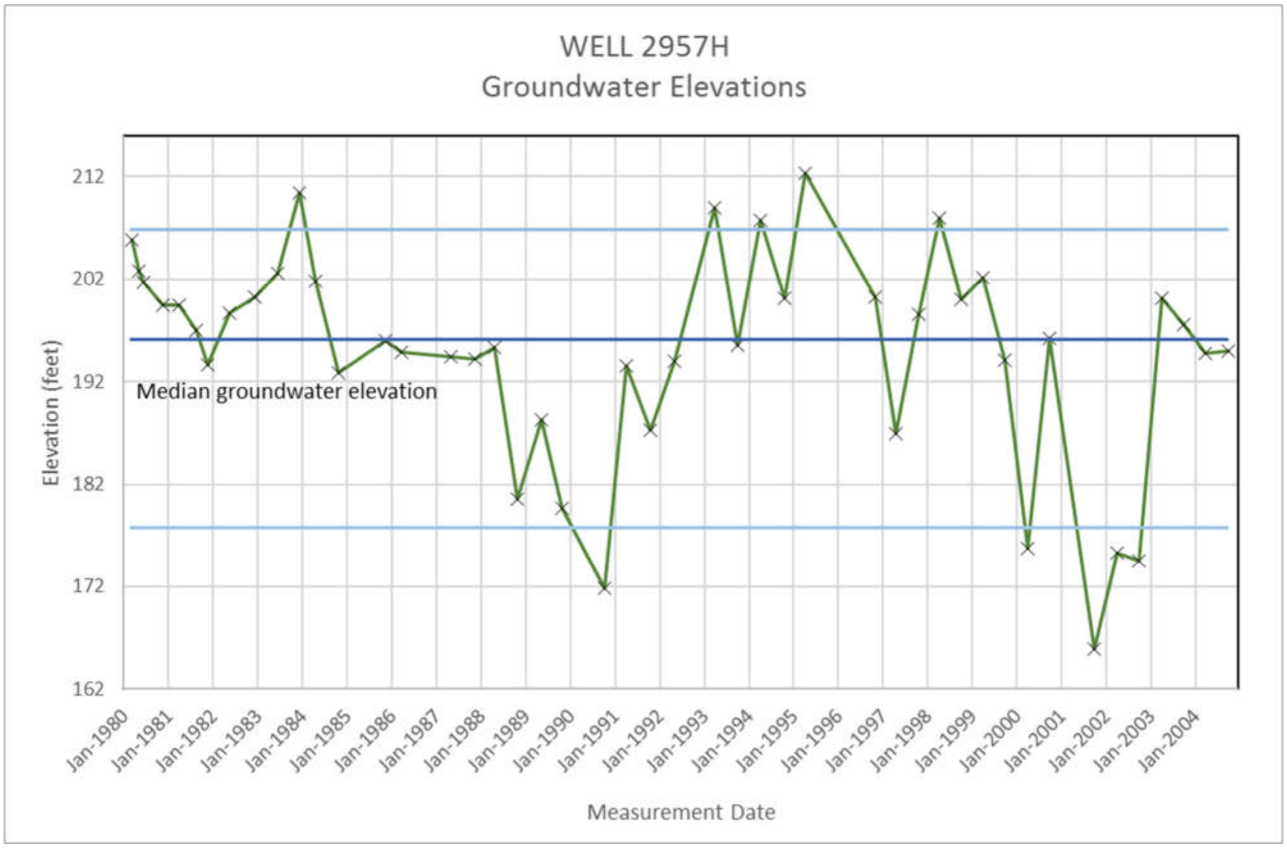
Figure 32
Interpolated Groundwater Elevation at Cross Section 1, 1980-2004



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 33
Groundwater Elevation Data (WELL 294EE) at Cross Section 1, 1980-2004



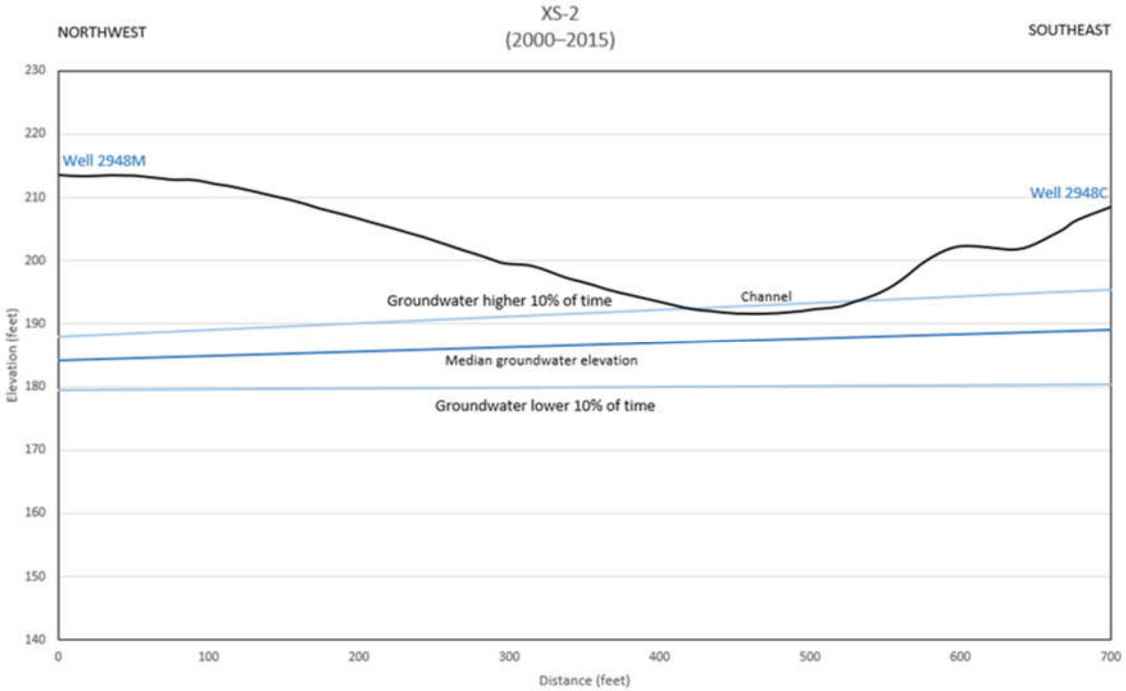
San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 34
Groundwater Elevation Data (WELL 2957H) at Cross Section 1, 1980-2004

Cross Section 2

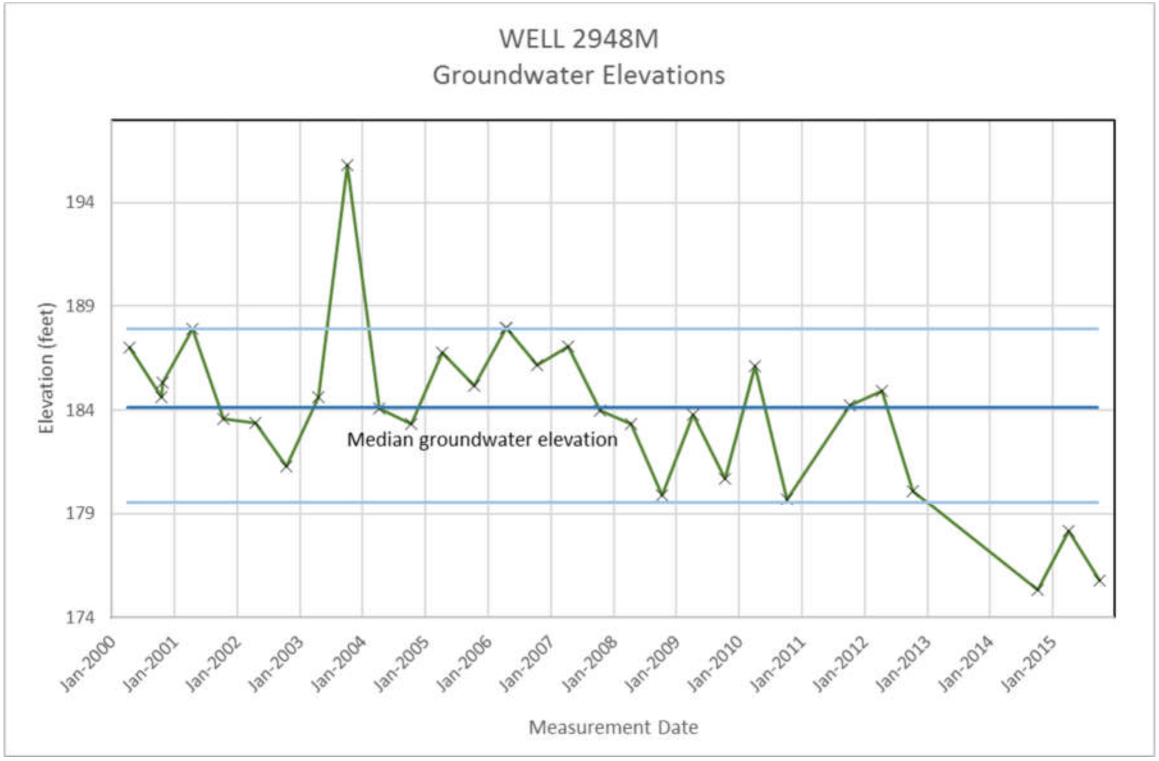
Cross section 2 is located just downstream of Whittier Narrows dam in Assessment Area 4. The groundwater table comes close to or at the channel bed elevation during the wet season of most years and during the dry season of wetter than average years. During the last few drought years it has dropped below the typical root zone for riparian trees. It appears likely that groundwater plays some role in sustaining riparian vegetation in this Assessment Area, but may not be reliable during drought conditions.



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 35
Interpolated Groundwater Elevation at Cross Section 2, 2000-2015



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 36
Groundwater Elevation Data (Well 2948M) at Cross Section 2, 2000-2015

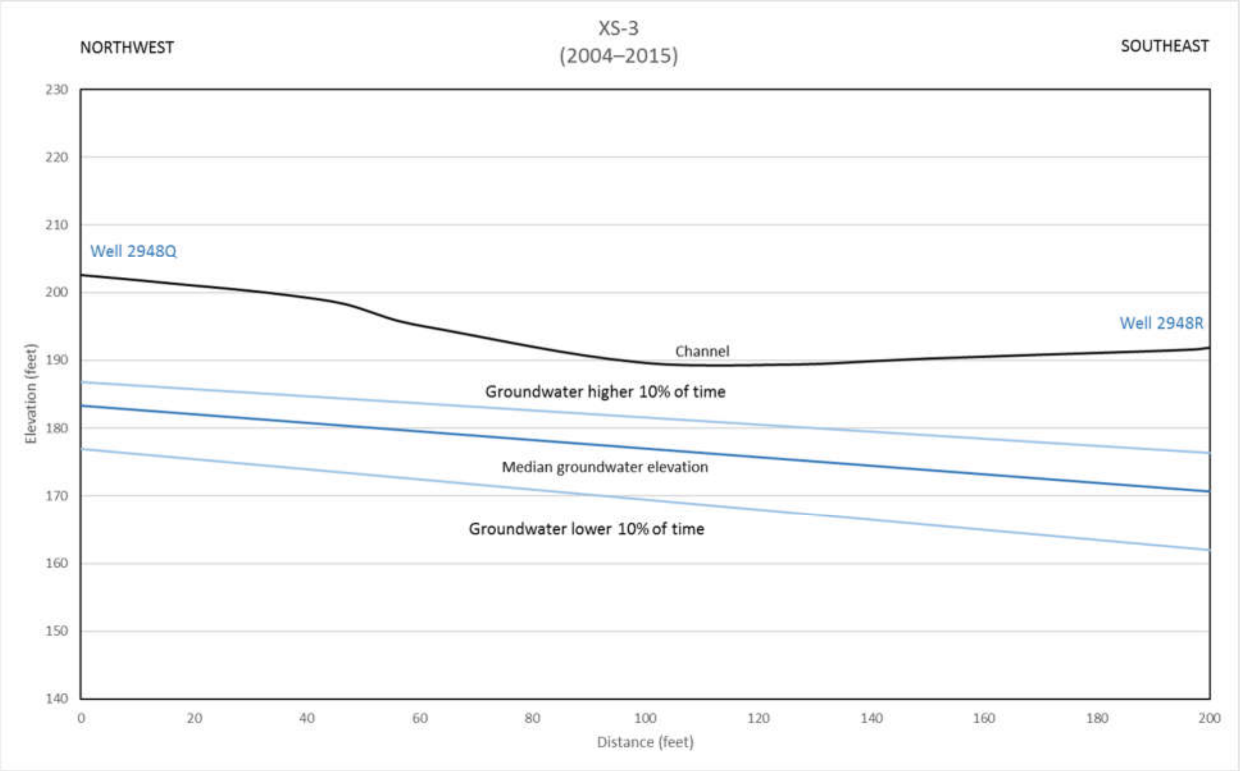
San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 37
Groundwater Elevation Data (Well 2948C) at Cross Section 2, 2000-2015

Cross Section 3

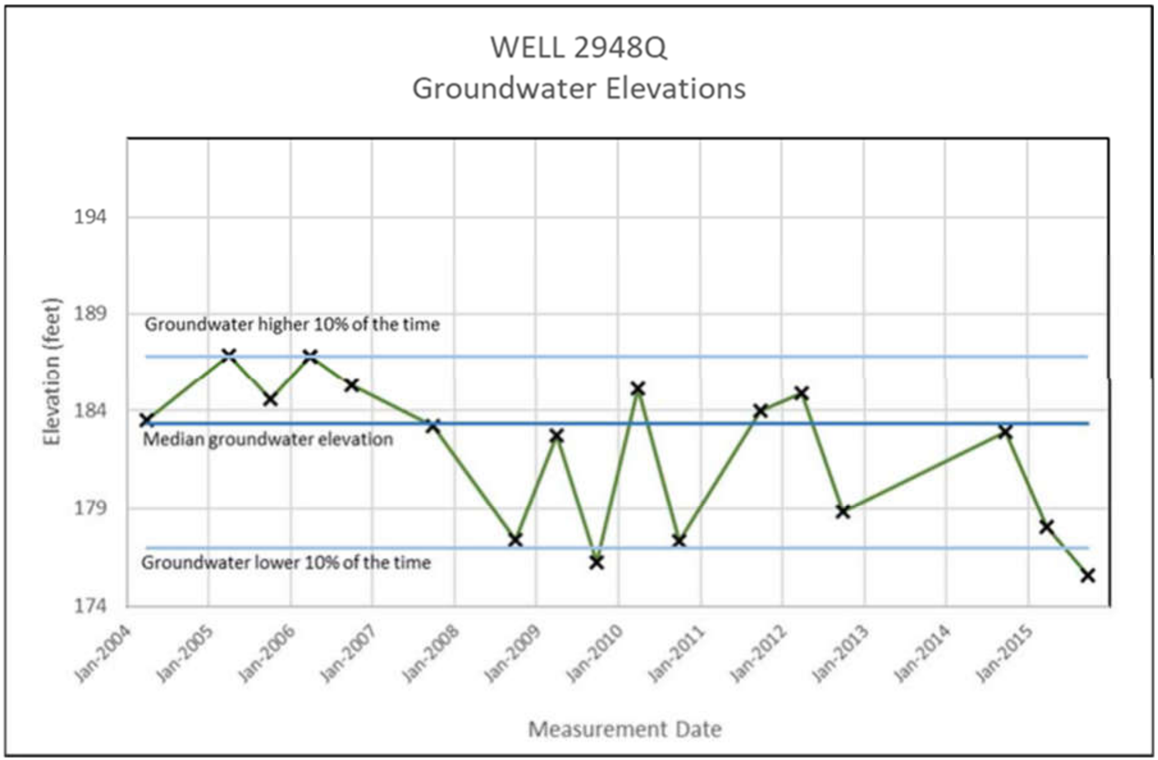
Cross section 3 is at the downstream limit of Assessment Area 4. It suggests that about half the time, groundwater is high enough to be reached by the roots of mature riparian trees. As with the other wells, groundwater levels have fallen during the drought and were below the typical root zone for most riparian trees.



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

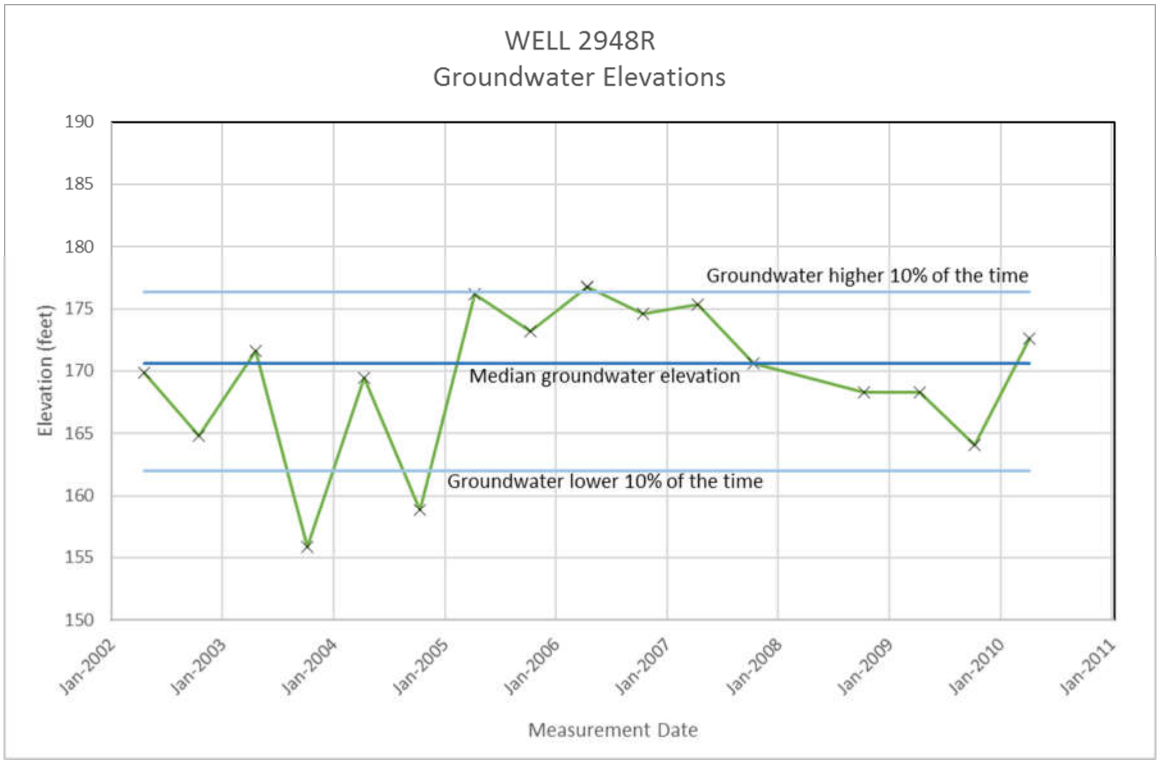
Figure 38
Interpolated Groundwater Elevation at Cross Section 3, 2004-2015



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 39
Groundwater Elevation Data (Well 2948Q) at Cross Section 3, 2004-2015



San Jose Creek WRP Change Petition / D170647

SOURCE: ESA

Figure 40
Groundwater Elevation Data (Well 2948R) at Cross Section 3, 2004-2015

Summary

The project will likely affect groundwater in a similar way to surface water. For example, underdry year conditions the additional dry season flows in the San Gabriel River would have also contributed to increased percolation and increased groundwater elevation during the summer, while the reduction in wet season flows would have slightly reduced groundwater recharge and lowered water surface elevations during the winter.

CHAPTER 5

Summary of Project Effects on Habitat Assessment Areas 1-5

Existing Conditions

- The system experiences great variability in flow between and within years, with wet season flow dominated by rainfall-runoff events and dry season flow dominated by WRP discharges, dry season urban flows and localized upwelling.

- The percolation areas between San Jose Creek and Peck Road infiltrate large volumes of water; during the summer the San Gabriel River usually runs dry downstream of the last weir despite inflows of around 20-40 cfs from upstream. To some degree this “dry gap” buffers downstream areas from the effects of flow changes at San Jose Creek WRP and Pomona WRP, since most of the dry season flows from these areas do not pass downstream of the lowest percolation area.

- The Zone 1 Ditch (Rio Hondo Bypass) currently diverts a monthly average of 22 cfs (2010-2016 to the Rio Hondo from the San Gabriel River.

- Groundwater likely supports some habitat areas (notably downstream of Whittier Narrows Dam) especially in winter and during wetter than average years, but is an unreliable source of water during drought conditions.

Project Conditions

- The District’s goal is to provide enough water to meet the evapotranspiration needs of the riparian habitats that currently are supported by surface flows in the channel.

- The District will implement an Adaptive Management Plan in coordination with CDFW to monitor the health of the existing vegetation riparian under the proposed new discharge plan.

- If monitoring shows an impact to habitat health, more water will be made available, up to existing discharge volumes.

Proposed Project Effects

The dry season flow results are summarized in Table 6, and the percent change from existing conditions are shown in Table 7.

TABLE 6
DRY SEASON AVERAGE FLOWS

	Habitat Assessment Area 1	Habitat Assessment Area 2	Habitat Assessment Area 3	Habitat Assessment Area 4	Habitat Assessment Area 5

	2011 wet year				
	Dry season average flow (cfs)				
Existing	95	55	8	0	33
Project 1 (San Jose Creek WRP)	78	45	8	0	31
Project 2 (San Jose Creek WRP + Pomona WRP + Whittier Narrows WRP)	73	39	8	0	31
Cumulative (Project 2 + No imported water)	27	18	8	0	31
	2015 dry year				
	Dry season average flow (cfs)				
Existing	37	26	5	5	1
Project 1 (San Jose Creek WRP)	24	19	5	5	1
Project 2 (San Jose Creek WRP + Pomona WRP + Whittier Narrows WRP)	21	14	5	5	1
Cumulative (Project 2 + No imported water)	21	14	5	5	1
	2011-16 average				
	Dry season average flow (cfs)				
Existing	35	19	6	2	11
Project 1 (San Jose Creek WRP)	24	17	6	2	10
Project 2 (San Jose Creek WRP + Pomona WRP + Whittier Narrows WRP)	21	13	5	2	9
Cumulative (Project 2 + No imported water)	13	9	5	2	9

TABLE 7
CHANGE IN DRY SEASON AVERAGE FLOWS

	Habitat Assessment Area 1	Habitat Assessment Area 2	Habitat Assessment Area 3	Habitat Assessment Area 4	Habitat Assessment Area 5
			2011 wet year		
			Dry season flow reduction (%)		
Existing	-	-	-	-	-
Project 1 (San Jose Creek WRP)	-18%	-17%	0%	-7%	-7%
Project 2 (San Jose Creek WRP + Pomona WRP + Whittier Narrows WRP)	-24%	-29%	-1%	-11%	-7%
Cumulative (Project 2 + No imported water)	-72%	-68%	-4%	-32%	-9%
			2015 dry year		
			Dry season flow reduction (%)		
Existing	-	-	-	-	-
Project 1 (San Jose Creek WRP)	-35%	-29%	-7%	-7%	0%
Project 2 (San Jose Creek WRP + Pomona WRP + Whittier Narrows WRP)	-42%	-47%	-6%	-6%	0%
Cumulative (Project 2 + No imported water)	-44%	-49%	-9%	-6%	0%
			2011-16 average		
			Dry season flow reduction (%)		
Existing	-	-	-	-	-
Project 1 (San Jose Creek WRP)	-30%	-13%	-3%	-7%	-13%
Project 2 (San Jose Creek WRP + Pomona WRP + Whittier Narrows WRP)	-40%	-32%	-3%	-8%	-14%
Cumulative (Project 2 + No imported water)	-62%	-51%	-6%	-9%	-15%

For all year types, certain trends and patterns are apparent.

- Wet season flows are dominated by watershed runoff, with treated wastewater only making up a small proportion of flow in the Habitat Assessment Areas. As a result, the project effects are small during the wet season (0-7% reduction in flow during the wet year type, 0-16% reduction in the dry year type).
- During the dry season, flows are much more dependent on treated wastewater discharges, and hence the project effects are greater (0-29% reduction in flow during the wet year type, 0-47% reduction in the dry year type).
- Assessment Areas 1, 2 and 5 receive a large proportion of flow from San Jose Creek WRP under existing conditions, and are sensitive to flow reductions from San Jose Creek and Pomona WRPs during the summer.
- Assessment Areas 3 and 4 receive wet season flow from San Jose Creek and the upstream San Gabriel River, but during the dry season a dry gap forms downstream of the in-channel ponded areas near Peck Road, and almost no surface flow from Peck Road ever reaches the Whittier Narrows Dam. As a result, surface flows to Assessment Areas 3 and 4 are insensitive to flow reductions from San Jose Creek and Pomona WRPs. There is insufficient groundwater historic data to show whether subsurface seepage can bridge the one-mile dry gap, and how sensitive this is to project flows.

- Assessment Area 3 is sensitive to flow reductions from Whittier Narrows WRP, but the proposed project reduction is very small.
- Almost no surface flow from Whittier Narrows WRP passes through the Whittier Narrows Dam during the summer, and therefore Assessment Area 4 does not appear to directly receive surface water from Whittier Narrows WRP. There is evidence of high groundwater table around the Whittier Narrows Dam, suggesting that surface water from Whittier Narrows WRP may reach Assessment Area 4 as groundwater. However, since little flow reduction is proposed from Whittier Narrows WRP, there is likely to be little groundwater impact in Assessment Area 4 either.
- Imported water is often a significant water source that is outside the District's control, and the effect of removing this from the water balance was larger than the effect of the proposed project in many months and habitat areas.

Wet Year (WY2011)

- During the dry season of the wet year type, the Project minimum flow was delivered to Assessment Area 1 under all project conditions, and flows close to the minimum were delivered to Assessment Areas 2 and 5 (which, being further downstream, require less than the full AMP flow).
- Assessment Area 3 received all its summer flow from Whittier Narrows WRP, but this was almost unchanged under Project Conditions.
- Assessment Area 4 received almost no flow throughout the summer, but is unchanged under Project Conditions.

Dry Year (WY2015)

- During the dry season of the dry year type, the Project minimum flow was delivered to Assessment Area 1 under all project conditions except for one month in which values were 1-3 cfs below the recommended 7.7 cfs value. Values close to the Project minimum were delivered to Assessment Area 2 with the exception of two months. Since Assessment Area 2 is further downstream from San Jose Creek, we would assume that it requires slightly less than the full Project flow.
- Assessment Area 3 received all its summer flow from Whittier Narrows WRP, but this was almost unchanged under Project Conditions.
- Assessment Area 4 received almost no flow throughout the summer, but is unchanged under Project Conditions.
- Assessment Area 5 did not receive any dry season flow under either existing or project conditions.

5-Year Average (WY2011-2015)

- During the dry season of the five-year average, the Project minimum flow was delivered to Assessment Areas 1, 2 and 5 under all project conditions.
- Assessment Area 3 received all its summer flow from Whittier Narrows WRP, but this was almost unchanged under Project Conditions.
- Assessment Area 4 received almost no flow throughout the summer, but is unchanged under Project Conditions.

Overall, while the proposed project reduces flow to several of the Assessment Areas, it still appears to deliver the Project recommended minimum flow (which is five to ten times the estimated evapotranspiration needs of the riparian habitat) to Assessment Areas 1 and 2 under almost all year types. Assessment Areas 3 and 4 do not appear to be hydrologically affected by San Jose Creek and Pomona WRPs during the dry season because of upstream percolation that creates a dry gap, and are barely affected by the small proposed reduction at Whittier Narrows WRP. Assessment Area 5 (Zone 1 Ditch Diversion) sees some reductions in dry season flows in order to maintain AMP recommended flows in the San Gabriel River mainstream, but again most flows are similar to existing condition during the dry season.

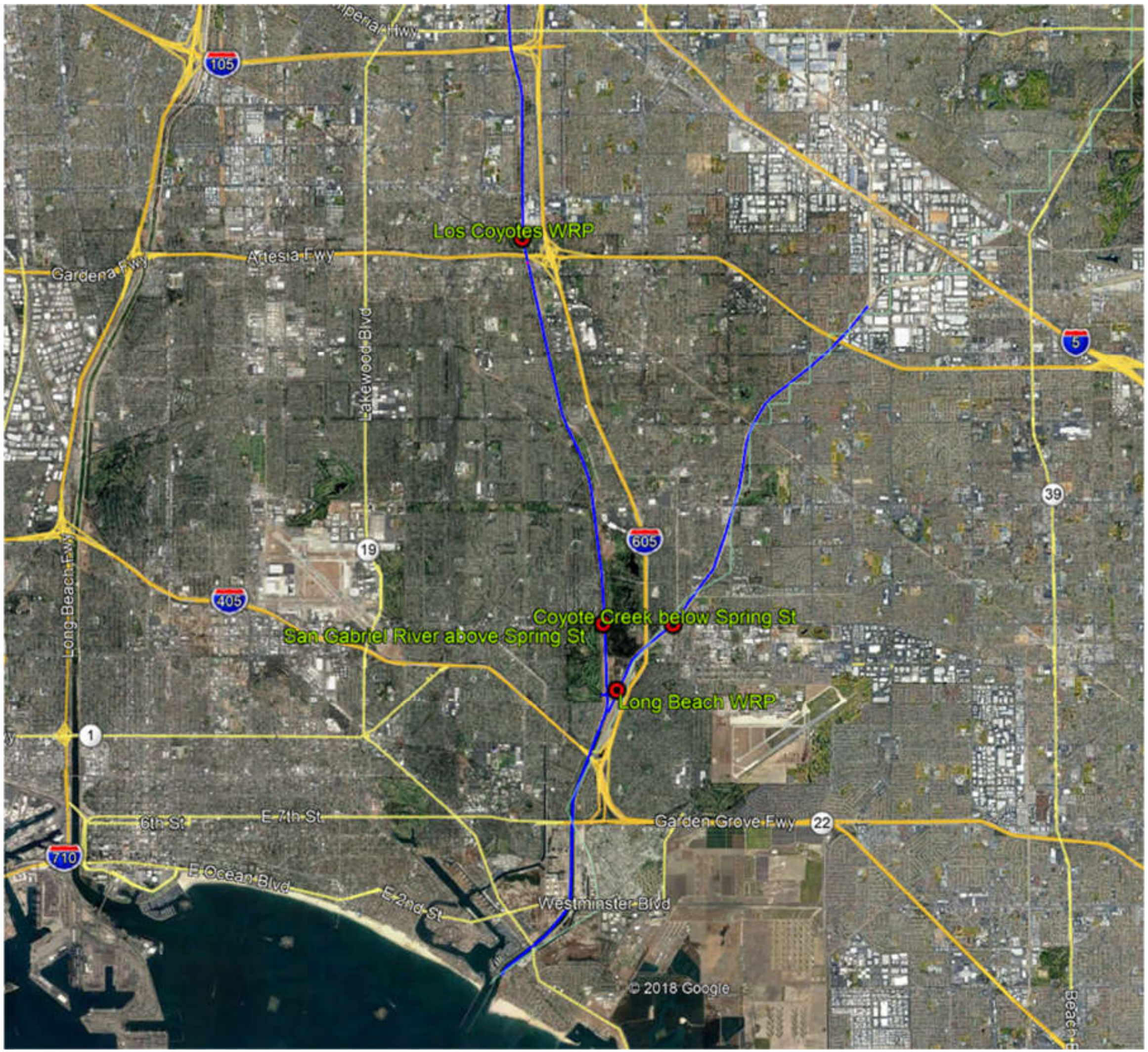
CHAPTER 6

Summary of Project Effects on Habitat in the Concrete Channel Reaches

Background

As part of the proposed project, the District's objective is to reduce discharges of recycled water from two additional downstream WRPs that discharge to the concrete portion of the San Gabriel River, downstream of the spreading grounds, and from there to the San Gabriel River estuary. The additional plants are Los Coyotes and Long Beach WRPs (**Figure 38**). For the last five years Los Coyotes WRP has discharged an average of 17.9 MGD (20,064 AFY, 27.7 cfs), and will discharge 2 MGD (2,242 AFY, 3.1 cfs) under project conditions. Long Beach WRP has discharged an average of 9.5 MGD (10,648 AFY, 14.7 cfs), and will discharge 2 MGD (2,242 AFY, 3.1 cfs) under project conditions. In response to comments from CDFW and USFWS about potential use of the concrete channel by wading birds, ESA performed a hydraulic assessment of the project conditions in the concrete channels.

Note that during the summer, no flows from upstream of the San Gabriel Spreading Grounds reach the concrete channel of the San Gabriel River (as evidenced by comparing daily flow records from USGS Gage 11087020 (at Peck Road), Whittier Narrows Dam, the San Gabriel River at the top of the concrete channel and the San Gabriel River at the point where the concrete channel discharges into the tidal part of the San Gabriel River estuary). In a wet year there are a few days per year when large winter storm events upstream of the spreading grounds reach the San Gabriel River estuary. There are no known cases during the dry season when a flow traveled through the spreading grounds and reached the concrete channel. As a consequence, project effects from San Jose Creek and Pomona WRPs will not be felt 14 miles downstream, and were not analyzed. Only the effects of changes at Los Coyotes and Long Beach WRPs were assessed in the concrete channel and the San Gabriel River estuary.



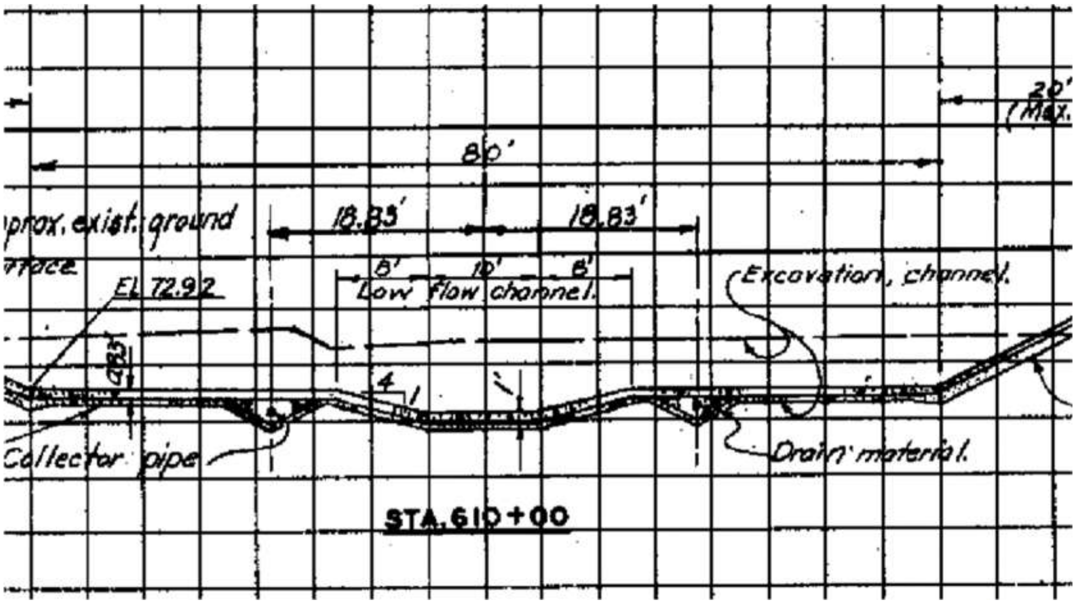
San Jose Creek Change Petition / D170647

SOURCE: ESA

Figure 41
Location of WRP along Concrete Lined Channels

Hydraulic Assessment

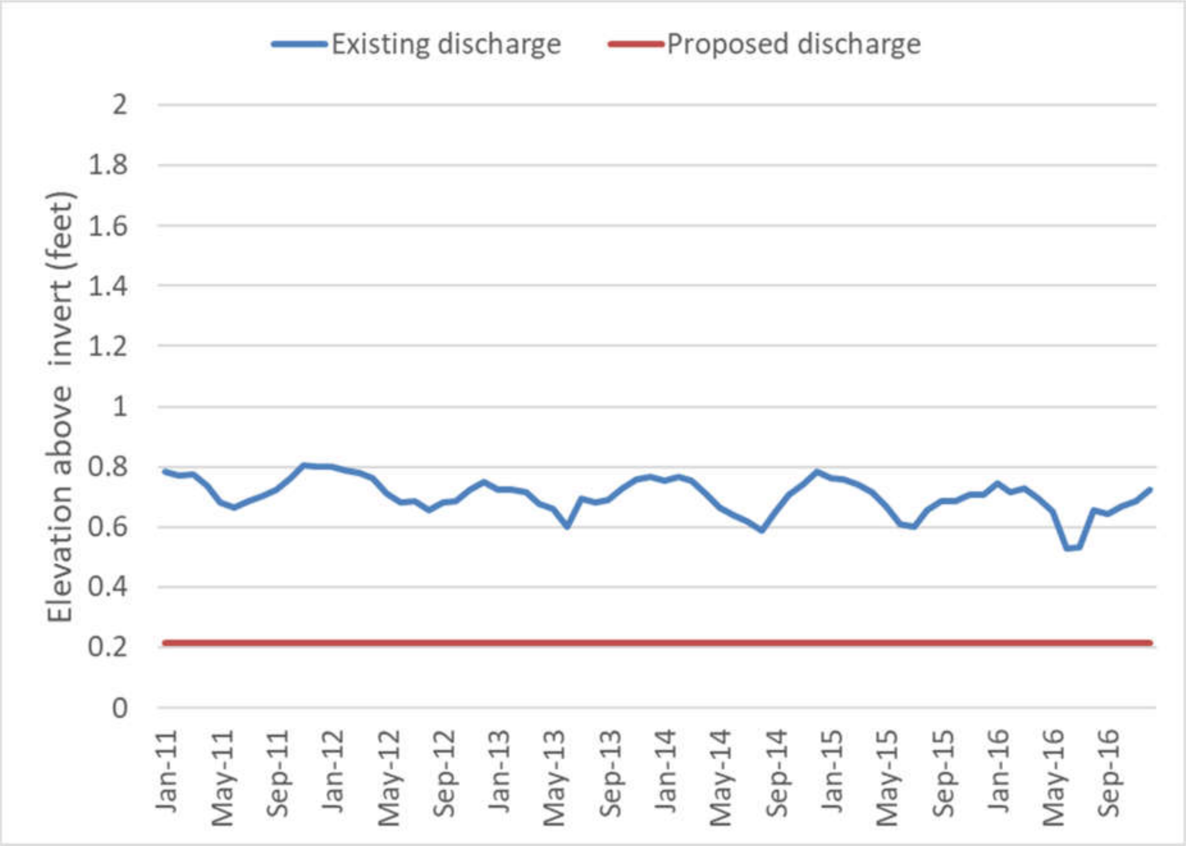
The hydraulic assessment modeled the low flow channel of the San Gabriel River and its confluence with Coyote Creek using a Manning's n calculation of a typical cross section. As-built cross sections for the river were provided by the District, and the channel gradient was measured in a USGS Digital Terrain Model. Due to the very uniform construction methods for the San Gabriel River, the cross section does not vary and gradient barely varies along the lower river. The low flow channel is 26 feet wide at top of bank, 10 feet wide at the bottom of the channel, and 2 feet deep, with a gradient of 0.0017 and a Manning's n of 0.014 **(Figure 42**). Existing discharges for the five-year period from October 2011 to October 2015 were provided by the District, and used to generate a time series and average water surface elevation within the typical channel cross section (**Figure 43**). A cross section showing average water surface elevation was calculated, and is shown in **Figure 44**.



SOURCE: ESA

San Jose Creek Change Petition / D170647

Figure 42
Typical Cross Section in the San Gabriel River

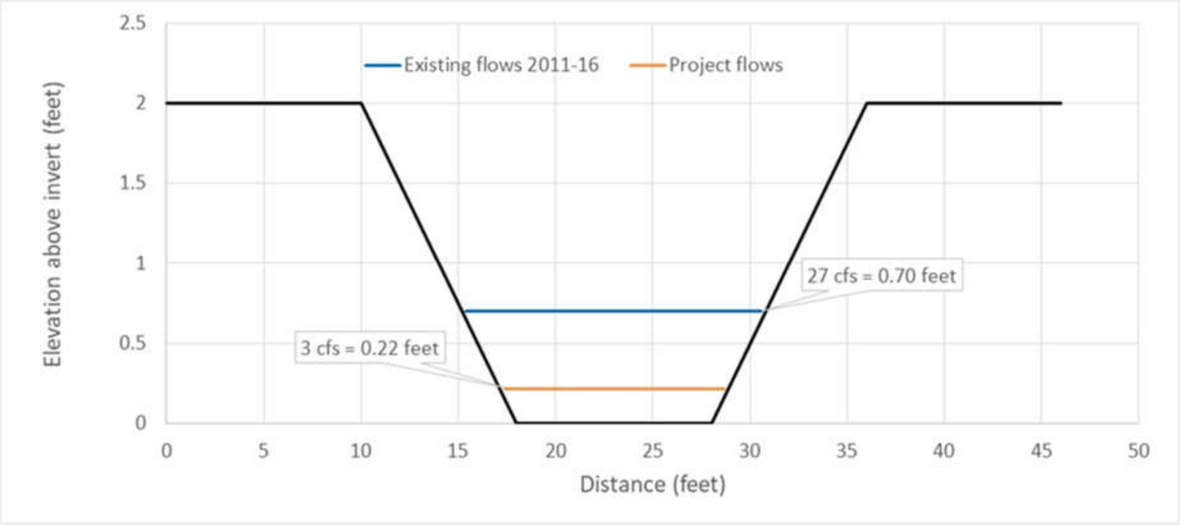


SOURCE: ESA

San Jose Creek Change Petition / D170647

Figure 43
Time Series of Estimated Water Surface in the San Gabriel River, 2011-2016

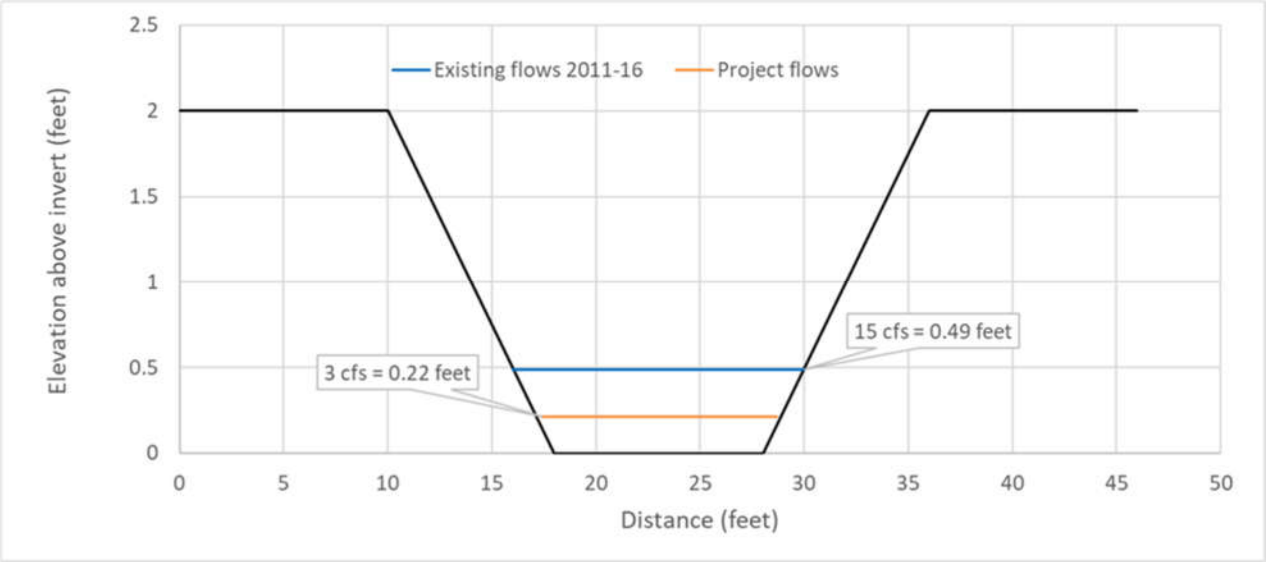
Under existing conditions, the average 27 cfs flow from Los Coyotes WRP fills the low flow channel to a depth of 0.7 feet, plus or minus about 0.1 foot (see **Figure 45**) and will have a velocity of 3 feet/sec. Under project conditions the average 3 cfs flow will fill the channel to a depth of 0.2 feet and have a velocity of 1.4 feet/sec. In both existing and project conditions the entire base of the channel will be wetted, supporting algal growth, though the water surface will cover less of the side slopes under project conditions. The same analysis was performed for Coyote Creek. Under existing conditions, the average flow depth in the low flow channel has been 0.5 feet, and under proposed conditions this will fall to 0.2 feet (Figure 42). This will continue to cover the entire base of the channel as before, though with less water covering the channel side slope.



San Jose Creek Change Petition / D170647

SOURCE: ESA

Figure 44
Average Flow Rate and Water Surface Elevation in the San Gabriel River under Existing and Project Conditions



San Jose Creek Change Petition / D170647

SOURCE: ESA

Figure 45
Average Flow Rate and Water Surface Elevation in Coyote Creek under Existing and Project Conditions

Conclusion

Overall, reducing wastewater discharges from Los Coyotes and Long Beach WRPs to the concrete channel reach of the San Gabriel River and Coyote Creek, respectively, will not result in any change to the wetted base of the low flow channels, but will cause slight shrinkage of water down the side slopes of the low flow channels.

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Appendix E3

Stetson Engineers, Inc. Reports, March 26, 2019 and May 15, 2019

STETSON
ENGINEERS INC.

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Phone: (626) 967-6202 • FAX: (626) 331-7065 • Web site: www.stetsonengineers.com

Northern California • Southern California • New Mexico • Arizona • Nevada • Colorado

Reply to: Covina

TO: **Tony Zampiello, Main San Gabriel Basin Watermaster**

FROM: **Stetson Engineers Inc.**

SUBJECT: **Numerical Groundwater Impact Evaluations of Recycled Water Discharge Reduction Near the Confluence of San Jose Creek and the San Gabriel River and Downgradient Groundwater Recharge Areas Scenario 1 Summary Report**

JOB NO.: **1205-103**

DATE: **March 26, 2019**

BACKGROUND

The Sanitation Districts of Los Angeles County's (District's) **"San Gabriel River Watershed Project to Reduce River Discharge in *Support of Increased Recycled Water Reuse" (Project)*** proposes to beneficially use more recycled water for direct and indirect reuse projects by reducing discharges of recycled water from the San Jose Creek (SJC) Water Reclamation Plant, (WRP) and the Pomona WRP.

The District, through an agreement with the Main San Gabriel Basin Watermaster (Watermaster), has directed Stetson Engineers Inc. (Stetson) to investigate the potential impacts on the groundwater levels and rising water from the proposed recycled water discharge reductions using Watermaster's 3D MODFLOW-based San Gabriel Basin Model. The District is planning to reduce recycled water discharge at the SJC WRP (SJC002 and SJC003) and the Pomona WRP (POM001), located within the Main San Gabriel Basin (Main Basin). The "modeling focus area" is located along the San Gabriel River from the confluence of the San Gabriel River (SGR) and SJC downstream to the

Whittier Narrows Dam (Study Area), as shown on Figure 1. Watermaster's Three Dimensional Basin Model (3D Basin Model) is being used to evaluate the potential impacts of reduced recycled water discharges on the groundwater levels and rising water within the Study Area. Up to three (3) different stream flow conditions and model simulations will be performed using the surface/groundwater capability in Watermaster's calibrated 3D Basin Model. These three (3) modeling scenarios are:

Scenario 1: "Existing" Condition (Baseline)

- The District provided the quarterly discharges from SJC and Pomona WRP;
- The 3D Basin Model considered only discharge points, SJC002, SJC003 and POM001;
- There is an average discharge of 9.5 million gallons per day (MGD) [approximately 10,600 acre-feet per year (AFY) or 2,650 acre-feet per quarter (AFQ)] at SJC002 and SJC003; and
- There is an average discharge of 3.3 MGD (approximately 3,700 AFY or 925 AFQ) at POM001.

Scenario 2: "With Project" Condition (proposed reduction of discharge at SJC002, SJC003 and POM001)

- Assume an average discharge of 5 MGD (approximately 5,600 AFY or 1,400 AFQ) at SJC002 and SJC003, and
- Assume 0 MGD discharge at POM001.

Scenario 3: "Modified With Project" Condition for an intermediate reference point (optional)

- Assume an average discharge of 7 MGD (approximately 7,800 AFY or 1,950 AFQ) at SJC 002 and SJC 003, and
- Assume 0 MGD discharge at POM 001.

The following summarizes the results for Scenario 1:

SUMMARY OF MODEL SIMULATION SCENARIO 1

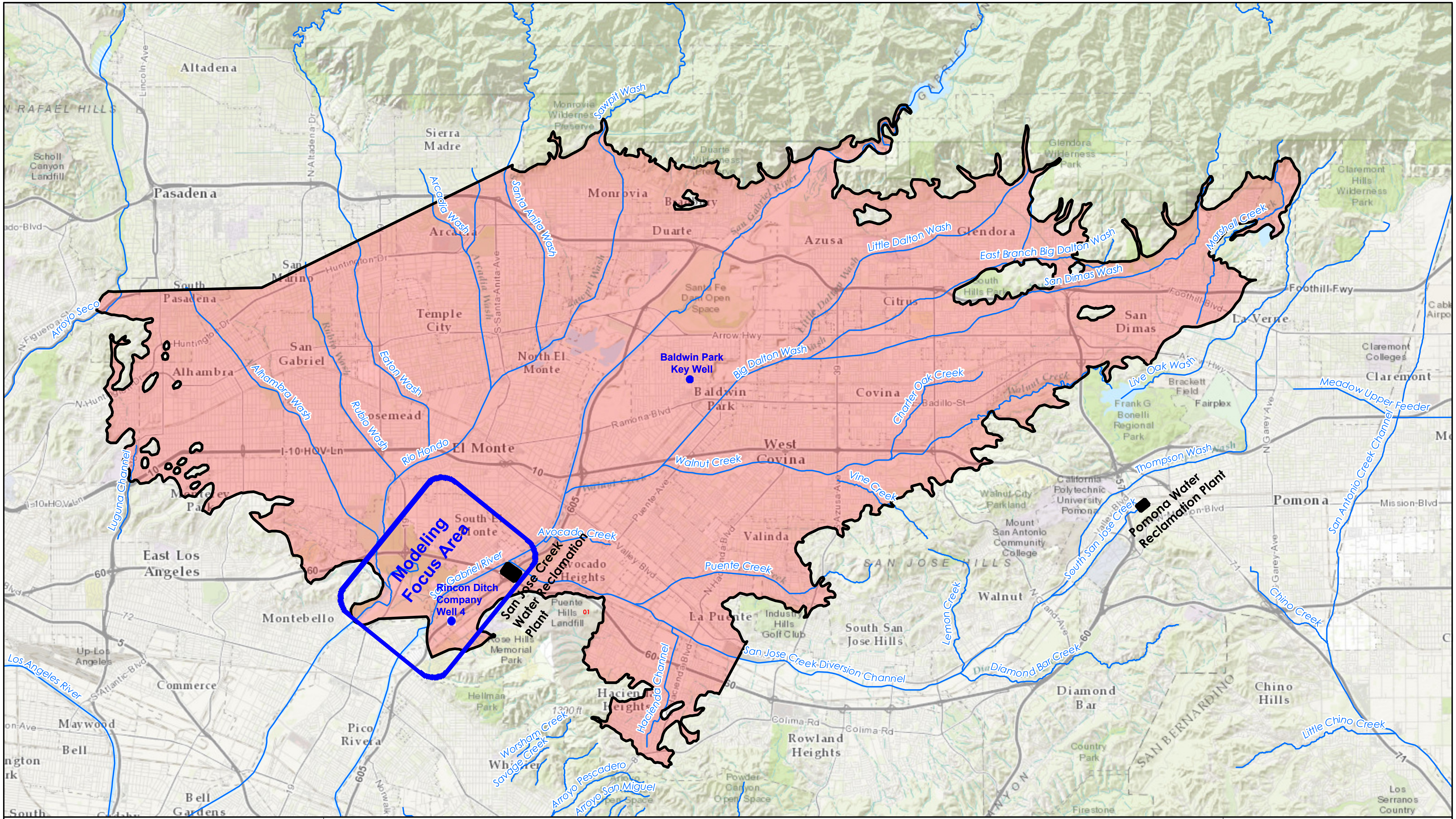
The Scenario 1 “Existing Condition (Baseline) Model Run” was performed using the Watermaster’s 3D MODFLOW-based San Gabriel Basin Model (3D Basin Model). The 3D Basin Model was developed and calibrated as a regional groundwater flow model with refined grid cells with uniform spacing of 200 feet x 200 feet to represent local geometry changes and improve simulation accuracy. The grid for the 3D Basin Model consists of 343 rows, 658 columns, and 7 layers, with 106,808 active cells per layer for a total of 747,656 active cells. The vertical dimension is separated into seven (7) layers to represent the shallow, upper and lower intermediate, and deep aquifers, as well as three (3) interbedded confined/semi-confined units with variable thicknesses depending on the geometry of the layer. Infiltration from the San Gabriel River, unlined portions of the Rio Hondo and San Jose Creek were simulated using the “Stream Flow Routing” package (Prudic et al., 2004). Based upon discussions with District staff, the Scenario 1 simulation was performed from the first quarter of 1985 (January 1985 to March 1985) to the second quarter of 2015 (April 2015 to June 2015). (This period was chosen to encompass a period of time which predates District discharges to the San Jose Creek which commenced December 1986.)

The 3D Basin Model area along with the Modelling Focus Area for this analysis for the District is shown on Figure 1. As part of the prior calibration work performed for the 3D Basin Model, numerous hydrographs were prepared showing the comparison between measured groundwater levels and the simulated groundwater levels developed by the 3D Basin Model. Figure 2 shows this relationship for the Baldwin Park Key Well, which is located southerly by the Santa Fe Dam (see Figure 1) and Rincon Ditch Company Well 4, which is located within the model focus area, as shown on Figure 1. Both hydrographs demonstrate that the simulated groundwater levels reasonably follow the pattern of the observed (measured) water levels. In addition to the comparison of groundwater levels, Figure 3 demonstrates the relationship between measured and simulated groundwater replenishment throughout the San Gabriel Valley. Similar to the groundwater levels, the simulated replenishment follows the same pattern as the measured amounts, and again demonstrates the 3D Basin Model is reasonably calibrated.

The reduced stream flow provided in Table 1 will be used for Scenario 2 (With Project Condition) to quantify the potential impacted from the reduced recycled water discharge.

Historical discharge data from the Pomona WRP and the San Jose Creek WRP were provided by the District. Simulated stream flow conditions for Scenario 2 will be generated assuming zero discharge from the Pomona WRP and an average discharge of 5 million gallons per day (MGD) from the San Jose Creek WRP. The simulated average discharge at the San Jose Creek WRP will then be calculated proportionally using the monthly trends of the historical discharge data; in doing so, the average discharge over each calendar year was equal to 5 MGD while following the same monthly trends as the historical discharge data.

The historical stream flow data in Segment 6 (F312B) and Segment 7 (G44B), as shown on Figure 4, will be adjusted to reflect the reductions in discharge from the Pomona WRP and the San Jose Creek WRP. The adjusted stream flow in Segment 6 (F312B) will account for a complete reduction in flow from the Pomona WRP. The adjusted stream flow in Segment 7 (G44B) will account for a complete reduction in flow from the Pomona WRP, plus a partial reduction in flow from the San Jose Creek WRP.



STETSON ENGINEERS INC.

- San Gabriel Groundwater Basin
- 🟥 Active Model Area
- ▢ Approximate Study Area

0 1 2 Miles

N

MAIN SAN GABRIEL BASIN WATERMASTER

Watermaster 3D Basin Model And Study Area

MainSanGabrielBasin WATERMASTER

FIGURE 1

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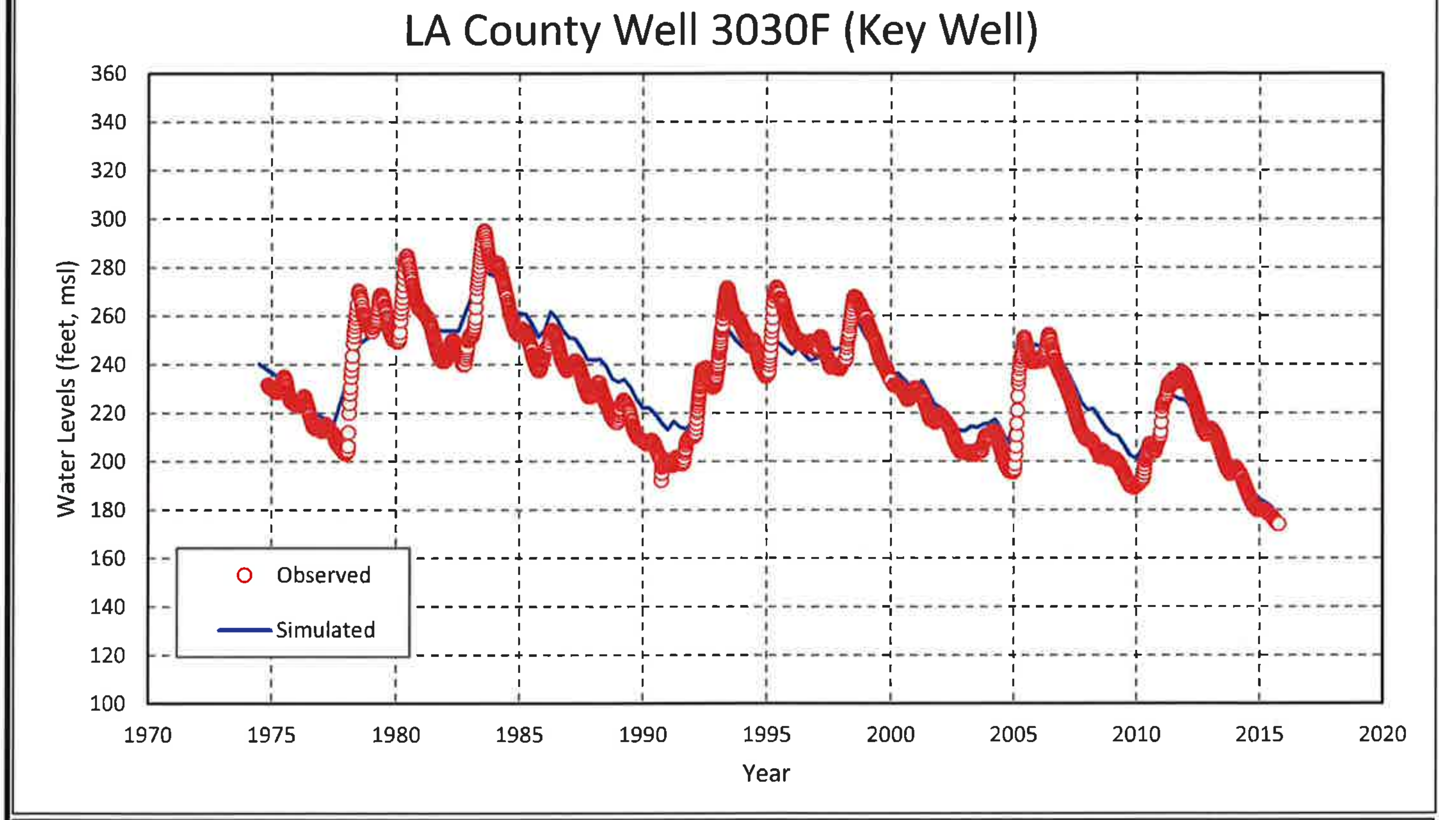
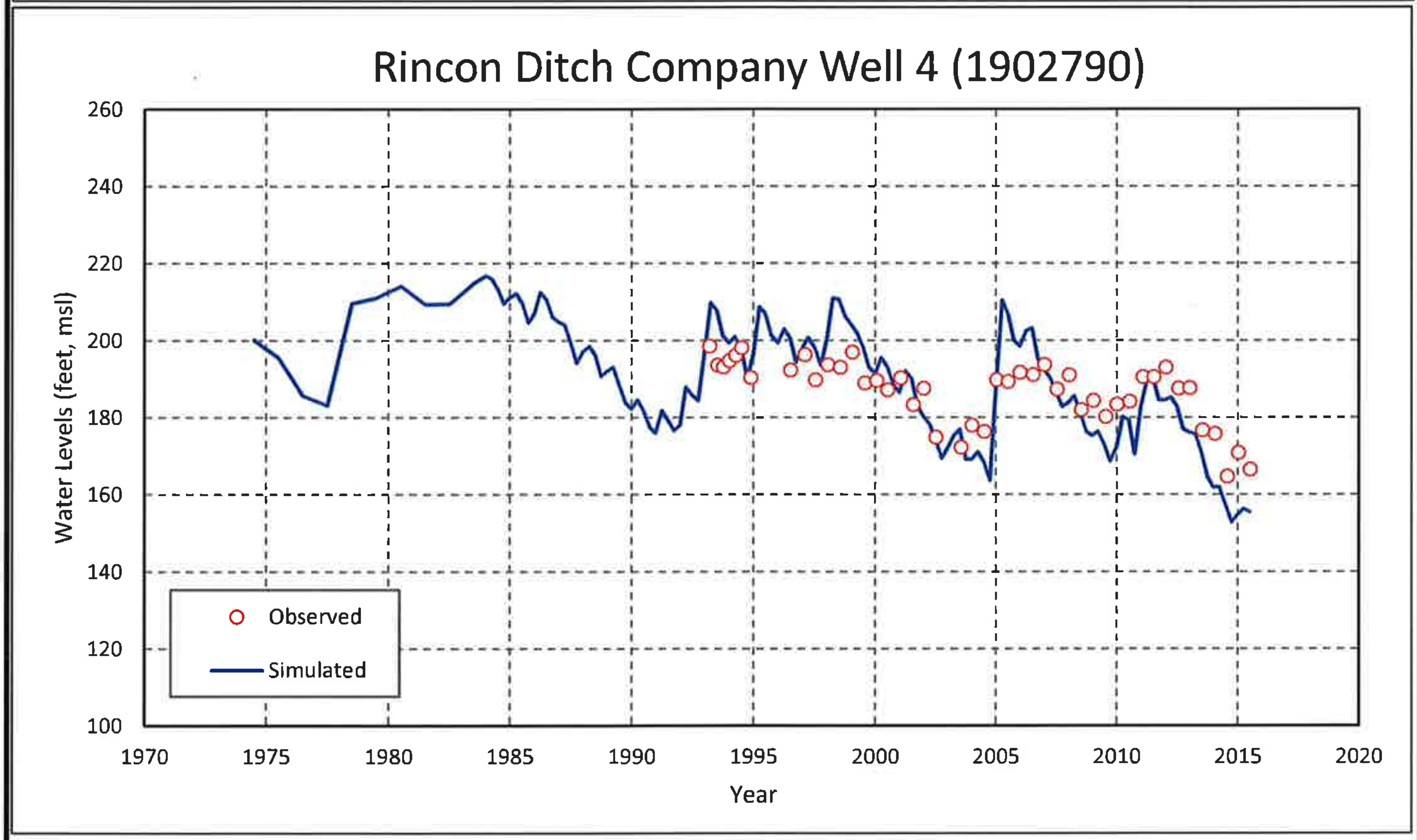
FIGURE 2





STETSON ENGINEERS INC.

MAIN SAN GABRIEL BASIN WATERMASTER

Calibration Results

Observed Heads versus Simulated Heads at
Key Well and Rincon ditch Company Well 4

MainSanGabrielBasin WATERMASTER

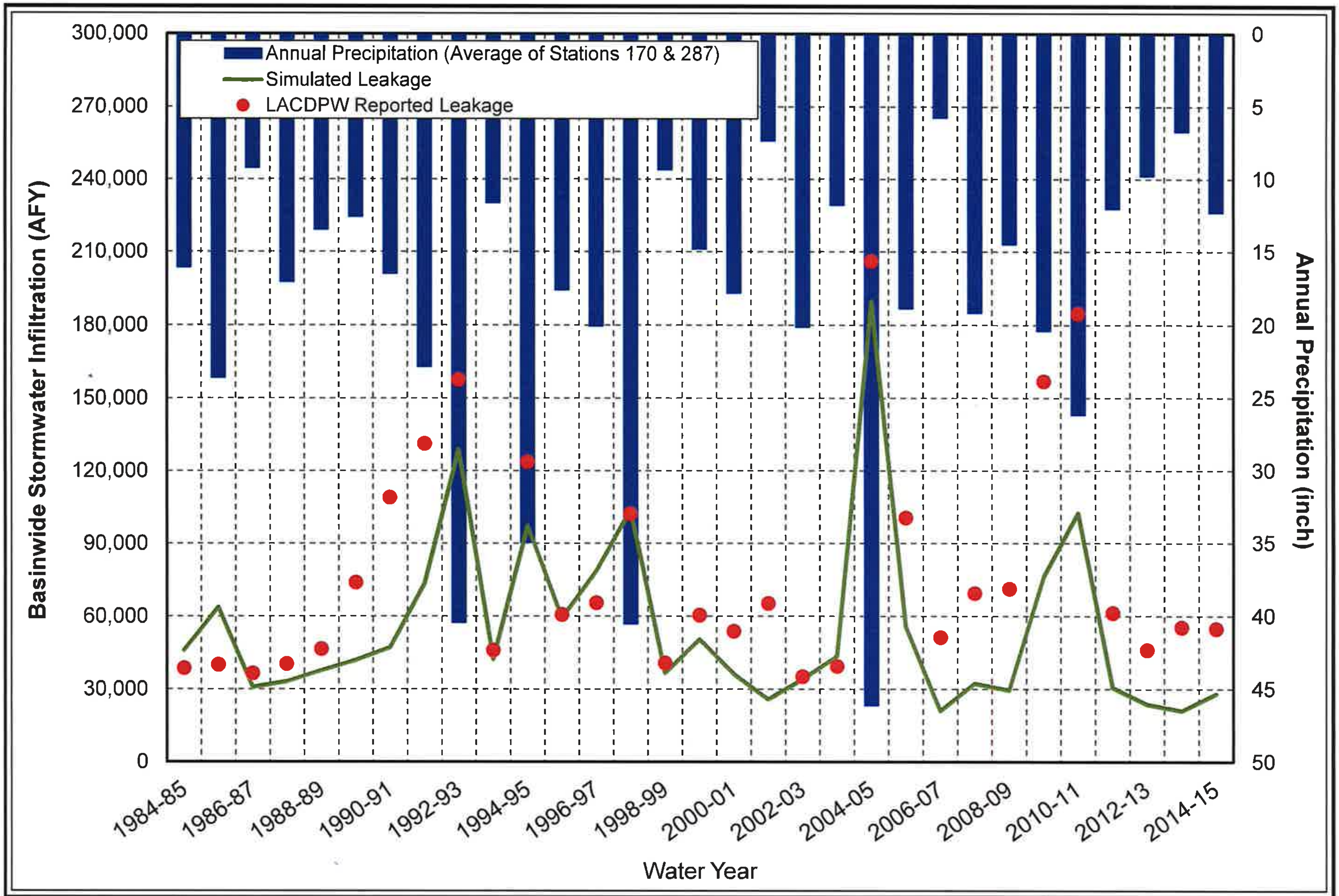


FIGURE 3

STETSON ENGINEERS INC.

MAIN SAN GABRIEL BASIN WATERMASTER
San Gabriel River and Rio Hondo Leakages
(WY1983-84 to WY2014-15)

MainSanGabrielBasin WATERMASTER

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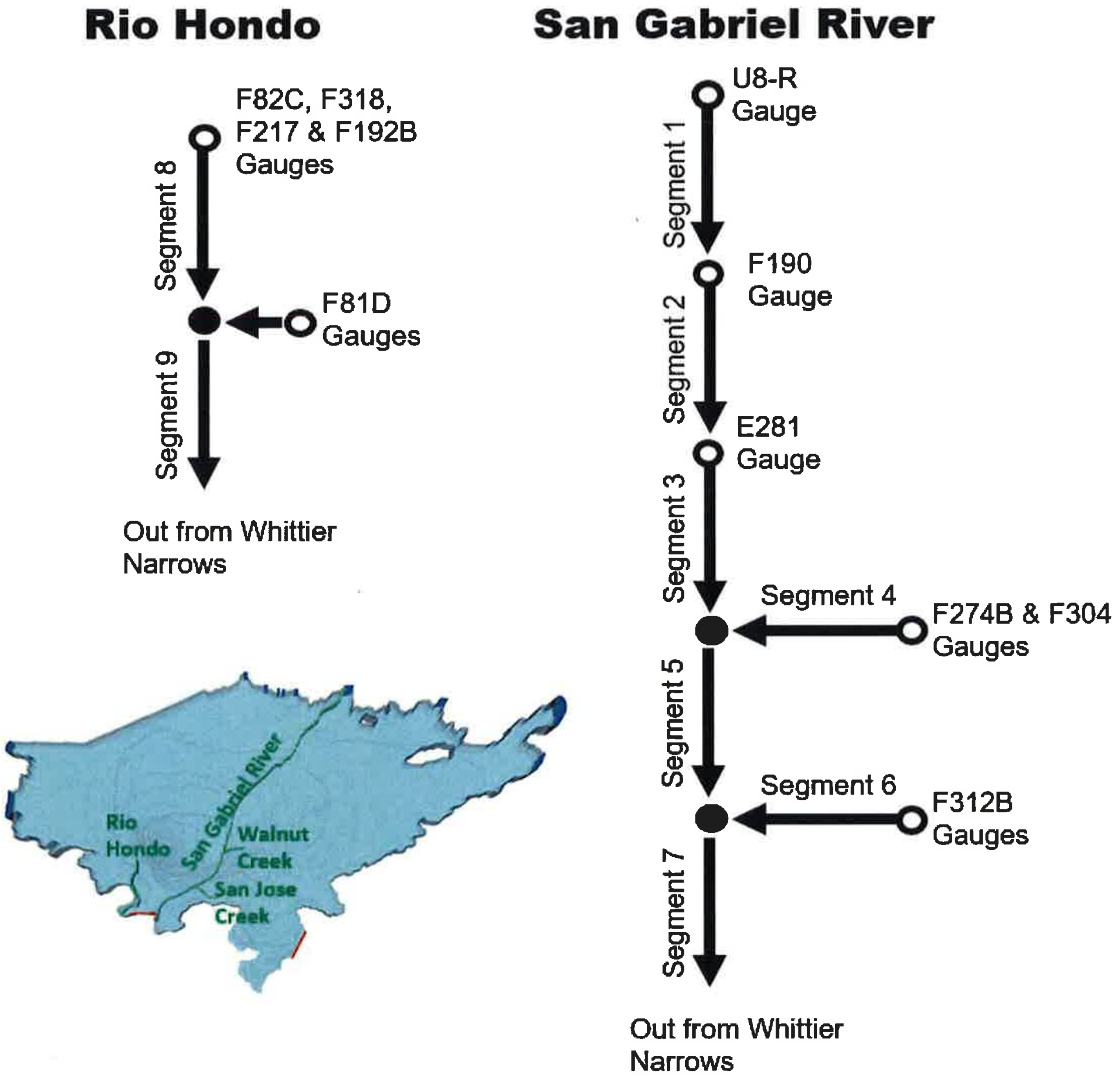
FIGURE 4

Schematic Stream Routing Simulation



MAIN SAN GABRIEL BASIN WATERMASTER

San Gabriel River and Rio Hondo

Schematic Stream Routing

J:\1205\1205-103\Report\Scenario-1\Figure 4 - Stream Routing Schematic.xlsx

Table 1

Stream Flow Data at the Gaging Station Within the Study Area (unit: cubic feet per day).

Year/ Quarter	Segment 03 (E281)	Segment 04 (F274B & F304)	(1) Segment 06 (F312B-AF)	(2) Segment 07 (G44B*-AF)[1]	(3) Historical Pomona WRP Recycled Water Discharge	(4) Historical San Jose WRP Recycled Water Discharge	(5) Proposed Pomona WRP Recycled Water Discharge	(6) Proposed San Jose WRP Recycled Water Discharge	(1) - (3) Adjusted Segment 06 (F312B-AF)	(2) - (3) - ((4 - (6)) Adjusted Segment 07 (G44B*-AF)[2]
1985/Q1	4,227,076.8	6,168,296.6	3,247,501.4	NA	0.00	0.00	0.00	0.00	3,247,501.4	NA
1985/Q2	2,322,853.8	8,716,525.5	2,757,775.5	NA	0.00	0.00	0.00	0.00	2,757,775.5	NA
1985/Q3	788,871.6	232,245.8	1,277,969.9	NA	0.00	0.00	0.00	0.00	1,277,969.9	NA
1985/Q4	1,620,659.3	1,158,604.6	4,134,617.7	NA	0.00	0.00	0.00	0.00	4,134,617.7	NA
1986/Q1	4,227,076.8	9,051,585.6	10,107,660.0	NA	738,882.09	0.00	0.00	0.00	9,368,777.9	NA
1986/Q2	2,322,853.8	6,748,693.4	2,068,098.6	NA	366,079.03	0.00	0.00	0.00	1,702,019.6	NA
1986/Q3	788,871.6	1,093,143.9	1,754,110.5	NA	86,572.68	0.00	0.00	0.00	1,667,537.9	NA
1986/Q4	1,620,659.3	6,902,138.8	2,060,360.1	NA	404,732.38	0.00	0.00	0.00	1,655,627.7	NA
1987/Q1	4,227,076.8	11,669,128.5	4,346,205.2	NA	601,696.14	0.00	0.00	0.00	3,744,509.1	NA
1987/Q2	2,322,853.8	5,509,566.0	964,832.0	NA	219,103.88	2,313,290.44	0.00	1,055,883.82	745,728.1	NA
1987/Q3	788,871.6	269,058.3	6,153,935.2	NA	46,381.34	2,017,704.42	0.00	920,965.83	6,107,553.9	NA
1987/Q4	1,620,659.3	5,091,306.1	5,417,000.9	NA	434,592.55	1,561,446.90	0.00	712,710.56	4,982,408.3	NA
1988/Q1	4,274,044.3	5,815,583.8	3,329,573.5	NA	181,981.82	612,286.28	0.00	301,226.00	3,147,591.6	NA
1988/Q2	2,322,853.8	7,952,977.5	2,334,984.0	NA	96,705.39	1,875,640.90	0.00	922,757.58	2,238,278.6	NA
1988/Q3	788,871.6	297,985.9	1,151,752.9	NA	38,389.57	1,198,329.85	0.00	589,541.40	1,113,363.3	NA
1988/Q4	1,620,659.3	2,966,526.4	6,663,035.6	NA	351,812.32	1,736,452.17	0.00	854,281.01	6,311,223.3	NA
1989/Q1	4,227,076.8	9,671,481.8	6,699,798.0	NA	623,114.73	1,501,232.53	0.00	498,139.06	6,076,683.2	NA
1989/Q2	2,322,853.8	8,467,579.6	1,571,435.1	NA	175,356.56	2,847,836.34	0.00	944,969.20	1,396,078.6	NA
1989/Q3	788,871.6	431,248.3	5,220,063.3	NA	103,573.36	2,108,084.09	0.00	699,504.57	5,116,489.9	NA
1989/Q4	1,620,659.3	4,866,761.4	4,222,881.6	NA	314,962.99	1,638,313.22	0.00	543,625.18	3,907,918.6	NA
1990/Q1	4,227,076.8	6,314,508.8	7,144,256.5	NA	572,227.01	1,103,607.18	0.00	217,033.40	6,572,029.4	NA
1990/Q2	2,322,853.8	6,185,955.1	2,261,285.8	NA	240,419.32	3,377,416.97	0.00	664,196.75	2,020,866.4	NA
1990/Q3	788,871.6	2,690,329.0	1,563,467.8	NA	67,421.49	3,508,053.61	0.00	689,887.52	1,496,046.3	NA
1990/Q4	1,620,659.3	1,917,795.8	4,222,881.6	NA	206,812.52	5,648,874.91	0.00	1,110,897.58	4,016,069.1	NA
1991/Q1	4,227,076.8	7,905,124.2	7,144,256.5	NA	484,265.21	1,606,840.17	0.00	1,020,109.77	6,659,991.2	NA
1991/Q2	2,322,853.8	333,162.7	2,261,285.8	NA	394,078.50	940,317.78	0.00	596,965.01	1,867,207.3	NA
1991/Q3	788,871.6	41,134.4	1,563,467.8	NA	323,405.21	1,092,257.25	0.00	693,424.47	1,240,062.6	NA
1991/Q4	1,620,659.3	1,468,894.3	11,086,903.5	557,843.6	507,143.31	523,243.09	0.00	332,183.25	10,579,760.2	0.0
1992/Q1	4,274,044.3	10,974,623.0	15,339,936.2	5,202,306.9	743,587.02	880,117.46	0.00	288,202.38	14,596,349.2	3,866,804.8
1992/Q2	2,322,853.8	294,234.4	1,204,002.7	0.0	329,632.72	149,487.17	0.00	48,950.92	874,370.0	0.0
1992/Q3	788,871.6	588,743.7	1,099,062.4	0.0	361,983.67	5,322,665.32	0.00	1,742,954.61	737,078.7	0.0
1992/Q4	1,620,659.3	6,068,754.6	9,897,402.5	6,986,754.6	820,580.60	1,775,335.78	0.00	581,349.66	9,076,821.9	4,972,187.9
1993/Q1	4,227,076.8	28,861,777.5	29,437,049.6	102,002,322.8	1,206,971.95	323,209.85	0.00	76,788.79	28,230,077.6	100,548,929.8
1993/Q2	2,322,853.8	1,335,782.7	2,597,602.9	5,601,758.1	586,842.91	1,156,189.82	0.00	274,689.71	2,010,760.0	4,133,415.1
1993/Q3	788,871.6	624,425.5	1,729,857.6	0.0	518,418.97	3,892,428.78	0.00	924,770.42	1,211,438.6	0.0
1993/Q4	1,620,659.3	1,511,718.1	2,199,830.7	885,599.9	945,818.93	5,856,225.06	0.00	1,391,332.77	1,254,011.7	0.0
1994/Q1	4,227,076.8	1,951,311.8	895,330.3	4,933,534.8	662,387.11	3,713,199.97	0.00	1,038,403.07	232,943.2	1,596,350.7
1994/Q2	2,322,853.8	800,861.6	303,634.7	838,364.9	507,060.60	2,671,422.09	0.00	747,068.01	0.0	0.0
1994/Q3	788,871.6	158,243.5	452,403.7	0.0	334,303.08	1,685,973.24	0.00	471,485.46	118,100.7	0.0
1994/Q4	1,620,659.3	760,883.8	4,222,881.6	322,121.9	458,233.66	1,507,684.07	0.00	421,626.57	3,764,647.9	0.0
1995/Q1	4,227,076.8	13,153,400.1	7,144,256.5	37,898,837.6	828,284.66	2,322,476.69	0.00	545,893.71	6,315,971.8	35,293,969.9
1995/Q2	2,322,853.8	896,376.7	2,261,285.8	469,977.9	500,729.13	3,168,522.75	0.00	744,755.22	1,760,556.6	0.0
1995/Q3	788,871.6	552,960.1	1,563,467.8	0.0	243,109.70	3,457,821.70	0.00	812,754.39	1,320,358.1	0.0
1995/Q4	1,620,659.3	531,171.6	1,949,515.5	0.0	502,711.51	2,437,301.50	0.00	572,883.06	1,446,804.0	0.0
1996/Q1	4,274,044.3	8,640,767.3	5,829,424.7	11,845,343.9	673,999.69	3,229,780.76	0.00	669,214.87	5,155,425.1	8,610,778.3
1996/Q2	2,322,853.8	751,423.9	5,051,134.8	78,804.3	176,252.66	2,931,599.69	0.00	607,431.36	4,874,882.1	0.0

Table 1

Stream Flow Data at the Gaging Station Within the Study Area (unit: cubic feet per day).

Year/ Quarter	Segment 03 (E281)	Segment 04 (F274B & F304)	(1) Segment 06 (F312B-AF)	(2) Segment 07 (G44B*-AF) [1]	(3) Historical Pomona WRP Recycled Water Discharge	(4) Historical San Jose WRP Recycled Water Discharge	(5) Proposed Pomona WRP Recycled Water Discharge	(6) Proposed San Jose WRP Recycled Water Discharge	(1) - (3) Adjusted Segment 06 (F312B-AF)	(2) - (3) - ((4 - (6)) Adjusted Segment 07 (G44B*-AF) [2]
1996/Q3	788,871.6	811,436.6	878,461.7	0.0	63,570.91	3,565,899.51	0.00	738,859.12	814,890.8	0.0
1996/Q4	1,620,659.3	3,551,086.5	5,435,257.7	4,667,769.3	540,824.99	3,181,974.79	0.00	659,309.41	4,894,432.7	1,604,279.0
1997/Q1	4,227,076.8	3,685,528.8	5,657,474.7	6,207,811.2	593,942.67	4,204,624.52	0.00	619,716.98	5,063,532.0	2,028,961.0
1997/Q2	2,322,853.8	7,404,213.9	1,405,539.5	0.0	173,887.54	5,226,336.44	0.00	770,306.47	1,231,652.0	0.0
1997/Q3	788,871.6	273,174.7	1,429,090.4	48,167.9	192,223.91	4,527,004.52	0.00	667,232.37	1,236,866.5	0.0
1997/Q4	1,620,659.3	1,945,341.8	3,884,254.2	2,662,716.7	436,699.47	4,200,024.81	0.00	619,039.03	3,447,554.7	0.0
1998/Q1	4,227,076.8	14,961,688.7	14,876,303.9	31,824,729.2	480,938.05	3,440,862.99	0.00	570,968.78	14,395,365.8	28,473,897.0
1998/Q2	2,322,853.8	3,831,009.1	3,813,254.4	0.0	256,945.76	3,421,634.38	0.00	567,778.03	3,556,308.6	0.0
1998/Q3	788,871.6	1,340,136.2	1,706,558.2	0.0	92,806.27	4,144,997.83	0.00	687,811.28	1,613,751.9	0.0
1998/Q4	0.0	962,842.7	2,450,577.2	642,252.4	343,835.08	5,056,321.36	0.00	839,034.18	2,106,742.1	0.0
1999/Q1	433,898.8	1,655,320.2	3,142,272.9	535,879.4	426,975.66	4,873,547.12	0.00	958,031.68	2,715,297.2	0.0
1999/Q2	0.0	1,162,556.1	2,359,880.2	315,018.3	318,159.70	3,914,048.87	0.00	769,415.52	2,041,720.5	0.0
1999/Q3	2,053,887.6	901,847.3	1,094,492.3	0.0	101,786.11	1,742,060.94	0.00	342,450.69	992,706.2	0.0
1999/Q4	72,266.0	1,949,231.4	3,970,248.3	0.0	361,547.76	3,085,550.43	0.00	606,551.04	3,608,700.5	0.0
2000/Q1	1,176,988.8	8,768,467.8	13,810,829.2	0.0	660,763.84	2,548,303.78	0.00	557,280.05	13,150,065.3	0.0
2000/Q2	1,334,006.3	2,793,255.3	9,167,561.5	0.0	546,371.49	2,495,712.97	0.00	545,779.14	8,621,190.0	0.0
2000/Q3	1,192.7	220,076.5	1,338,986.6	0.0	204,458.58	4,554,002.17	0.00	995,899.54	1,134,528.0	0.0
2000/Q4	20,059.9	3,217,235.5	7,440,562.7	951,292.2	282,574.52	2,615,053.03	0.00	571,877.22	7,157,988.2	0.0
2001/Q1	182,883.1	5,016,678.8	15,939,102.3	8,017,283.1	600,804.94	2,788,130.59	0.00	708,101.86	15,338,297.4	5,336,449.4
2001/Q2	89,371.7	3,295,628.5	4,160,674.6	817,344.0	452,545.37	2,627,777.60	0.00	667,376.99	3,708,129.2	0.0
2001/Q3	0.0	295,386.0	1,286,158.7	0.0	161,608.16	2,489,800.17	0.00	632,334.85	1,124,550.6	0.0
2001/Q4	1,037,260.2	8,255,971.3	13,469,394.0	1,054,737.2	408,684.68	2,614,471.81	0.00	663,997.72	13,060,709.4	0.0
2002/Q1	285,253.4	2,477,723.9	8,889,959.8	160,476.5	290,398.71	3,997,345.40	0.00	524,474.97	8,599,561.1	0.0
2002/Q2	0.0	148,634.4	2,104,082.0	0.0	245,663.71	5,492,977.72	0.00	720,710.63	1,858,418.3	0.0
2002/Q3	0.0	243,180.8	1,141,174.5	0.0	58,833.97	5,349,517.67	0.00	701,887.84	1,082,340.5	0.0
2002/Q4	154,374.3	7,085,168.9	7,322,120.2	5,775,402.1	416,211.47	5,548,323.89	0.00	727,972.37	6,905,908.7	538,839.1
2003/Q1	474,955.3	7,264,518.4	8,222,101.3	9,541,510.7	621,837.34	5,409,011.97	0.00	920,160.63	7,600,263.9	4,430,822.0
2003/Q2	28,535.6	2,213,178.8	4,310,225.1	1,554,215.5	74,699.51	3,613,194.19	0.00	614,662.91	4,235,525.6	0.0
2003/Q3	35,402.9	213,166.1	1,442,135.7	0.0	22,682.10	3,109,990.73	0.00	529,059.84	1,419,453.6	0.0
2003/Q4	140,306.3	1,855,468.0	2,719,203.2	2,420,681.3	342,614.52	3,556,047.84	0.00	604,941.39	2,376,588.6	0.0
2004/Q1	287,155.3	4,225,603.6	13,450,367.7	7,362,187.4	517,049.91	2,002,417.06	0.00	606,412.42	12,933,317.8	5,449,132.9
2004/Q2	3,323.0	4,718,740.9	1,506,503.5	165,839.1	277,203.51	1,980,572.78	0.00	599,797.09	1,229,299.9	0.0
2004/Q3	0.0	2,201,678.2	808,524.3	0.0	167,957.98	2,607,061.26	0.00	789,523.00	640,566.3	0.0
2004/Q4	3,524,050.4	12,509,151.7	13,428,865.2	12,581,201.4	586,610.58	2,227,670.06	0.00	674,628.09	12,842,254.7	10,441,548.8
2005/Q1	145,586,343.1	33,376,984.5	19,096,970.6	116,119,710.5	664,377.46	3,129,476.44	0.00	732,666.08	18,432,593.2	113,058,522.7
2005/Q2	3,881,795.3	791,386.1	3,526,903.4	709,714.0	204,501.86	2,834,615.19	0.00	663,633.82	3,322,401.5	0.0
2005/Q3	0.0	243,732.9	3,356,040.4	0.0	94,811.47	2,896,654.01	0.00	678,158.21	3,261,229.0	0.0
2005/Q4	2,707,478.9	1,390,652.5	6,886,043.9	20,191.5	400,431.36	2,561,435.51	0.00	599,677.60	6,485,612.5	0.0
2006/Q1	241,759.4	6,260,481.5	13,368,158.1	4,034,110.7	629,902.73	3,947,289.46	0.00	673,889.12	12,738,255.3	130,807.7
2006/Q2	1,702,242.9	3,729,926.0	7,878,132.4	1,920,102.3	277,820.49	3,955,328.25	0.00	675,261.52	7,600,311.9	0.0
2006/Q3	0.0	1,276,574.1	7,713,662.6	0.0	133,360.88	3,678,757.86	0.00	628,044.87	7,580,301.7	0.0
2006/Q4	0.0	4,380,975.5	8,348,052.9	0.0	309,455.93	4,119,249.79	0.00	703,246.53	8,038,597.0	0.0
2007/Q1	0.0	4,220,610.7	9,500,772.0	616,953.2	474,729.33	3,938,377.43	0.00	770,558.11	9,026,042.7	0.0
2007/Q2	0.0	2,892,576.9	4,712,217.9	556,378.0	460,698.42	3,646,247.08	0.00	713,401.72	4,251,519.5	0.0
2007/Q3	0.0	1,659,212.7	2,042,421.4	0.0	139,928.66	3,276,946.10	0.00	641,146.62	1,902,492.7	0.0
2007/Q4	14,556.6	1,485,778.6	3,548,316.6	1,416,255.9	605,936.14	2,793,778.11	0.00	546,613.02	2,942,380.5	0.0

Table 1

Stream Flow Data at the Gaging Station Within the Study Area (unit: cubic feet per day).

Year/ Quarter	Segment 03 (E281)	Segment 04 (F274B & F304)	(1) Segment 06 (F312B-AF)	(2) Segment 07 (G44B*-AF) 1	(3) Historical Pomona WRP Recycled Water Discharge	(4) Historical San Jose WRP Recycled Water Discharge	(5) Proposed Pomona WRP Recycled Water Discharge	(6) Proposed San Jose WRP Recycled Water Discharge	(1) - (3) Adjusted Segment 06 (F312B-AF)	(2) - (3) - ((4 - (6)) Adjusted Segment 07 (G44B*-AF) 2
2008/Q1	349,151.8	6,782,745.0	9,486,336.1	10,288,406.4	834,974.57	4,193,455.91	0.00	1,121,452.43	8,651,361.5	6,381,428.3
2008/Q2	8,345.8	433,196.1	1,988,254.1	467,604.6	415,335.17	3,113,434.61	0.00	832,623.23	1,572,918.9	0.0
2008/Q3	5,534,305.1	66,058.3	1,253,174.8	0.0	304,835.24	1,574,524.35	0.00	421,073.74	948,339.6	0.0
2008/Q4	268,206.0	2,500,321.7	4,005,296.1	3,448,007.9	589,080.76	1,137,011.17	0.00	304,069.95	3,416,215.3	2,025,985.9
2009/Q1	1,068,890.6	4,967,725.5	5,659,105.5	5,796,965.3	810,089.26	1,230,752.23	0.00	293,519.18	4,849,016.3	4,049,643.0
2009/Q2	0.0	219,713.3	1,624,168.1	0.0	465,428.65	1,058,632.41	0.00	252,470.73	1,158,739.5	0.0
2009/Q3	0.0	231,909.7	1,305,767.8	0.0	265,050.74	4,417,924.10	0.00	1,053,620.23	1,040,717.1	0.0
2009/Q4	1,643.4	1,486,239.7	7,258,444.5	2,059,231.3	621,890.62	4,475,784.52	0.00	1,067,419.23	6,636,553.8	0.0
2010/Q1	3,892.6	8,046,156.2	19,845,319.9	11,927,909.4	934,352.75	4,677,051.57	0.00	790,066.86	18,910,967.2	7,106,571.9
2010/Q2	5,547,545.0	4,241,869.9	5,627,762.9	424,214.6	509,264.12	4,409,166.36	0.00	744,814.58	5,118,498.8	0.0
2010/Q3	2,331,353.9	191,122.3	1,003,395.1	0.0	276,166.57	4,117,811.27	0.00	695,597.68	727,228.6	0.0
2010/Q4	2,751,483.0	11,058,533.2	17,555,616.1	19,156,664.3	811,048.59	2,627,520.20	0.00	443,851.56	16,744,567.5	16,161,947.1
2011/Q1	6,020,399.4	5,465,455.0	8,939,153.0	6,906,512.2	846,465.22	2,074,410.16	0.00	650,577.80	8,092,687.7	4,636,214.6
2011/Q2	7,838,169.6	1,466,245.9	4,605,594.5	73,297.6	597,419.83	2,103,911.45	0.00	659,830.02	4,008,174.7	0.0
2011/Q3	4,252,777.5	3,165,301.6	4,316,948.0	0.0	398,803.94	2,128,136.17	0.00	667,427.39	3,918,144.0	0.0
2011/Q4	61,700.8	1,355,437.6	2,498,115.3	1,216,549.8	741,723.60	2,220,404.81	0.00	696,364.74	1,756,391.7	0.0
2012/Q1	0.0	1,320,806.0	4,534,656.0	2,153,510.6	718,731.25	3,578,084.69	0.00	826,211.63	3,815,924.8	0.0
2012/Q2	0.0	1,137,479.4	2,287,340.4	648,474.8	478,502.90	2,335,164.10	0.00	539,210.19	1,808,837.5	0.0
2012/Q3	0.0	638,871.3	1,398,458.8	0.0	333,925.29	3,029,026.81	0.00	699,429.28	1,064,533.5	0.0
2012/Q4	0.0	1,204,340.7	3,024,563.5	391,429.7	721,061.24	2,636,994.08	0.00	608,905.42	2,303,502.3	0.0
2013/Q1	0.0	782,889.0	2,611,615.9	134,594.2	865,388.44	2,051,090.33	0.00	770,082.77	1,746,227.4	0.0
2013/Q2	0.0	220,339.4	1,469,606.7	0.0	445,743.83	1,826,384.76	0.00	685,716.96	1,023,862.9	0.0
2013/Q3	0.0	113,785.3	680,202.7	0.0	326,006.17	1,759,308.64	0.00	660,533.21	354,196.5	0.0
2013/Q4	0.0	286,650.8	1,619,633.7	0.0	663,404.24	1,486,077.23	0.00	557,948.35	956,229.5	0.0
2014/Q1	0.0	1,398,835.1	2,687,153.7	1,991,472.7	723,078.07	2,517,130.42	0.00	1,040,015.77	1,964,075.6	0.0
2014/Q2	0.0	258,877.6	1,126,675.1	3,171.3	383,854.14	1,542,071.21	0.00	637,145.52	742,821.0	0.0
2014/Q3	0.0	63,701.3	710,649.2	0.0	307,872.11	1,351,902.65	0.00	558,572.60	402,777.1	0.0
2014/Q4	0.0	1,614,750.3	3,444,100.8	2,245,000.5	560,993.32	1,028,976.94	0.00	425,147.72	2,883,107.4	1,080,177.9
2015/Q1	0.0	9,709,490.0	1,598,998.6	343,321.3	512,768.87	2,053,452.02	0.00	709,053.32	1,086,229.7	0.0
2015/Q2	0.0	3,190,172.6	1,987,351.8	30,477.2	379,447.09	1,434,965.18	0.00	495,490.92	1,607,904.7	0.0

Notes:

Segment 03 E281 Gauge - Inflow to San Gabriel River Segment 3 (Segment 3 discharge to Segment 5)
Segment 04 Combined F274B & F304 Gauges - Inflow to Walnut Creek Segment 4 (Segment 4 discharge to Segment 5)
Segment 06 F312B Gauge - Inflow to San Jose Creek Segment 6 (Segment 6 discharge to Segment 7)
Segment 07 G44B Gauge - Outflow to Central Basin. It is not needed in SFR package.
(Inflow of Segment 7 is the combined flow from Segments 5 & 6)

1) Gaging station G44B started operations in 1991, Quarter 4. Data is not available prior to the 4th quarter of 1991.
2) Adjusted Segment 7 stream flow assumed to equal zero if calculated as negative.

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Reply to: Covina

MEMORANDUM

TO: **Tony Zampiello, Main San Gabriel Basin Watermaster**

FROM: **Stetson Engineers Inc.**

SUBJECT: **Numerical Assessment of Recycled Water Discharge Reduction Impacts on Groundwater Levels Near the Confluence of San Jose Creek and the San Gabriel River and Downgradient Groundwater Recharge Areas**

JOB NO.: **1205-103**

DATE: **May 15, 2019**

BACKGROUND

The Sanitation Districts of Los Angeles County's (Districts') "**San Gabriel River Watershed Project to Reduce River Discharge in *Support of Increased Recycled Water Reuse" (Project)*** proposes to beneficially use more recycled water for direct and indirect reuse projects by reducing discharges of recycled water from the San Jose Creek (SJC) Water Reclamation Plant, (WRP) and the Pomona WRP. The Districts, through an agreement with the Main San Gabriel Basin Watermaster (Watermaster), has directed Stetson Engineers Inc. (Stetson) to investigate the potential impacts on the groundwater levels and rising water from the proposed recycled water discharge reductions. The Districts is planning to reduce recycled water discharge at the SJC WRP (SJC002 and SJC003) and the Pomona WRP (POM001), located within the Main San Gabriel Basin (Main Basin), as shown on Figure 1. The "modeling focus area" is located along the San Gabriel River from the confluence of the San Gabriel River (SGR) and SJC downstream to the Whittier Narrows Dam (Study Area), as shown on Figure 2.

To assess the potential impacts resulting from the reduction of recycled water discharge within the Study Area, the Districts decided to use Watermaster's Three-Dimensional Basin Model (3D Basin Model). The 3D Basin Model was used to first evaluate the existing groundwater conditions within the Study Area to establish the baseline conditions. Subsequent simulations were then performed to quantify groundwater changes under different recycled water discharge plans. Based upon discussions with Districts staff, the model simulation period covered the first quarter (January to March) of 1985 through the second quarter (April to June) of 2015. This period was chosen to encompass a period of time which predates District discharges to the San Jose Creek which commenced January 1986. Up to three (3) different stream flow simulations using the surface/groundwater capability in Watermaster's calibrated 3D Basin Model were performed and evaluated. These three (3) modeling scenarios include:

*Scenario 1: "Existing" Condition (**Baseline**)*

- The Districts provided the historical quarterly discharges from SJC and Pomona WRP;
- The 3D Basin Model considered only discharge points, SJC002, SJC003 and POM001;
- There is an average combined discharge of 9.5 million gallons per day (MGD) [approximately 10,600 acre-feet per year (AFY) or 2,650 acre-feet per quarter (AFQ)] for the recent five (5) years at SJC002 and SJC003; and
- There is an average discharge of 3.2 MGD (approximately 3,600 AFY or 925 AFQ) at POM001.

*Scenario 2: "**With Project**" Condition (proposed reduction of discharge at SJC002, SJC003 and POM001)*

- Assume an average combined discharge of 5 MGD (approximately 5,600 AFY or 1,400 AFQ) at SJC002 and SJC003, and
- Assume 0 MGD discharge at POM001.

*Scenario 3: "**Modified With Project**" Condition for an intermediate reference point (optional)*

- Assume an average combined discharge of 7 MGD (approximately 7,800 AFY or 1,950 AFQ) at SJC 002 and SJC 003, and
- Assume 0 MGD discharge at POM 001.

Model simulations were primarily focused on the first two (2) Scenarios (***Baseline*** and ***With Project***). The optional Scenario 3 (***Modified With Project***) would be performed only if the simulation results showed severe impacts on groundwater conditions in the Study Area.

Results of model simulations are evaluated to quantify the impacts based on changes in groundwater levels, storage, stream gain and loss, subsurface outflow through the Whittier Narrows to the Central Basin, and groundwater levels at five (5) monitoring wells with long-term measurements. A Technical Memorandum (TM) dated March 26, 2019 was provided to the Districts which summarized the findings of Scenario 1. This TM summarizes the modeling results, and addresses the potential impacts within the Study Area, resulting from the reduction of recycled water discharged from the SJC WRP and the Pomona WRP as part of Scenario 2.

MODEL STUDY AREA

The domain of the 3D Basin Model covers the entire Main Basin. It is bounded by the Raymond fault to the northwest, the San Gabriel Mountains to the north, the Chino fault and the San Jose fault to the east, and the exposed consolidated rocks of the Repetto, Merced, and Puente Hills to the south and west. The Rio Hondo and the San Gabriel River generally flow southwesterly across the San Gabriel Valley and exit through the Whittier Narrows. The 3D Basin Model coverage area is shown on Figure 2. The Study Area is located in the southern portion of the Main Basin, particularly along the SGR from the confluence of the SGR and SJC, downstream to the Whittier Narrows Dam.

HYDROLOGY AND HYDROGEOLOGY

The Los Angeles County Department of Public Works (LACDPW) monitors precipitation in the Main Basin through a network of rainfall gauge stations. The annual average rainfall is 17.1 inches based on rainfall data from four (4) gaging stations, San Dimas Station 95, Pomona Station 356C, Pasadena Station 610B, and El Monte Station 108D, recorded between Water Year (WY) 1958-59 and WY 2017-18. A plot of the accumulated departure from the mean precipitation (the long-term average is 18.52 inches) between WY 1958-59 and WY 2017-18 is presented in Figure 3. Wet and dry periods are identified in the plot via trends of departures from the mean. Downtrends indicate below average precipitation (dry periods) while uptrends indicate above average precipitation (wet periods). Groundwater levels in the Main Basin generally follow a similar pattern as the departure from the mean plot.

Geological formations in the Study Area generally consist of confined and/or semi-confined units with high but discontinuous silt and clay contents. The lateral extension of these silt and clay layers are generally not continuous and difficult to delineate. The vertical extent can be determined from information in driller’s logs, geophysical data, and/or depth-specific heads from multiport monitoring wells. Aquifer characteristics have been tested by the aquifer performance test (APT) and other aquifer test methods. The aquifer tests performed at the United States Environmental Protection Agency (US EPA) remedy wells (EW4-3, EW4-4 and EW4-5) within the Whittier Narrows Operable Unit (WNOU) show that overall hydraulic conductivity ranges from 120 ft/day to over 2,000 ft/day (CH2M, 2000).

The depth to water table (DTW) varies significantly in the entire Main Basin. It may be hundreds of feet below ground surface (bgs) near the mountainous areas to the north or close to the land surface in the vicinity of the Whittier Narrows. Whittier Narrows is a 1.5-mile gap that separates the Main Basin and the Montebello Forebay portion of the Central Basin. Groundwater levels at Whittier Narrows are close to the ground surface, so rising water is more likely to occur. The DTW is also influenced by discharge and recharge activities in the Main Basin. The primary sources of discharge in the Main Basin are groundwater pumping, seepage to surface water bodies (rising water), and evapotranspiration (ET). The sources of recharge include storm runoff, spreading activities (imported water), irrigation return flow, and seepage from surface water bodies.

Most of the streams in the Main Basin are concrete lined except the SGR, a small portion of SJC near the confluence of SJC and the SGR, and an approximately three-mile reach of the Rio Hondo north of the Whittier Narrows Dam. Lined and unlined stretches of the SGR, Rio Hondo, and their tributaries and stream gaging locations are shown on Figure 4. Groundwater in the Main Basin may gain water from, or lose water to, streamflow depending on the head differences between stream stages and groundwater levels. Because of the relatively deep DTW in the Main Basin, the SGR and Rio Hondo generally lose water to the Main Basin and are therefore considered to be losing streams. However, both streams may receive groundwater in areas around the Whittier Narrows due to the shallow DTW conditions observed in that area, particularly during wet hydrologic conditions. The historical relationship of the rising water measurements around Whittier Narrows and the water levels at Baldwin Park Key Well (Key Well) is shown on Figure 5. This relationship indicates that rising water may occur when Key Well water levels rise above approximately 240 feet above mean sea level (amsl).

STREAM GAIN/LOSS IN THE STUDY AREA

Quantification of the water exchange rates between groundwater and stream flow in the Whittier Narrows area has been previously performed by the California Department of Water Resources (DWR, 1966), CH2M Hill (2002), Stetson (2007), and the LACDPW. In addition, LACDPW has been estimating and maintaining groundwater recharge records for the SGR and Rio Hondo. Review of the previous studies show that annual stream recharge from the SGR and Rio Hondo ranges from approximately 37,000 acre-feet (AF) to 200,000 AF with an average of about 77,000 AF.

MODEL SIMULATION

3D BASIN MODEL, ASSUMPTIONS, AND CALIBRATION

Groundwater modeling requires various simplified assumptions to describe groundwater movement; therefore, results from model simulations are subject to uncertainties due to the assumptions made. Despite the uncertainties involved in the numerical model, the 3D Basin Model was conceptualized to describe the major hydrogeologic features; to specify appropriate initial conditions and boundary conditions; and to identify known inflow and outflow components for a reasonable representation of the Main Basin's groundwater system. In addition, calibration of the 3D Basin Model was properly performed to ensure the simulated results agree with measured conditions.

The 3D Basin Model was constructed using the United States Geological Survey's (USGS) modular three-dimensional finite-difference groundwater flow model, MODFLOW-2005 (Harbaugh, 2005). MODFLOW-2005 is a modular structure model, and the module that represents the water budget component is generally referred to as a package. All water budget components can be represented by applying the appropriate packages, which are available in MODFLOW-2005. The model grid of the 3D Basin Model consists of 343 rows, 658 columns, and 7 layers with 106,808 active cells per layer for a total of 747,656 active cells. The horizontal dimensions of each model cell are a constant 200 ft x 200 ft. The top, east to west, and south to north cross-sectional views of the 3D Basin Model are illustrated in Figure 6. The model layer thicknesses vary depending on the geometry of subsurface formation. A total of 42 years of simulation period [Fiscal Year (FY) 1973-74 to FY 2014-15] has been discretized into annual and quarterly stresses for transient simulations, yielding a total of 138 stress periods. Annual stress was applied to the first 10 years (between FY 1973-74 and FY 1982-83), and quarterly stress was applied to the remaining simulation period (between FY 1983-84 and FY 2014-15). The assumptions associated with the numerical codes used in the modeling work are described in the USGS MODFLOW-2005 report (Harbaugh, 2005).

As part of the prior calibration work performed for the 3D Basin Model, numerous hydrographs were prepared showing the comparison between measured groundwater levels and the simulated groundwater levels developed by the 3D Basin Model. Because of the large quantity of wells located within the Main Basin, only wells with long-term water level data were selected for model calibration. A scatter plot of observed versus simulated water levels for various wells in the Main Basin is shown on Figure 7. The closely clustered data around the diagonal line shown in Figure 7 illustrates a good fit of the simulated water levels to observed water levels, with no trend or bias to the errors. Statistic evaluations of the simulated water levels are also presented in Figure 7.

Time series plots of simulated and observed heads at the Baldwin Park Key Well (Key Well), the Rincon Ditch Company (Rincon) Well 4, the City of Whittier (Whittier) Wells 15 and 18, and the San Gabriel Valley Water Company (SGVWC) Well B2 are shown on Figures 8a to 8e, respectively. As shown on Figures 1 and 2, these five (5) wells are located within the Study Area except for the Key Well. The Key Well is included in the discussion because it is used by Watermaster as an index well to monitor changes in groundwater supply for the Main Basin. All hydrographs demonstrate that model-simulated water levels closely follow the patterns of the observed water levels. In addition, Figure 9 demonstrates the comparison of the simulated net annual stream and aquifer exchanges (from WY 1984-85 through WY 2013-14) and the annual stream leakages estimated by LACDPW. A simple and intuitive R-squared ($\boldsymbol{R^2}$) statistic of 0.80 can be calculated between the simulated streambed leakage and the LACDPW estimates. The high $\boldsymbol{R^2}$ value indicates that the annual stream leakages simulated by the 3D Basin Model are in good agreement with the LACDPW estimated stream leakages.

MODELING SCENARIOS

Model simulations were mainly performed under two (2) different stream flow conditions [***Baseline*** (Scenario 1) and ***With Project*** (Scenario 2)]. The ***Baseline*** condition represents the existing groundwater conditions, and the ***With Project*** condition represents the potential groundwater conditions resulting from the Districts' proposed recycled water discharge of 5 MGD (about 5,600 AFY) at the SJC WRP and the zero discharge at the Pomona WRP. The historical combined recycled water discharge (SJC002 and SJC003) at the SJC WRP is about 19 MGD (about 21,300 AFY); however, the current combined recycled water discharge for the past 5-year average has reduced to about 9.5 MGD (about 10,600 AFY). The historical recycled water discharge at the Pomona WRP is about 3.2 MGD (about 3,600 AFY), and the current recycled water discharge based on the past 5-year average is about 3.25 MGD (about 3,650 AFY). The potential impacts on groundwater conditions were quantified through the evaluations of changes in groundwater storage, stream gain and loss, subsurface outflow, and groundwater levels. In the event that groundwater conditions within the Study Area are significantly impacted, the Scenario 3 simulation (***Modified With Project***) would be performed for further evaluations.

The entire stream network in the Main Basin is divided into nine (9) segments in the 3D Basin Model. The stream flow schematic and the segments are shown in Figure 10. Historical recycled water discharge from the SJC and Pomona WRPs has been recorded at the stream gaging stations F312B and G44B. This historical stream flow data was applied to the 3D Basin Model for the Scenario 1 simulation (***Baseline***).

Stream flow data for the Scenario 2 simulation (***With Project***) was determined assuming zero discharge from the Pomona WRP and an average discharge of 5 MGD from the SJC WRP. The simulated average discharge at the SJC WRP for Scenario 2 was calculated proportionally using the monthly trends of the historical discharge data; in doing so, the average discharge over each calendar year was equal to 5 MGD while following the same monthly trends as the historical discharge data. The historical stream flow data at stream gaging stations F312B (Segment 6) and G44B (Segment 7) was then adjusted to reflect the reductions in discharge from the SJC WRP and the Pomona WRP. The adjusted stream flow data in stream gaging station F312B accounted for a complete reduction in flow from the Pomona WRP, while the adjusted stream flow in stream gaging station G44B accounted for a complete reduction in flow from the Pomona WRP, plus a partial reduction in flow from the SJC WRP. The adjusted stream flow at stream gaging stations F312B and G44B is shown in Table 1 and was applied to the 3D Basin Model for the Scenario 2 simulation to quantify the potential impacted from the reduced recycled water discharge.

STREAM DEPLETION QUANTIFICATION

The Districts plan to reduce recycled water discharge at the SJC WRP and the Pomona WRP. Groundwater levels can be affected by the local stream flow system. At an area where stream stage is higher than the underlying groundwater level, the stream will lose its water to the aquifer and is characterized as a losing stream; otherwise, the stream is characterized as a gaining stream and rising water occurs. Temporally, a losing stream may change to a gaining stream or vice versa depending on the hydrologic conditions. The water exchange between the SGR and unlined portions of the Rio Hondo and SJC are simulated using the “Stream Flow Routing” package (Prudic et al., 2004). The assumptions associated with the model stream flow routing is discussed in the USGS report (Prudic et al., 2004) and is not repeated herein. In short, the “Stream Flow Routing” package calculates the stream stage and compares the stream stage with the groundwater levels. The volume of stream gain or loss is calculated based on the head difference between the simulated stream stage and groundwater level at any given stress period.

MODEL SIMULATION RESULTS

Results of model simulations are presented sequentially to discuss the impacts from the changes of water budget components of groundwater storage, stream gain/loss, and Whittier Narrows subsurface outflow, as well as groundwater levels at five (5) monitoring wells. The water budget components are presented as the annual volumetric flow rate (in AFY) between WY 1984-85 and WY 2013-14. Results for WY 2014-15 are not discussed because model simulations for both Scenarios 1 and 2 do not encompass the full WY 2014-15. (Model simulations ended in the second quarter of 2015.) However, simulated water levels are demonstrated at each stress period between the first quarter of 1985 and the second quarter of 2015.

DWR (1966) estimated the total groundwater in storage in the Main Basin was approximately 9,700,000 AF in 1960. DWR (1975) also estimated the storage capacity of the Main Basin was approximately 10,438,000 AF. Although calculations of the total groundwater in storage for the model simulation period were not performed, the largest storage difference of 1,315 AFY in WY 1991-92 provided in Table 2, which represents the most impact due to recycled water reduction, is only a fraction (between 0.01% and 0.02%) of the overall basin groundwater storage; therefore, the focus of this study is on the changes in groundwater storage. Changes in groundwater storage lead to changes in groundwater levels. Results of the simulated annual change in groundwater storage, cumulative mean change, and annual storage differences for both the ***Baseline*** and ***With Project*** simulations are summarized in Table 2. The change of storage cumulative mean departure plot over the period from WY 1984-85 through WY 2013-14 is shown on Figure 11. The downtrend in storage as shown in Figure 11 indicates aquifer storage recovery (rise of water level) for the Main Basin, and vice versa. Table 2 indicates that simulated groundwater storage for both Scenarios is fairly close. The differences and absolute percentage change in the annual change in storage for both Scenarios (results of the ***Baseline*** subtracted by the ***With Project***) ranges from the minimum of -586 AFY to the maximum of 1,315 AFY with an average of 126 AFY. As can be seen, the annual storage difference is generally two (2) or three (3) orders of magnitude less than the annual storage change under ***Baseline Scenario*** (Table 2).

It is noted the absolute percentage change discussed in this TM is calculated in general by taking the difference of both Scenarios results (Scenario 2 – Scenario 1), divided by the result from Scenario 1 (see equation below),

$$C_i\% = \left|\frac{S_{Wi} - S_{Bi}}{S_{Bi}}\right| x\ 100\%$$

Where

$C_i\%$ **:** percentage change at the end of simulation stress period *i;*

S_{Wi} **:** **With Project** simulated result at the end of simulation stress period *i;*

S_{Bi} **:** **Baseline** simulated result at the end of simulation stress period *i*.

Simulated result can be either simulated stream gain/loss, water level (msl), or storage change depending on the variable targeted for "*Percentage Change"* calculation. It is noted the percentage change is only for reference purposes because large percentage changes often occur with low simulated storage changes. For example, the model simulated storage changes in WY 2002-03 for the ***Baseline*** and ***With Project*** are -295 AFY and -424 AFY, respectively; however, the percentage storage change is about 44 percent (%). The identical plots of change of storage cumulative mean departure shown on Figure 11 demonstrates the minimum annual storage difference has insignificant impacts on the overall groundwater conditions in the Main Basin and the Study Area.

The stream gain/loss was calculated based on the head differences between the simulated stream stage and groundwater level. Figure 12 shows the comparison of the simulated annual groundwater gained by the stream within the Study Area from WY 1985-86 through WY 2013-14 for the ***Baseline*** and ***With Project***. Figure 13 shows the comparison of the simulated annual streamflow lost to the aquifer for the ***Baseline*** and ***With Project***. Stream gain, loss, and percentage change, as well as recycled water discharge for both the ***Baseline*** and ***With Project*** are tabulated in Table 3. The percentage change is also calculated using the same equation discussed above. Again, the percentage change is only for reference purposes. The potential impacts are evaluated by the simulated quantity of the stream flow change. Table 3 shows the largest change in stream gain occurred in WY 1995-96 (388 AFY) due to a relatively large recycled water reduction (26,673 AFT) and high water level conditions (Figure 8, and Key Well elevations are over 270 feet amsl). The largest change in stream loss occurred in WY 1991-92 (1,480 AF). Both the stream gain and loss shown on Table 3 are generally two (2) orders of magnitude less than the proposed reduced recycled water discharge, so the impacts to the Study Area are expected to be insignificant, as demonstrated on Figures 12 and 13.

The simulated subsurface outflows at Whittier Narrows for both the ***Baseline*** and ***With Project*** are plotted on Figure 14. The simulated annual subsurface outflows between WY 1984-85 and WY 2013-14 are tabulated in Table 4. The differences in the simulated subsurface outflows for both Scenarios range from 0 AFY (WY 1984-85) to 185 AFY (WY 1994-85) with an average of 84 AFY. The minimum subsurface outflow decrease also demonstrates that the Districts' proposed recycled water discharge reduction plan (***With Project***) has insignificant impacts on the groundwater conditions in the Study Area.

The impacts from the recycled water discharge reduction on groundwater conditions within the Study Area are evaluated by examining simulated water levels at five (5) wells: the Key Well, Rincon Well 4, Whittier Wells 15 and 18, and SGVWC Well

B2, as shown on Figures 8a to 8e, respectively. Figures 8a to 8e show simulated water levels and historic observed water levels at the five wells. In addition, reference points of elevation (RPEs) are provided on each figure as an approximation of land surface elevations at each well, as measured by Stetson staff. It should be noted that the RPEs are fairly close to actual land surface elevations at each well but are not exact due to minor differences in measurement point. For example, an RPE may correspond to the elevation beneath the well casing, or it may correspond to the elevation at an adjacent building or structure.

The Key Well elevations are expected to have the least impacts due to its upgradient location from the Study Area. All hydrographs shown on Figures 8a to 8e demonstrate that the model simulated heads for both Scenarios follow the same pattern with minimal head differences resulting from reductions in recycled water discharge. Head differences are shown on Figures 8a to 8e as a percentage change in groundwater levels (in feet amsl) between the two Scenarios (using the same equation discussed above):

The percentage changes in Key Well elevations between the ***Baseline*** and the ***With Project*** Scenarios are generally less than 0.15 percent (%) as shown on Figure 8a (the simulated head differences range from 0.0 feet to 0.4 feet). Similarly, the percentage changes between the ***Baseline*** and the ***With Project*** for other four (4) wells are generally less than 0.25% (range from 0.0 feet to 1.1 feet). The percentage change may be occasionally above 0.5%; however, these relatively large percentage changes all occurred in the summer time where the Main Basin experiences high volumes of groundwater pumping and low volumes of replenishment from imported water. For example, the three (3) largest percentage changes of 0.67% (1.1 feet), 0.59% (0.9 feet), and 0.44% (0.9 feet) at the Rincon Ditch Company Well 4 occurred in the third quarter 2013, the third quarter 2014, and the second quarter of 1995 (Figure 8b); the three (3) largest percentage changes of 0.54% (0.9 feet), 0.52% (0.8 feet), and 0.48% (1.0 feet) at the City of Whittier Well 15 occurred in the third quarter 2013, the third quarter 2014, and the second quarter of 1995 (Figure 8c); the three (3) largest percentage changes of 0.61% (1.0 feet), 0.53% (0.8 feet), and 0.49% (0.9 feet) at the City of Whittier Well 18 occurred in the third quarter of 2013, the third quarter of 2014, and the second quarter of 1992 (Figure 8d); and the three (3) largest percentage changes of 0.57% (0.9 feet), 0.47% (0.8 feet), and 0.47% (0.9 feet) at the SGVWC Well B2 occurred in the third quarter 2014, the third quarter 1992, and the third quarter of 2013 (Figure 8e). These relative larger head changes are the combined factors of the recycled water discharge reduction, the seasonally high volume of groundwater pumping, and low volume of imported water replenishment in the Main Basin during the summer.

SUMMARY AND CONCLUSIONS

Watermaster's 3D Basin Model performed groundwater simulations for the ***Baseline*** and the ***With Project*** Scenarios to evaluate potential impacts on the Districts' proposed recycled water discharge reductions at the SJC WRP and the Pomona WRP. The 3D Basin Model performed the simulations over a study period covering the first quarter of 1985 through the second quarter of 2015. The ***Baseline*** simulation was performed to establish the existing groundwater condition based on the Districts' average historical annual recycled discharge of 19 MGD (about 21,300 AFY) at SJC WRP and average historical annual recycled discharge of 3.2 MGD (about 3,600 AFY) at the Pomona WRP. The ***With Project*** simulation was preformed based on the Districts' proposed recycled water discharge of 5 MGD (about 5,600 AFY) at the SJC WRP and zero discharge at the Pomona WRP. Modeling results from the ***Baseline*** and ***With Project*** were evaluated by examining changes in groundwater storage, stream gain and loss, subsurface outflow through the Whittier Narrows, and groundwater levels within the Study Area. An assessment of potential groundwater impacts associated with the Districts' proposed recycled water discharge reduction plan in the Study Area was quantified based on differences from the simulation results. The following conclusions can be drawn from the simulation results:

- The District's proposed recycled water discharge (***With Project***) shows negligible impacts on the annual change in storage in the entire Main Basin. It is expected that the resulting storage change in the Study Area would be minimal due to insignificant changes in water levels, stream leakages, and subsurface outflow through the Whittier Narrows within the Study Area, as demonstrated below. The annual groundwater storage differences in the Main Basin from both the ***Baseline*** and ***With Project*** simulations range from the minimum of -586 AFY to the maximum of 1,315 AFY with an average of 126 AFY (see Table 2). The annual groundwater storage differences at each stress period are generally two (2) or three (3) orders of magnitude less than the annual storage changes, as indicated by the almost identical cumulative mean departure plots (see Figure 11). It can be concluded that the Districts' proposed recycled water discharge reductions would have insignificant groundwater impacts within the Main Basin and the Study Area.

- The stream flow system in the Main Basin is generally considered a losing stream, except for the Whittier Narrows area where rising water is likely to occur due to shallow DTW conditions. Results of model simulations show the largest change of stream gain (388 AFY) occurred in WY 1993-94, and the largest change of stream loss (1,480 AFY) occurred in WY 1991-92. These changes in stream gain/loss are not expected to change groundwater conditions in the Study Area because the quantity of change is relatively low. The impacts on groundwater conditions in the Study Area are concluded to be insignificant and are demonstrated on Figures 12 and 13.

- Results of the simulated Whittier Narrows subsurface outflows (see Figure 14 and Table 4) indicate the differences in simulated subsurface outflows between the ***Baseline*** and ***With Project*** simulations range from 0 AFY (WY 1984-85) to 185

AFY (WY 1994-85) with an average of 84 AFY. Annual subsurface outflow ranges from about 25,000 AFY to 30,000 AFY; the Project represents less than 0.5 percent. The minimum subsurface outflow decrease demonstrates that the Districts' proposed recycled water discharge reduction plan has insignificant impacts on groundwater conditions in the Study Area.

- The simulated hydrographs of the Key Well, Rincon Well 4, Whittier Wells 15 and 18, and SGVWC Well B2, (Figures 8a to 8e, respectively) show that the model simulated heads for both the ***Baseline*** and ***With Project*** simulations are almost identical. The percentage changes in groundwater levels are generally less than 0.25%. There are a few circumstances in which percentage changes in groundwater level are above 0.5% but do not exceed 1.0%. (For example, Basin groundwater levels at the Key Well typically have ranged from about 0 feet to about 20 feet on an annual basis; consequently, a 1 percent change over 20 feet represents about 2.5 inches at the Key Well.The impacts on groundwater levels may not be solely from the reduced stream flow; the seasonally high volume of groundwater pumping and low volume of imported water replenishment also contribute to groundwater changes in the summer. Overall, the percentage changes in groundwater levels are considered negligible, and the Districts' proposed recycled water discharge reduction plan has insignificant impacts on the groundwater conditions in the Study Area.

- The simulation results for groundwater storage, stream gain and loss, and subsurface outflow indicate that groundwater conditions within the Study Area will be negligibly impacted under the Districts' proposed recycled water discharge reduction plan. Based upon the analyses in this TM, it would appear that the Districts' recycled water discharge reduction plan (***With Project***) at the SJC WRP and the Pomona WRP is not expected to cause noticeable groundwater changes in the Study Area. Because of the negligible impacts concluded from the results of the ***With Project*** simulation, an additional simulation (Scenario 3 - ***Modified With Project***) is not considered necessary to further evaluate impacts to the Main Basin resulting from the Districts' recycled water discharge reduction plan.

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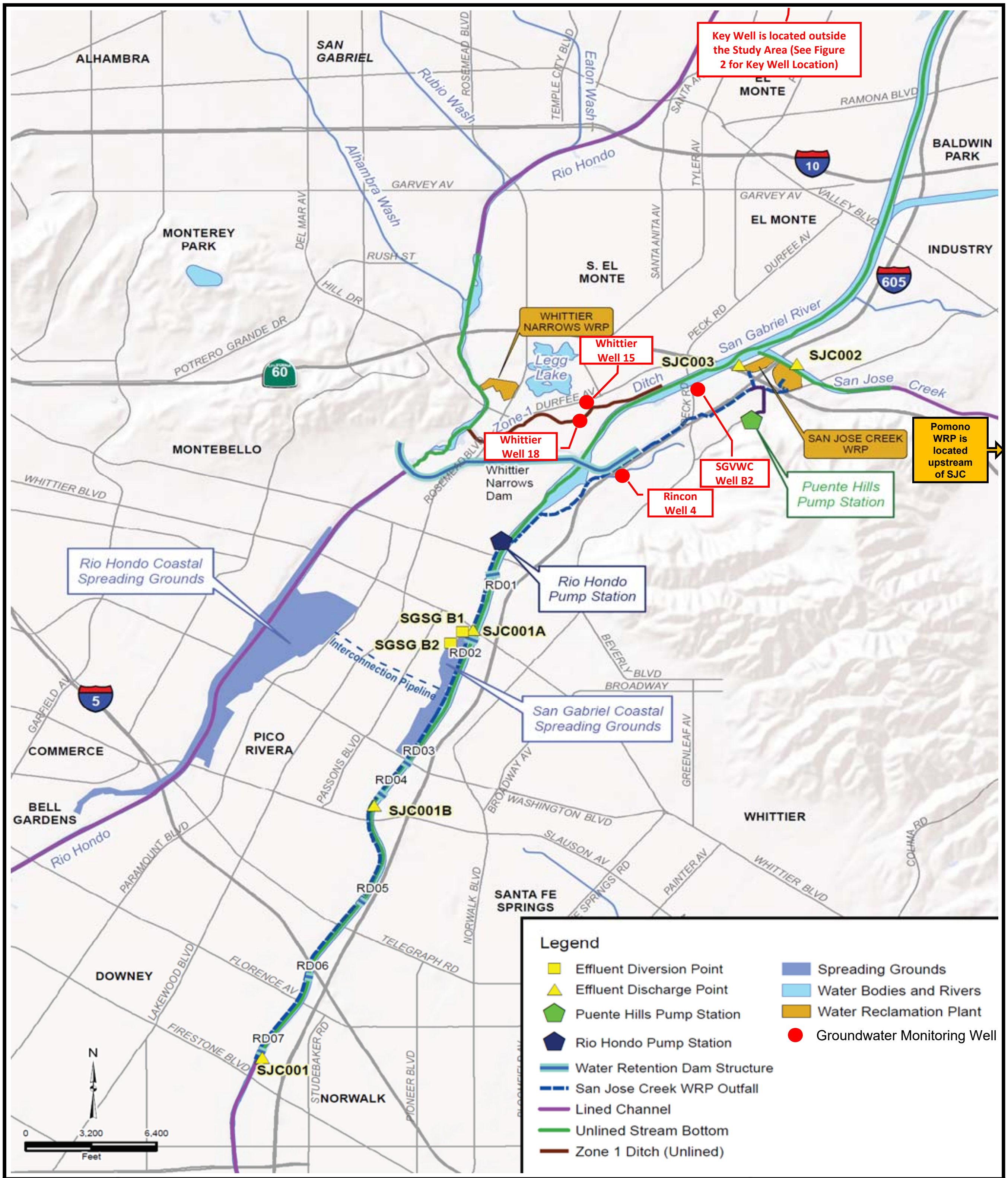
FIGURE 1



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MAIN SAN GABRIEL BASIN WATERMASTER

Recycled Water Reuse Study Area

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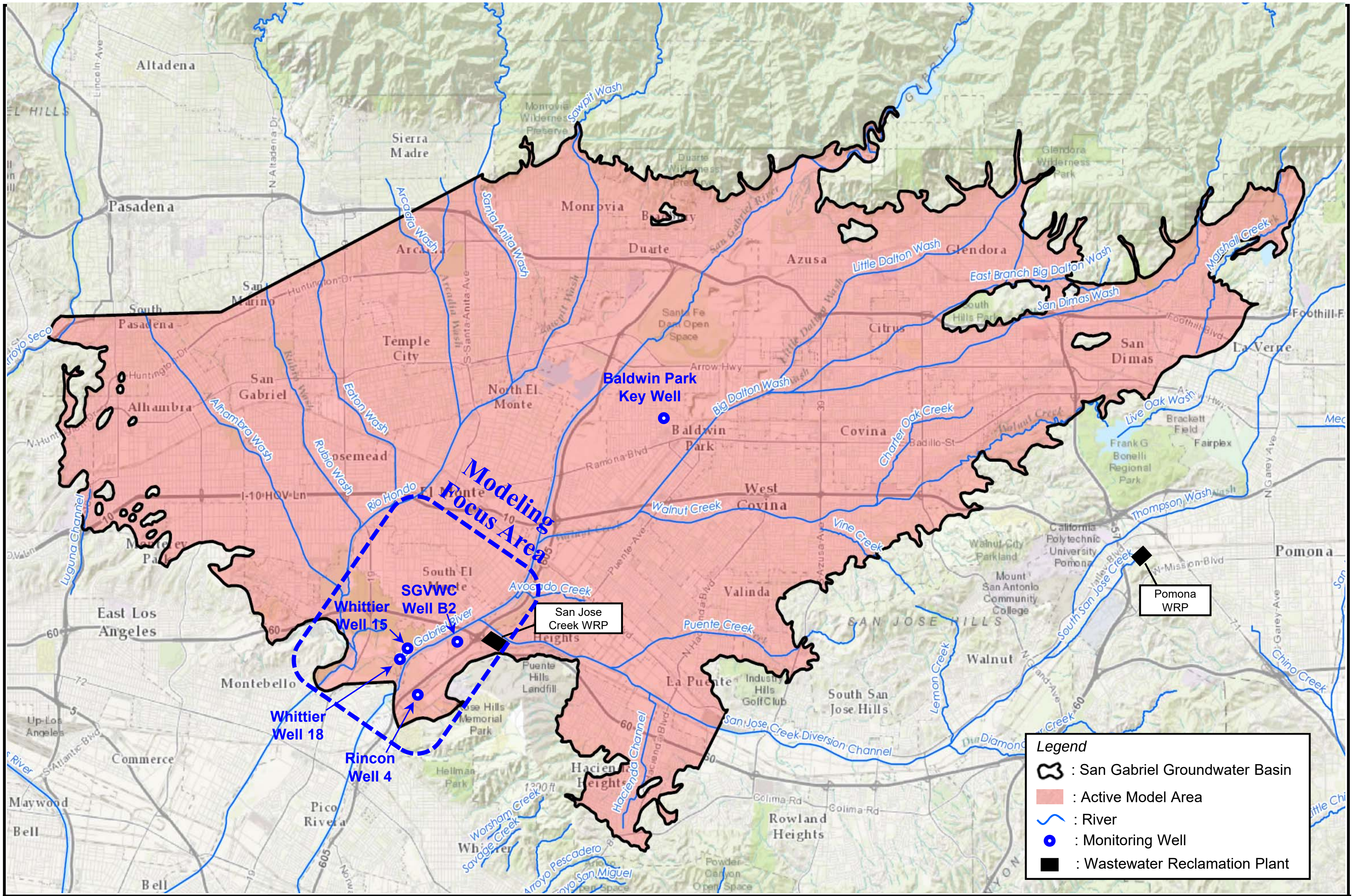
Figure modified from the source file (Amec, Foster, Wheeler, 2017)
J:\1205\1205-103\Report\Scenario-2\Figure 1 - Study Area.pdf



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MAIN SAN GABRIEL BASIN WATERMASTER

Three Dimensional San Gabriel Basin Model Coverage

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MainSanGabrielBasin WATERMASTER

FIGURE 2

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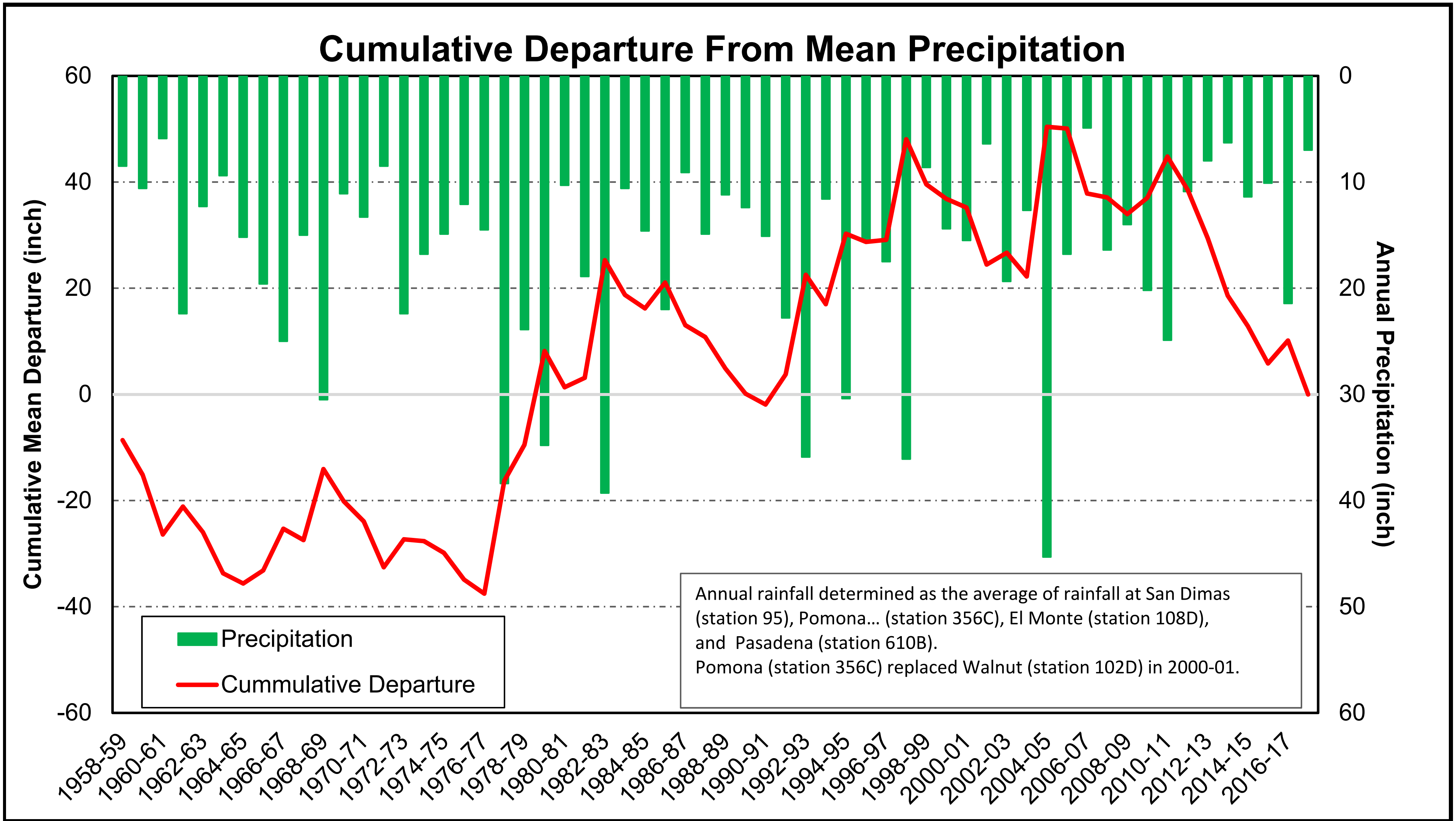

Annual rainfall determined as the average of rainfall at San Dimas (station 95), Pomona... (station 356C), El Monte (station 108D), and Pasadena (station 610B).
Pomona (station 356C) replaced Walnut (station 102D) in 2000-01.

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MAIN SAN GABRIEL BASIN WATERMASTER

Cumulative Departure from Mean Precipitation
Average of Stations 95, 356C, 108D, and 610B*
WY 1958-59 to WY 2017-18

MainSanGabrielBasin
WATERMASTER

FIGURE 3

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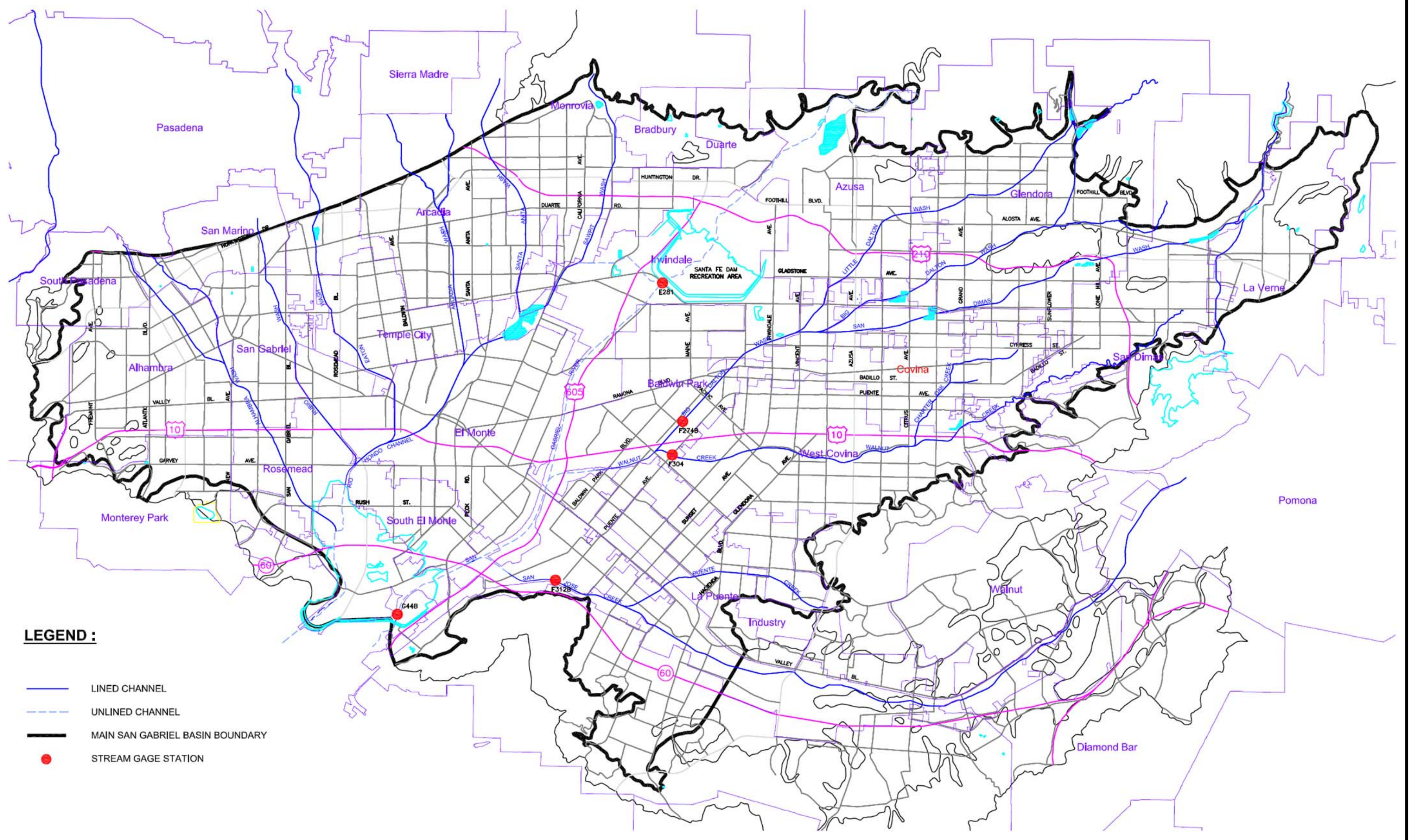

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N

0’ 4,500’ 9,000’

Approximate Scale

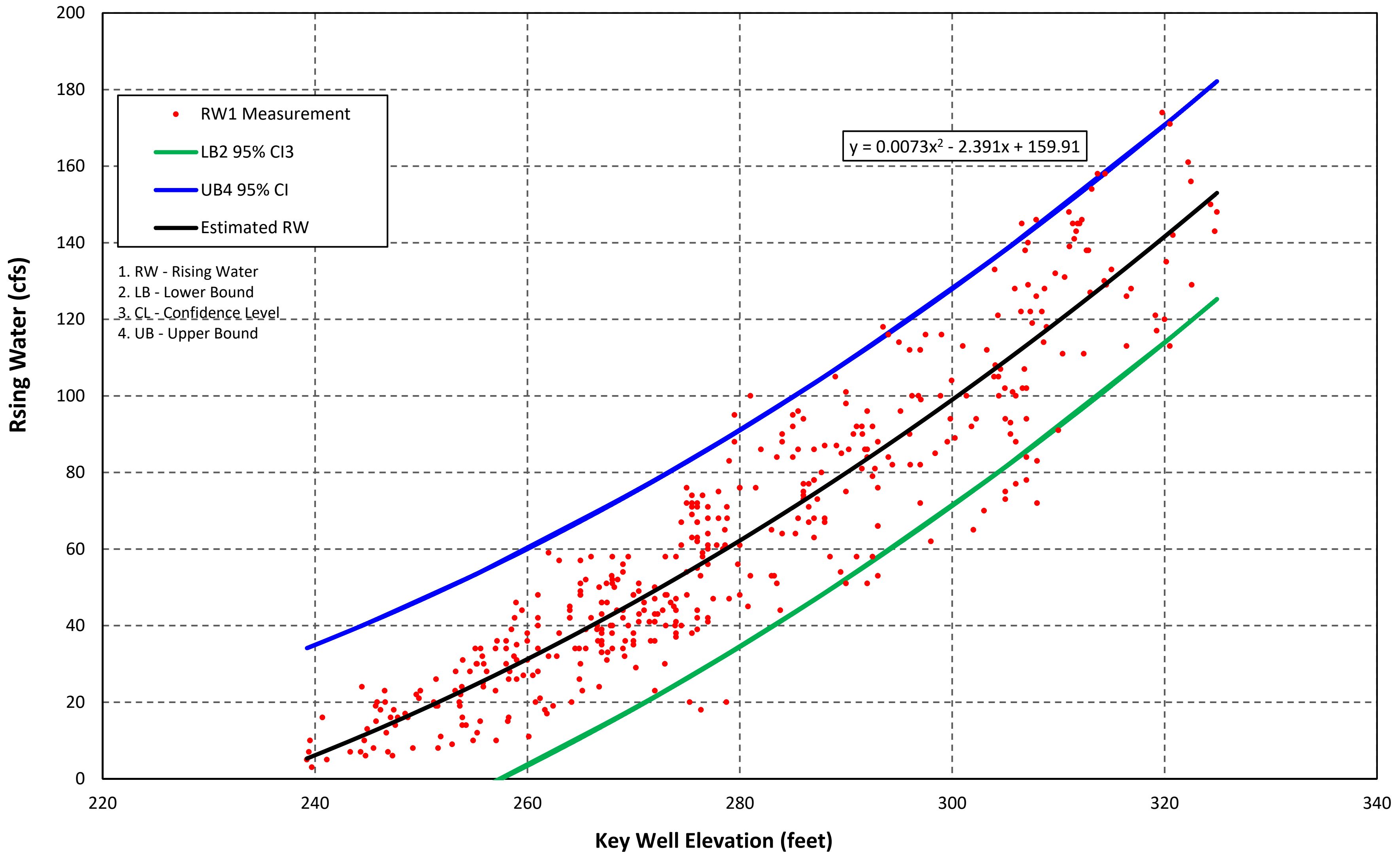
MAIN SAN GABRIEL BASIN WATERMASTER

Tributaries of the Rio Hondo and San Gabriel River, Stream and Gauge Locations

MainSanGabrielBasin WATERMASTER

FIGURE 4

J:\1205\1205-103\Report\Scenario-2\Figure 4 - Stream Gages & Rivers.pptx



1. RW - Rising Water
2. LB - Lower Bound
3. CL - Confidence Level
4. UB - Upper Bound

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Relationships of the Key Well Elevations and Impacts to Rising Water at Whittier Narrows

(with Upper and Lower 95% Confidence Interval)

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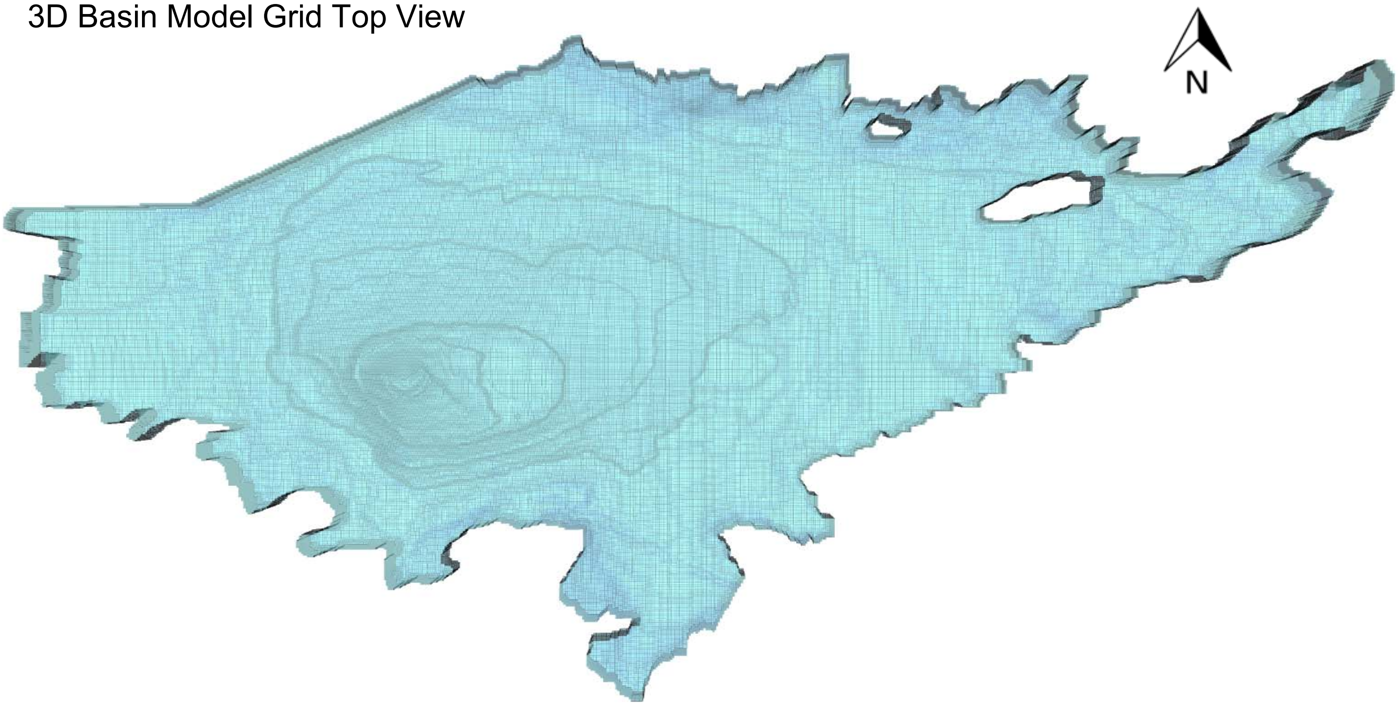
FIGURE 5

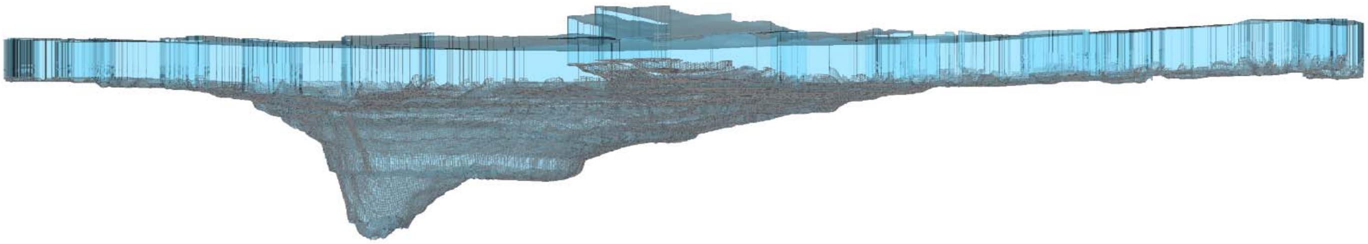
J:\1205\1205-103\Report\Scenario-2\Figure 5 - Key Well Elev vs Rising Water 95%.xlsx

FIGURE 6

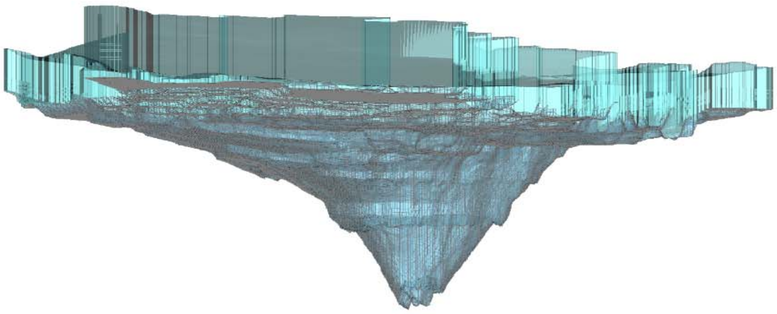
3D Basin Model Grid Top View



3D Basin Model Grid East to West Cross Section



3D Basin Model Grid South to North Cross Section



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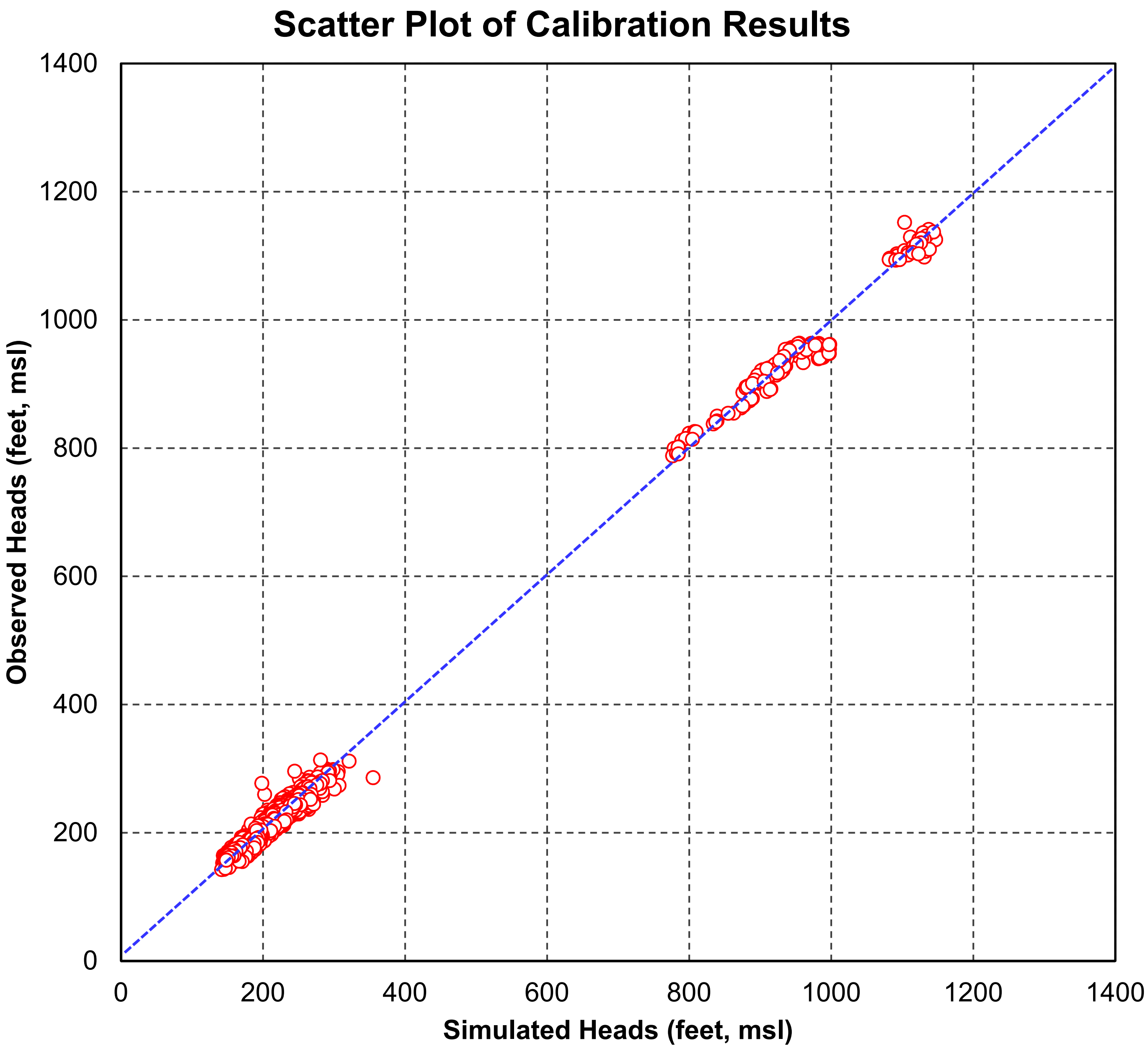
MAIN SAN GABRIEL BASIN WATERMASTER

3D Basin Model
Top and Cross-Sectional Views

MainSanGabrielBasin WATERMASTER



Root Mean Square Error (RMSE) : 11.36 ft

Residual Mean (RM) : -3.16 ft

Residual Standard Deviation (σ_R) : 11.36 ft

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MAIN SAN GABRIEL BASIN WATERMASTER

Calibration Results

Scatter Plot of Simulated Heads versus Observed Heads

MainSanGabrielBasin WATERMASTER

FIGURE 8a (i)

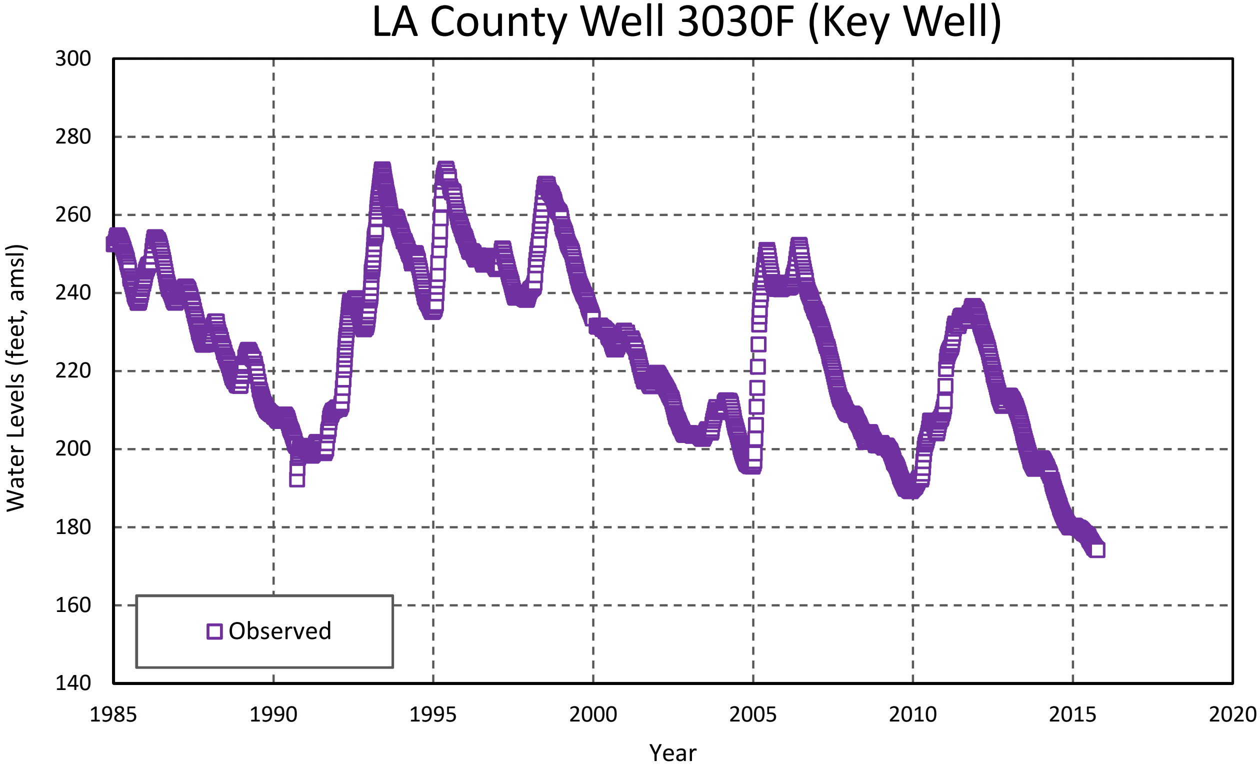
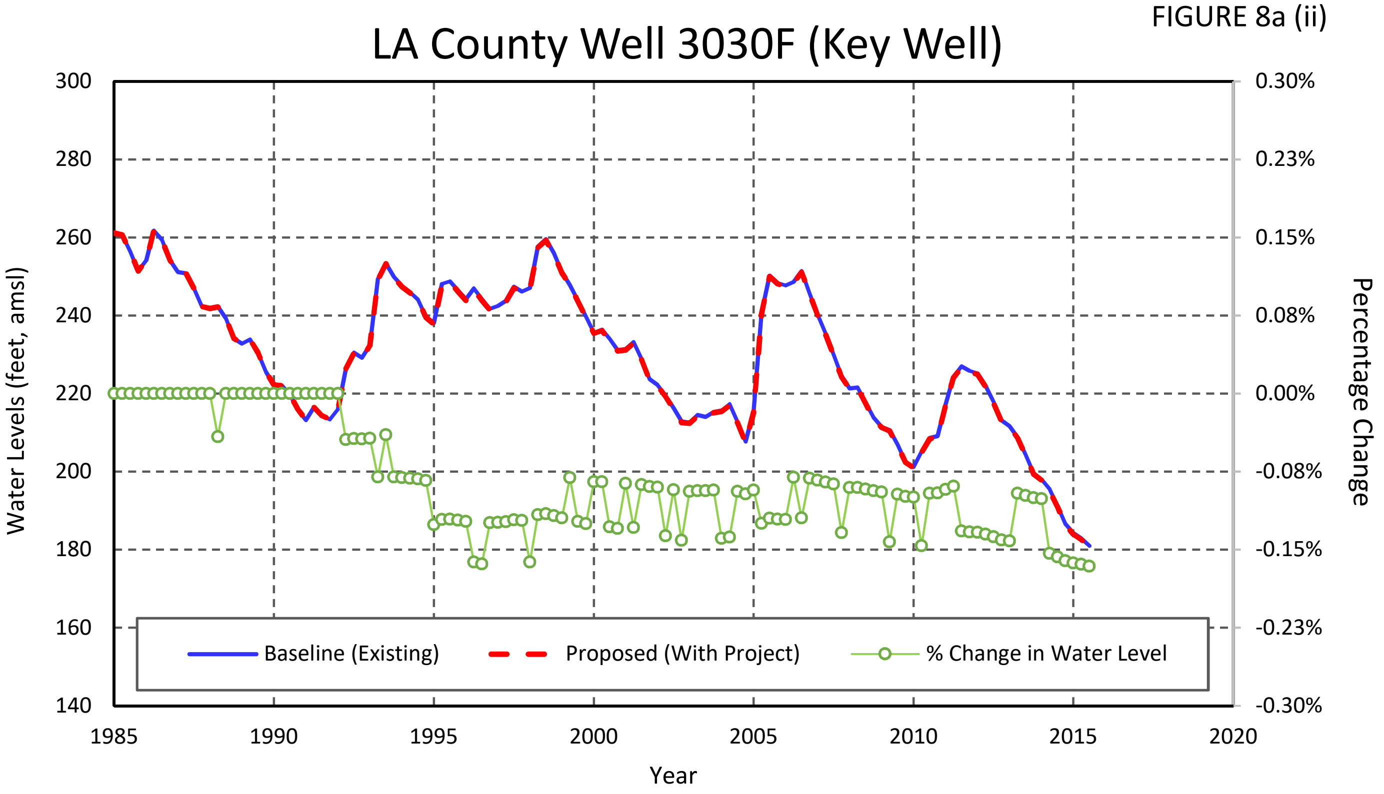


FIGURE 8a (ii)



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MAIN SAN GABRIEL BASIN WATERMASTER

Groundwater Simulation Scenario 2 (With Project Condition)
Observed and Simulated Heads at Selected Wells
(between 1985/Q1 and 2015/Q2)

MainSanGabrielBasin WATERMASTER

FIGURE 8b

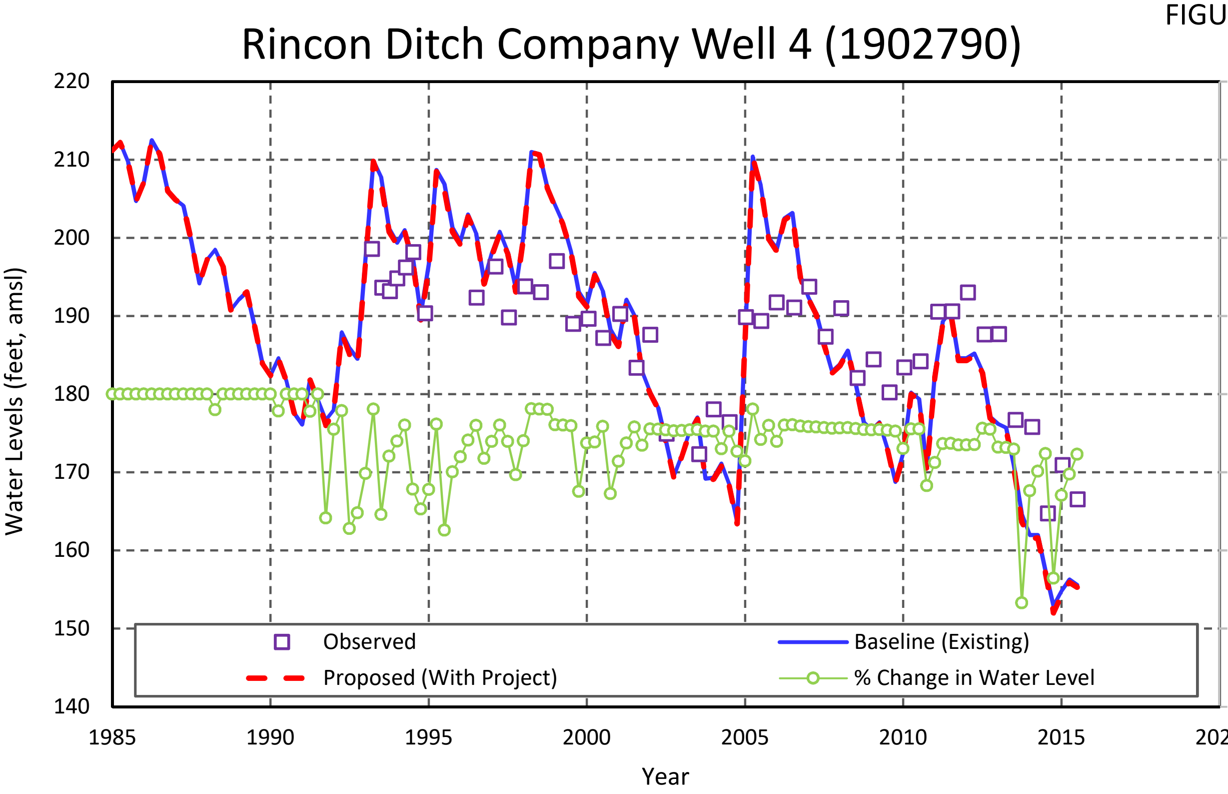
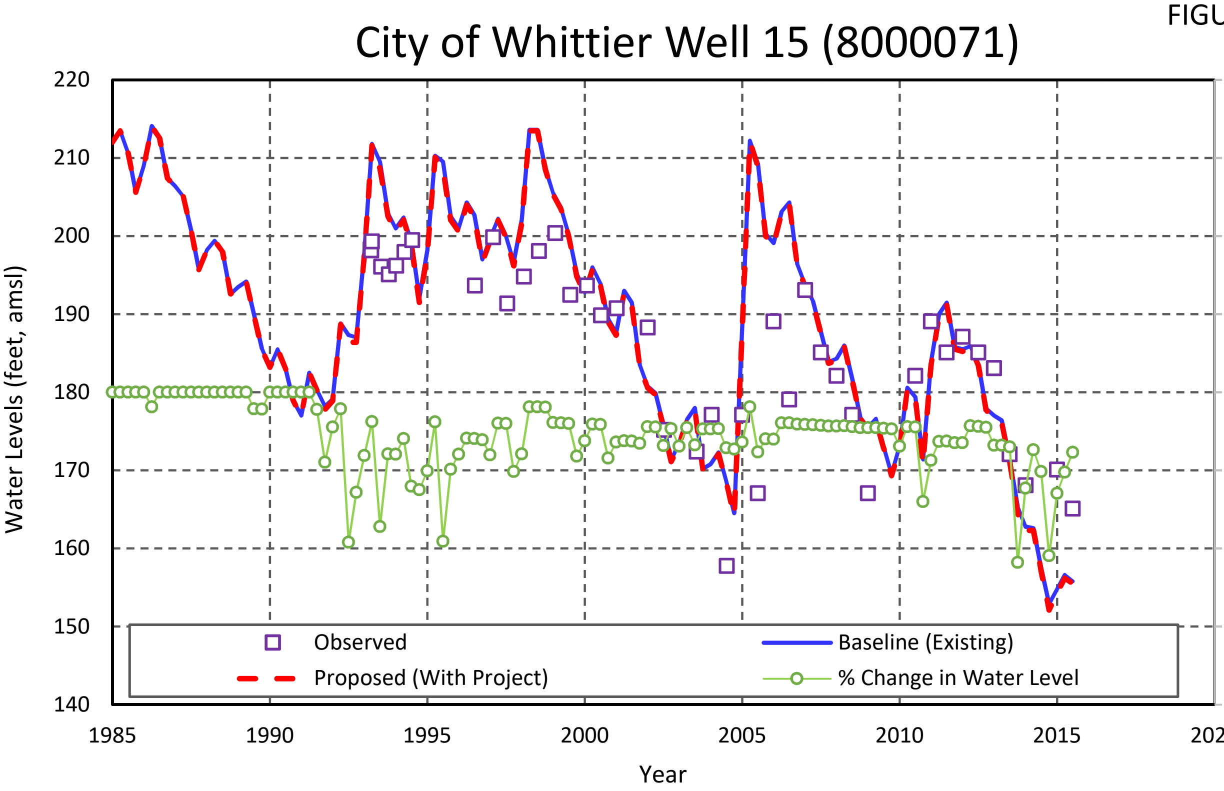


FIGURE 8c



STETSON ENGINEERS INC.

MAIN SAN GABRIEL BASIN WATERMASTER

Groundwater Simulation Scenario 2 (With Project Condition)
Observed and Simulated Heads at Selected Wells
(between 1985/Q1 and 2015/Q2)

MainSanGabrielBasin WATERMASTER

FIGURE 8d

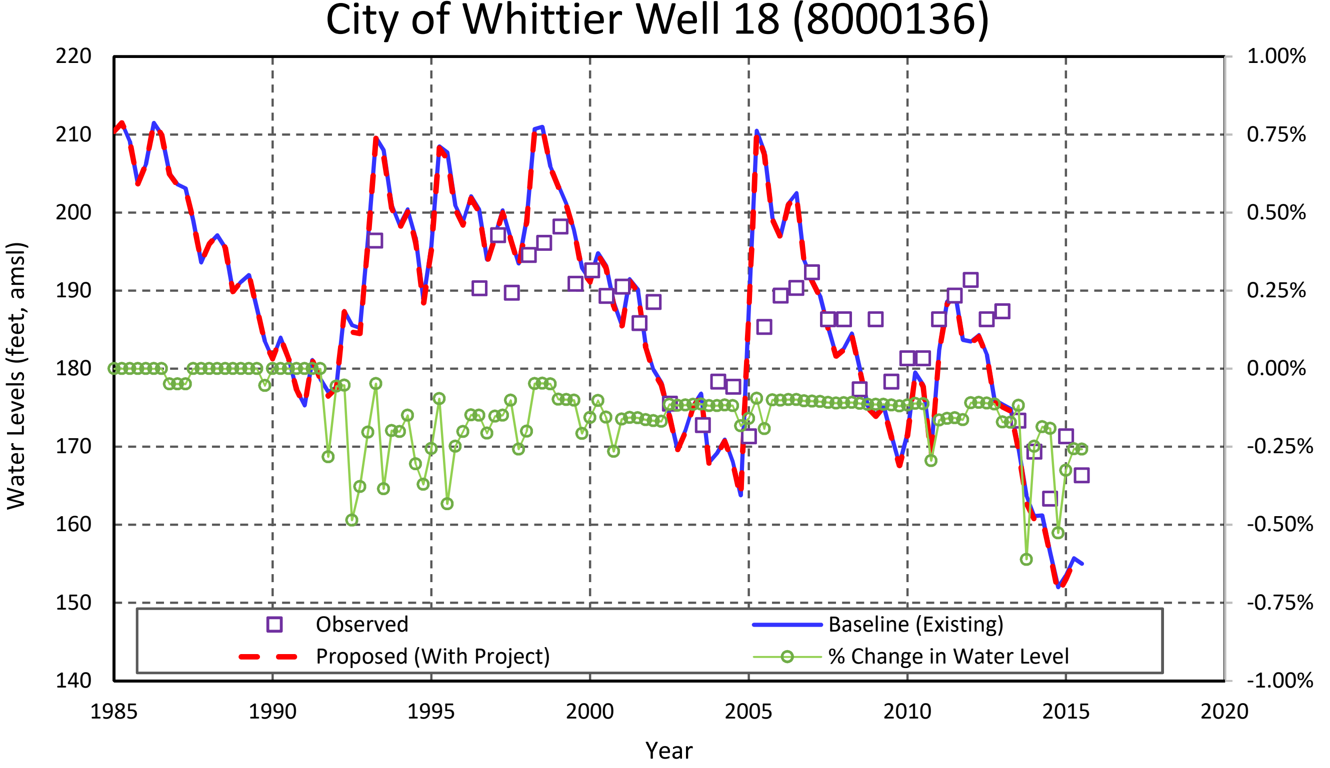
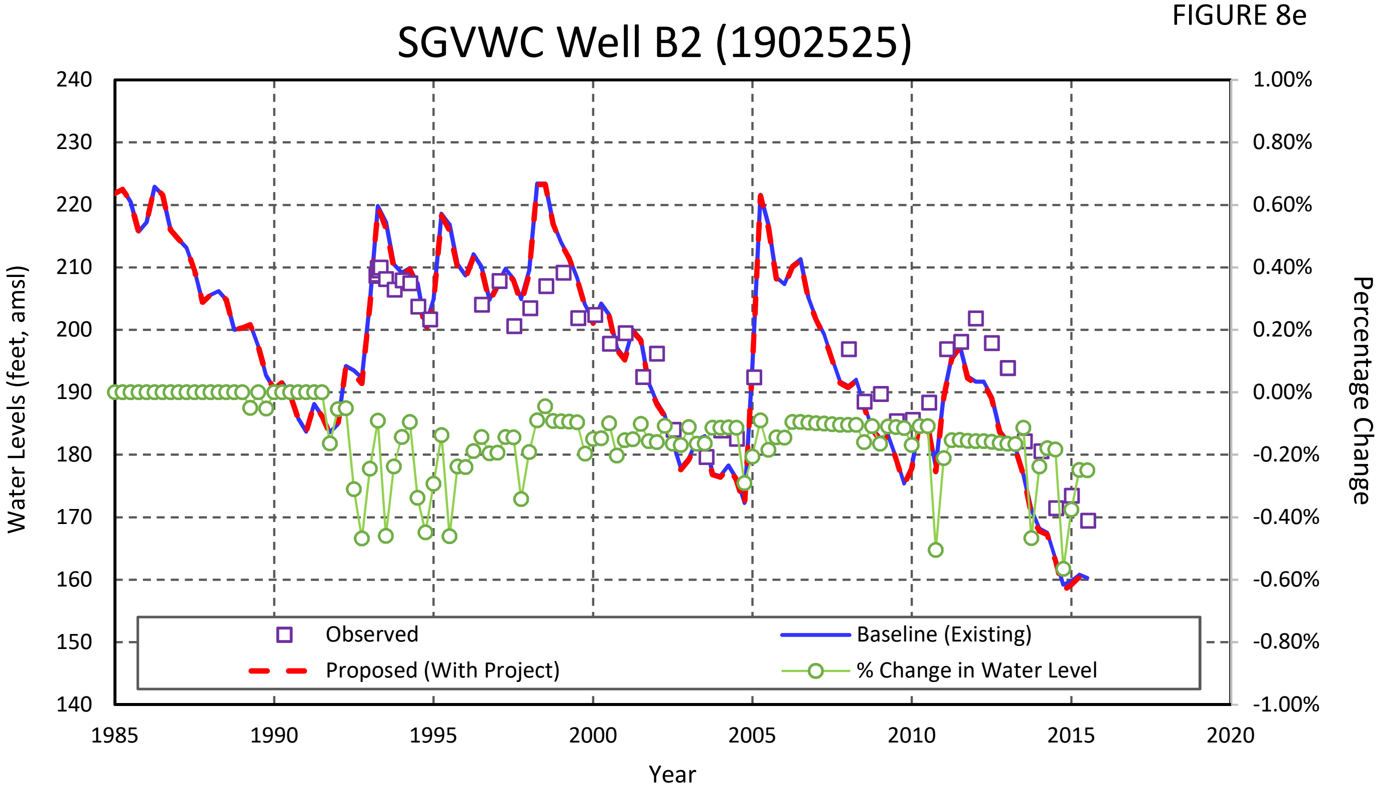


FIGURE 8e



STETSON ENGINEERS INC.

MAIN SAN GABRIEL BASIN WATERMASTER

Groundwater Simulation Scenario 2 (With Project Condition)
Observed and Simulated Heads at Selected Wells
(between 1985/Q1 and 2015/Q2)

MainSanGabrielBasin WATERMASTER

FIGURE 8a (i)

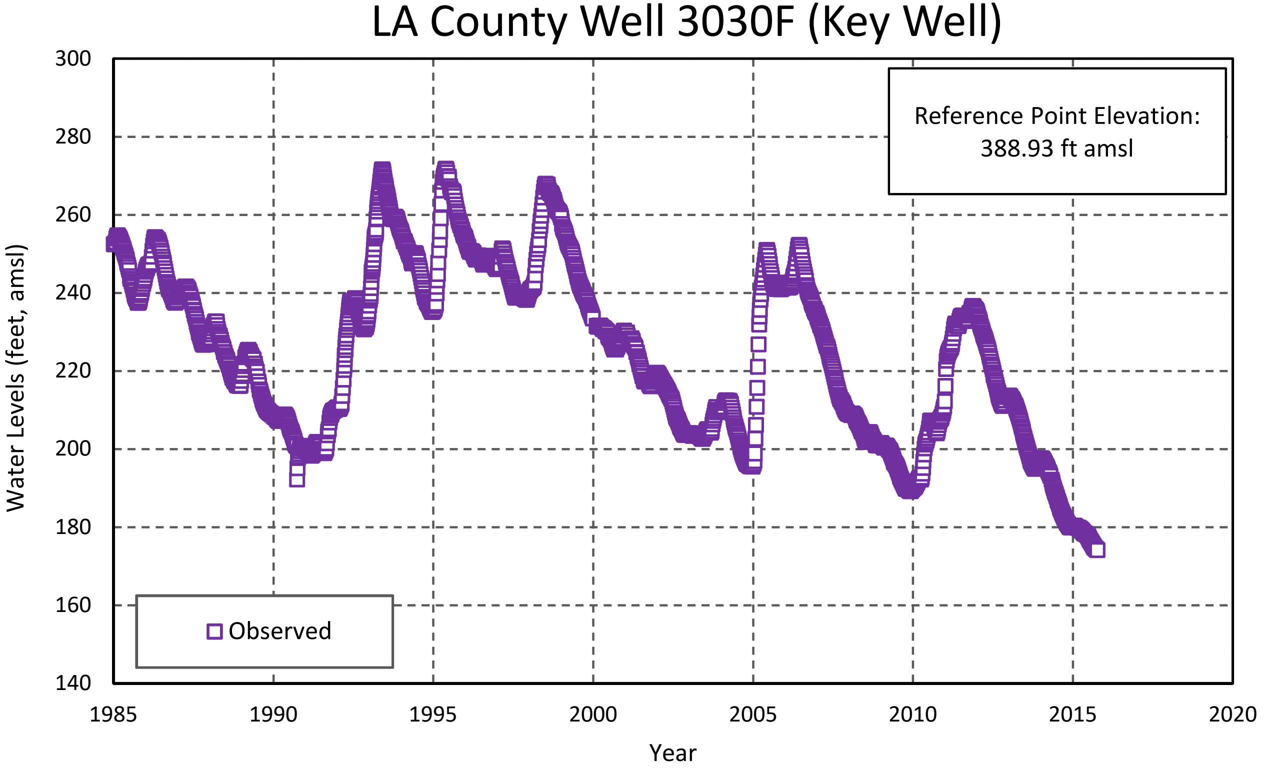
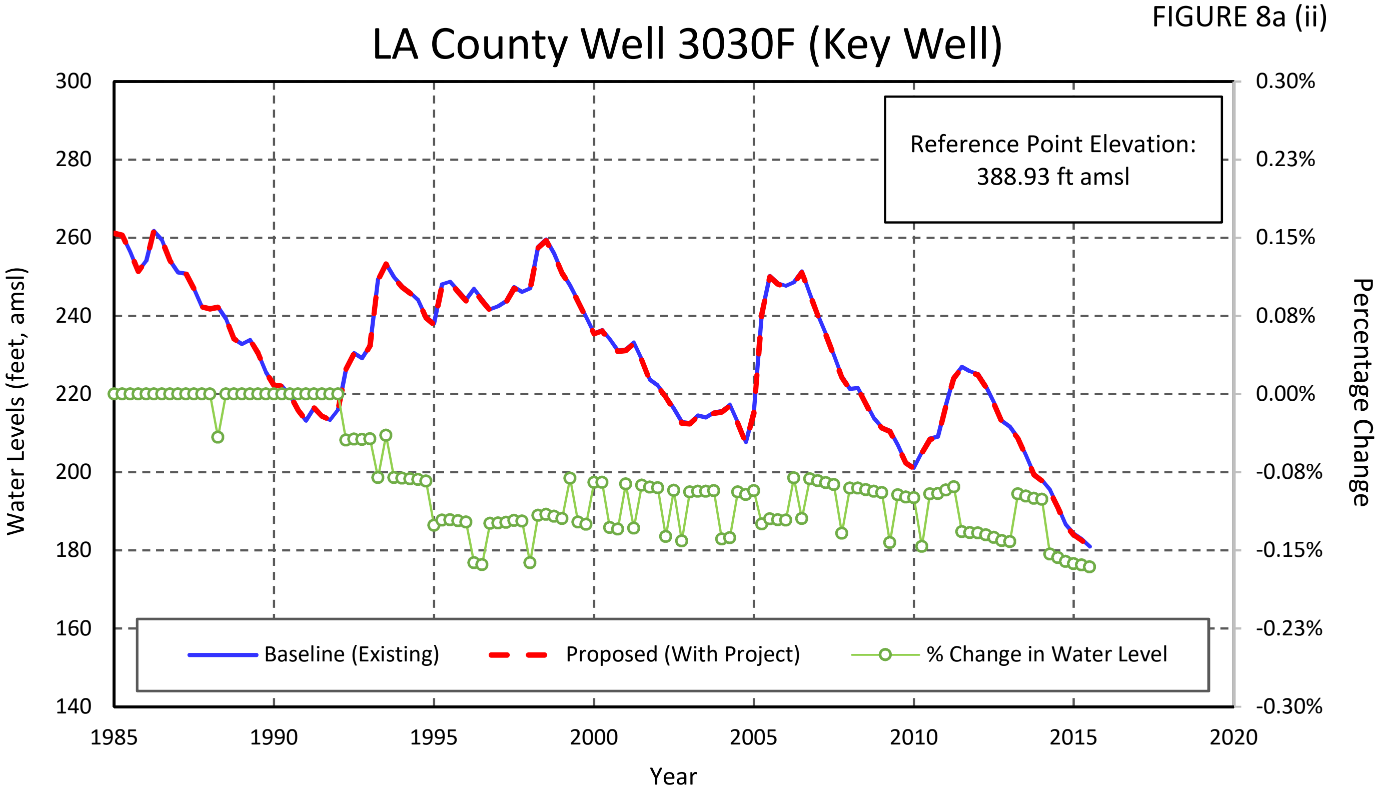


FIGURE 8a (ii)



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MAIN SAN GABRIEL BASIN WATERMASTER

Groundwater Simulation Scenario 2 (With Project Condition)
Observed and Simulated Heads at Selected Wells
(between 1985/Q1 and 2015/Q2)

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FIGURE 8b

Rincon Ditch Company Well 4 (1902790)

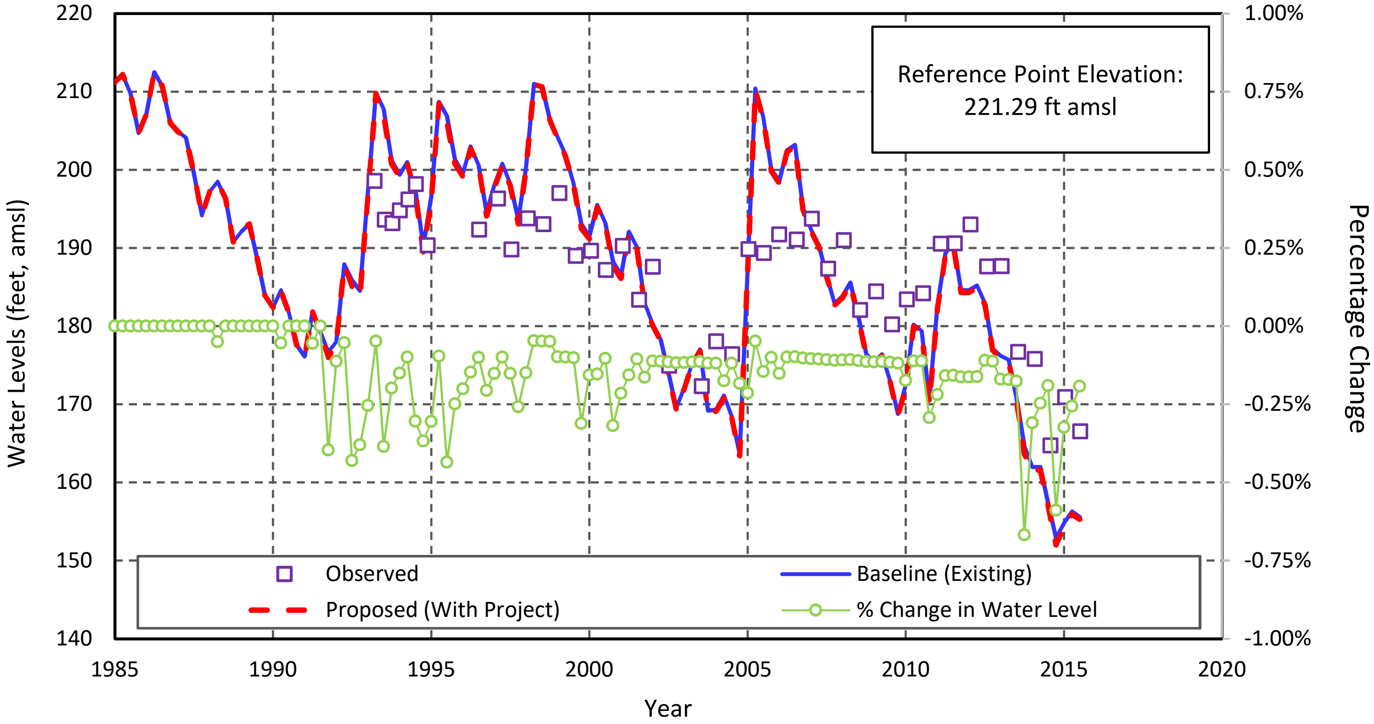
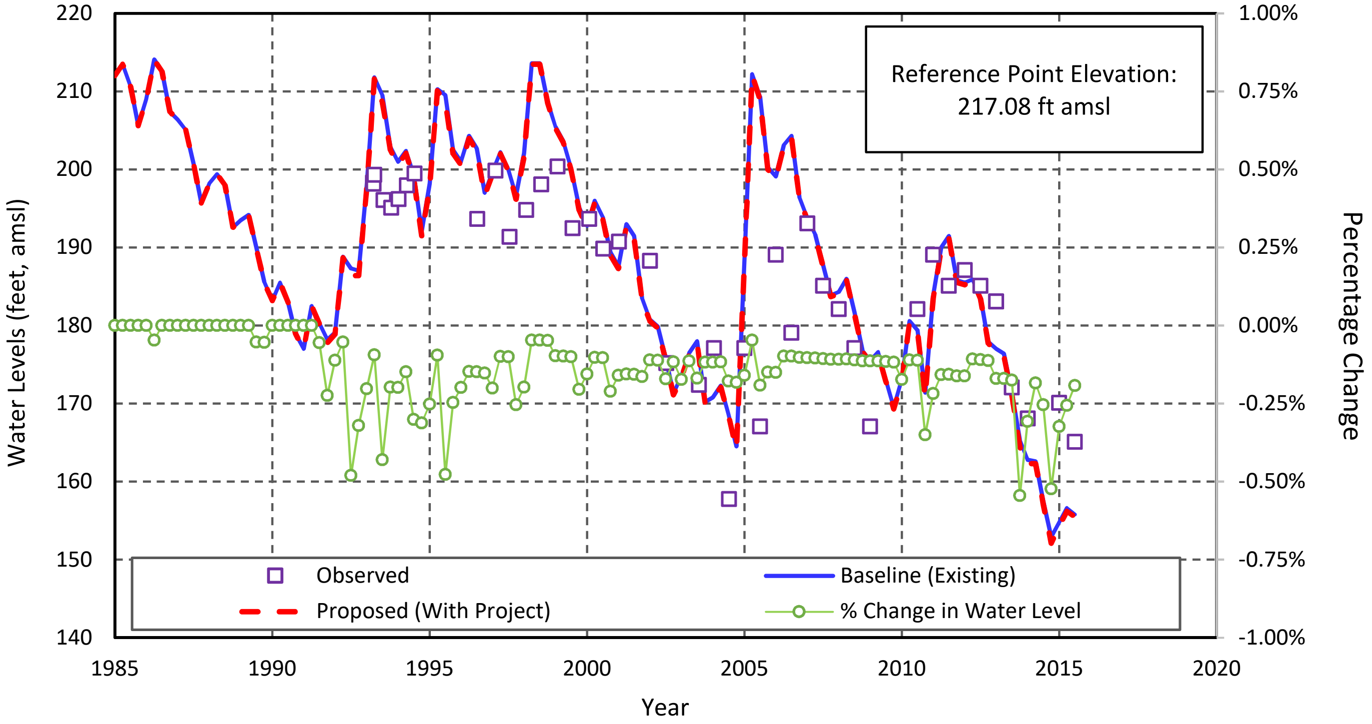


FIGURE 8c

City of Whittier Well 15 (8000071)



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MAIN SAN GABRIEL BASIN WATERMASTER

Groundwater Simulation Scenario 2 (With Project Condition)
Observed and Simulated Heads at Selected Wells
(between 1985/Q1 and 2015/Q2)

MainSanGabrielBasin WATERMASTER

FIGURE 8d

City of Whittier Well 18 (8000136)

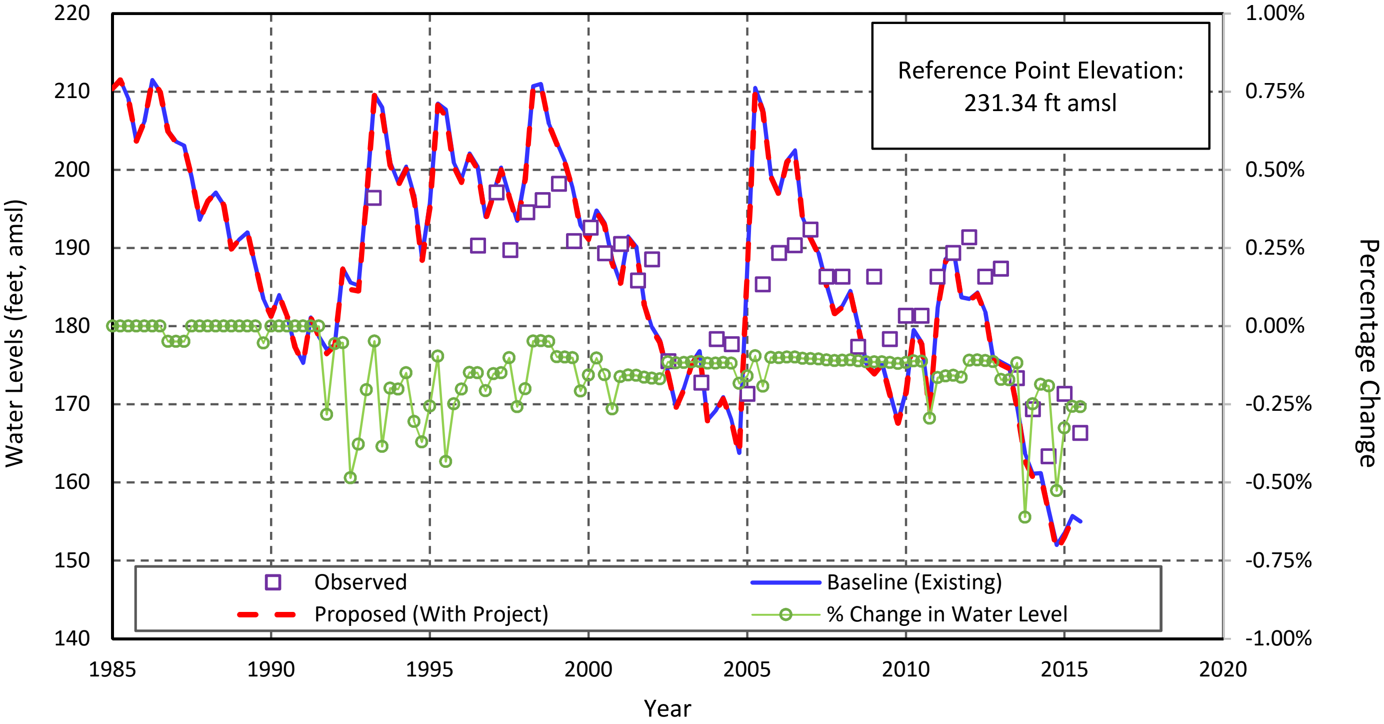
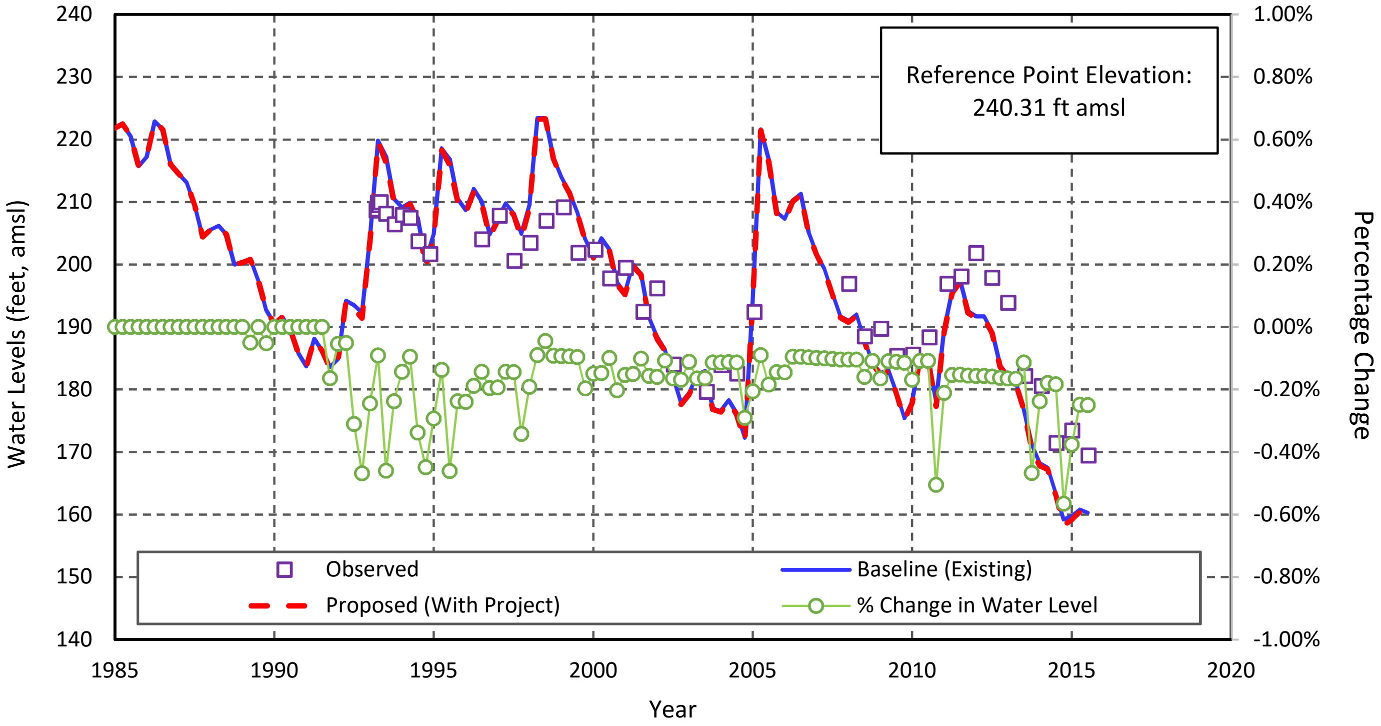


FIGURE 8e

SGVWC Well B2 (1902525)



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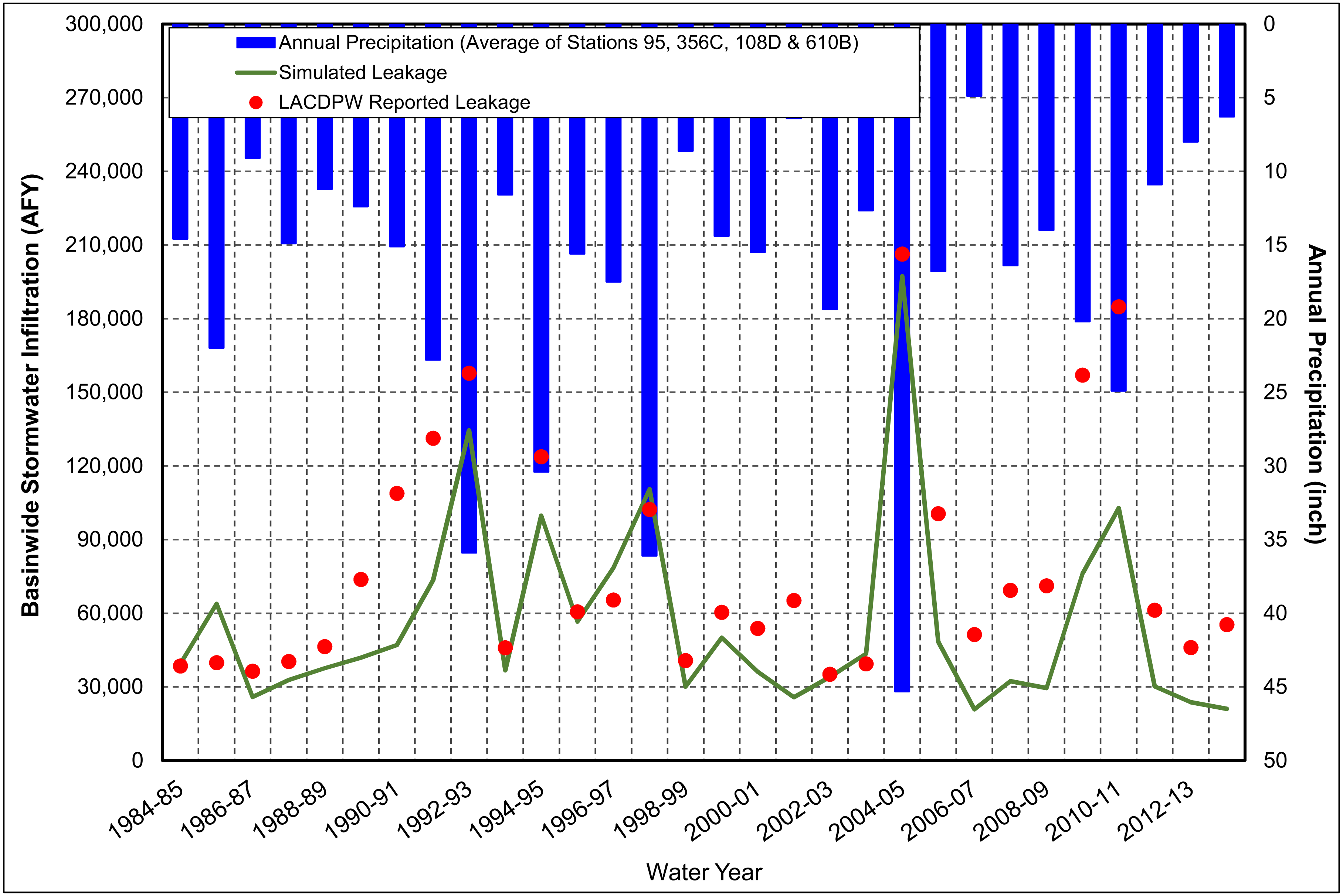
MAIN SAN GABRIEL BASIN WATERMASTER

Groundwater Simulation Scenario 2 (With Project Condition)
Observed and Simulated Heads at Selected Wells
(between 1985/Q1 and 2015/Q2)

MainSanGabrielBasin WATERMASTER



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MAIN SAN GABRIEL BASIN WATERMASTER

San Gabriel River and Rio Hondo Leakages
(WY1983-84 to WY2014-15)

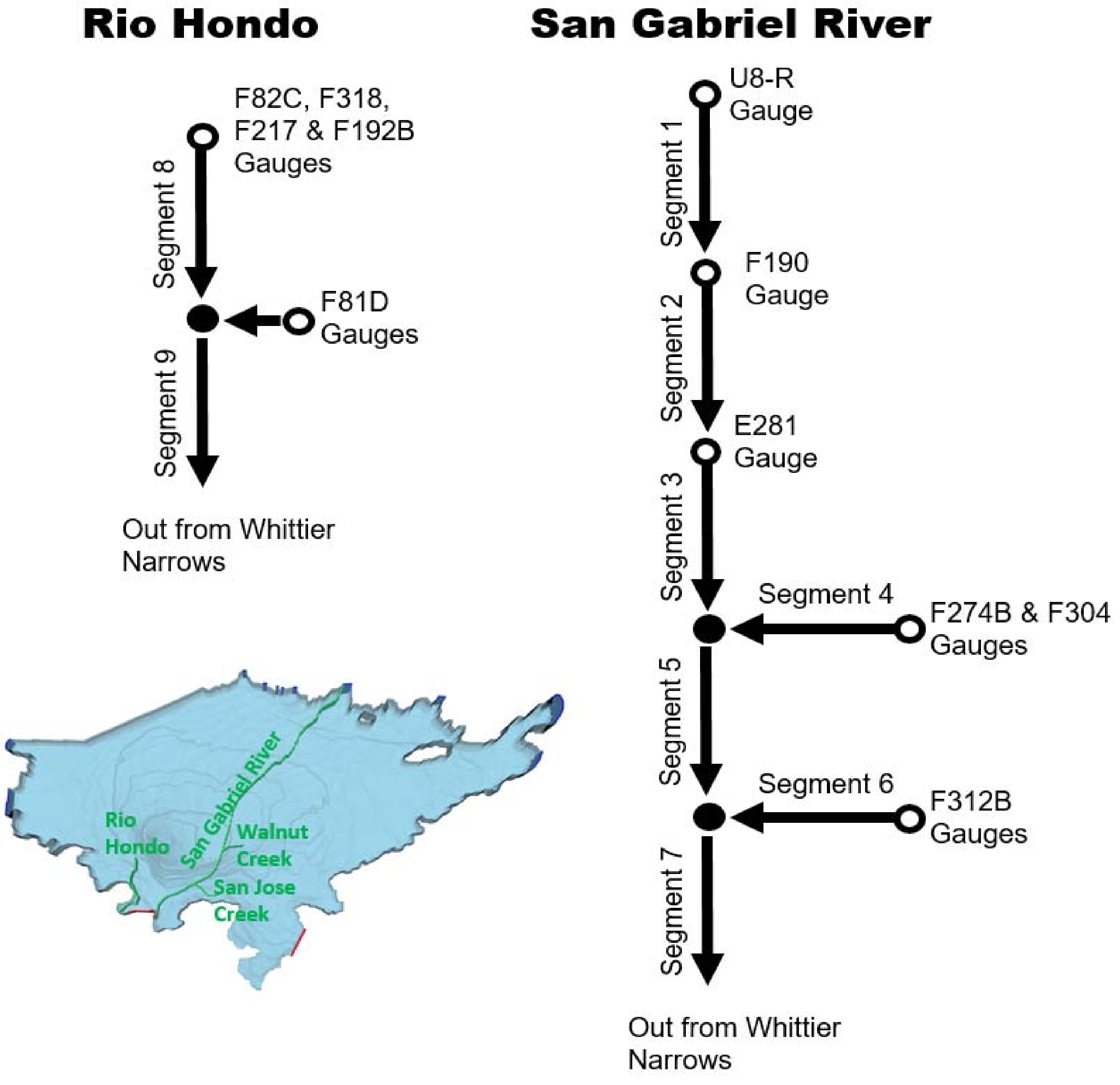
MainSanGabrielBasin WATERMASTER

Figure 9

J:\1205\1205-103\Report\Scenario-2\Figure 9 - Baseline Net Stream Leakage.xlsx

FIGURE 10

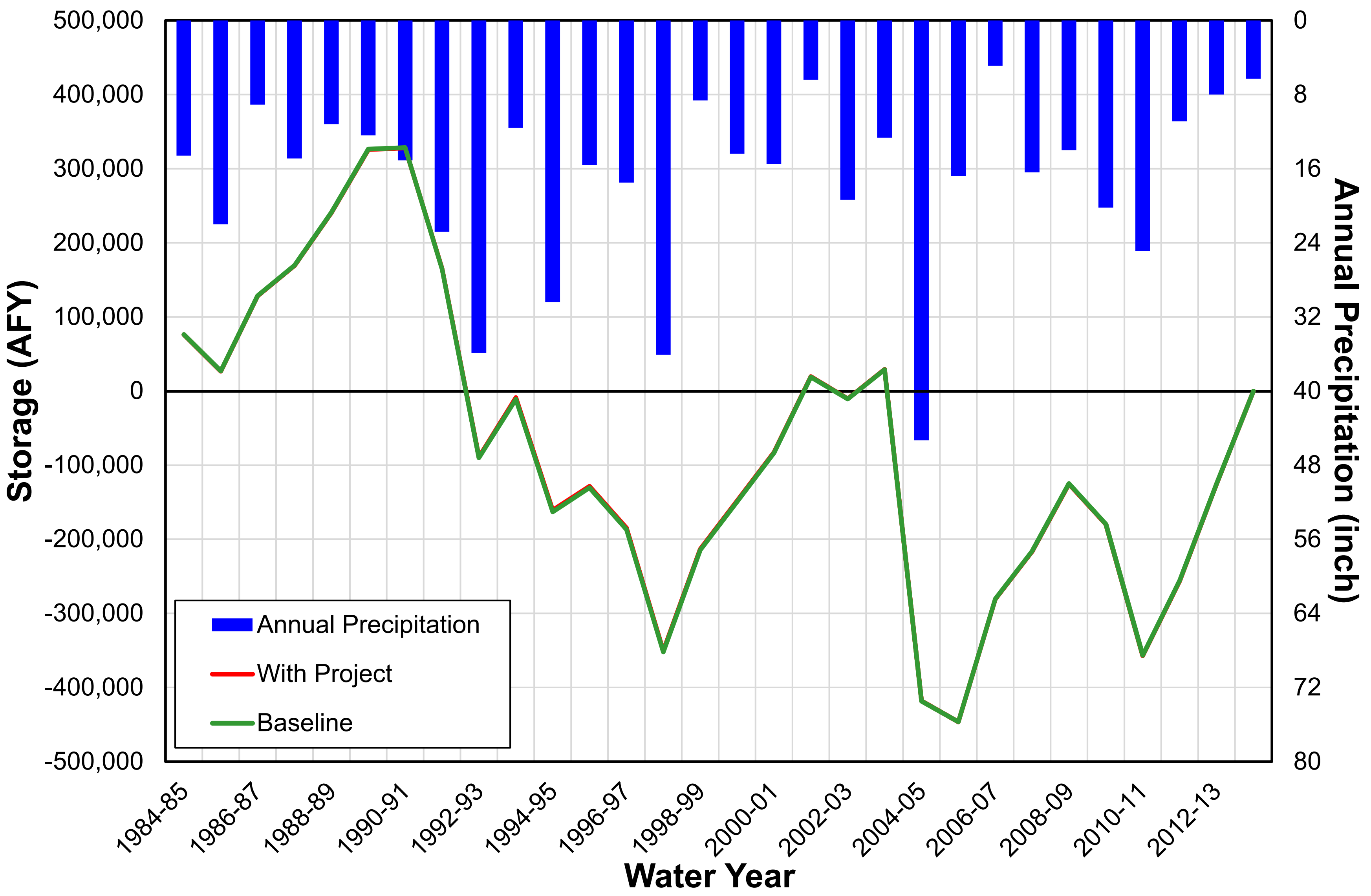
Schematic Stream Routing Simulation



STETSON ENGINEERS INC.

MAIN SAN GABRIEL BASIN WATERMASTER
San Gabriel River and Rio Hondo
Schematic Stream Routing

MainSanGabrielBasin WATERMASTER



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MAIN SAN GABRIEL BASIN WATERMASTER

Change of Storage Cumulative Mean Departure
(WY 1984-85 to WY 2013-14)

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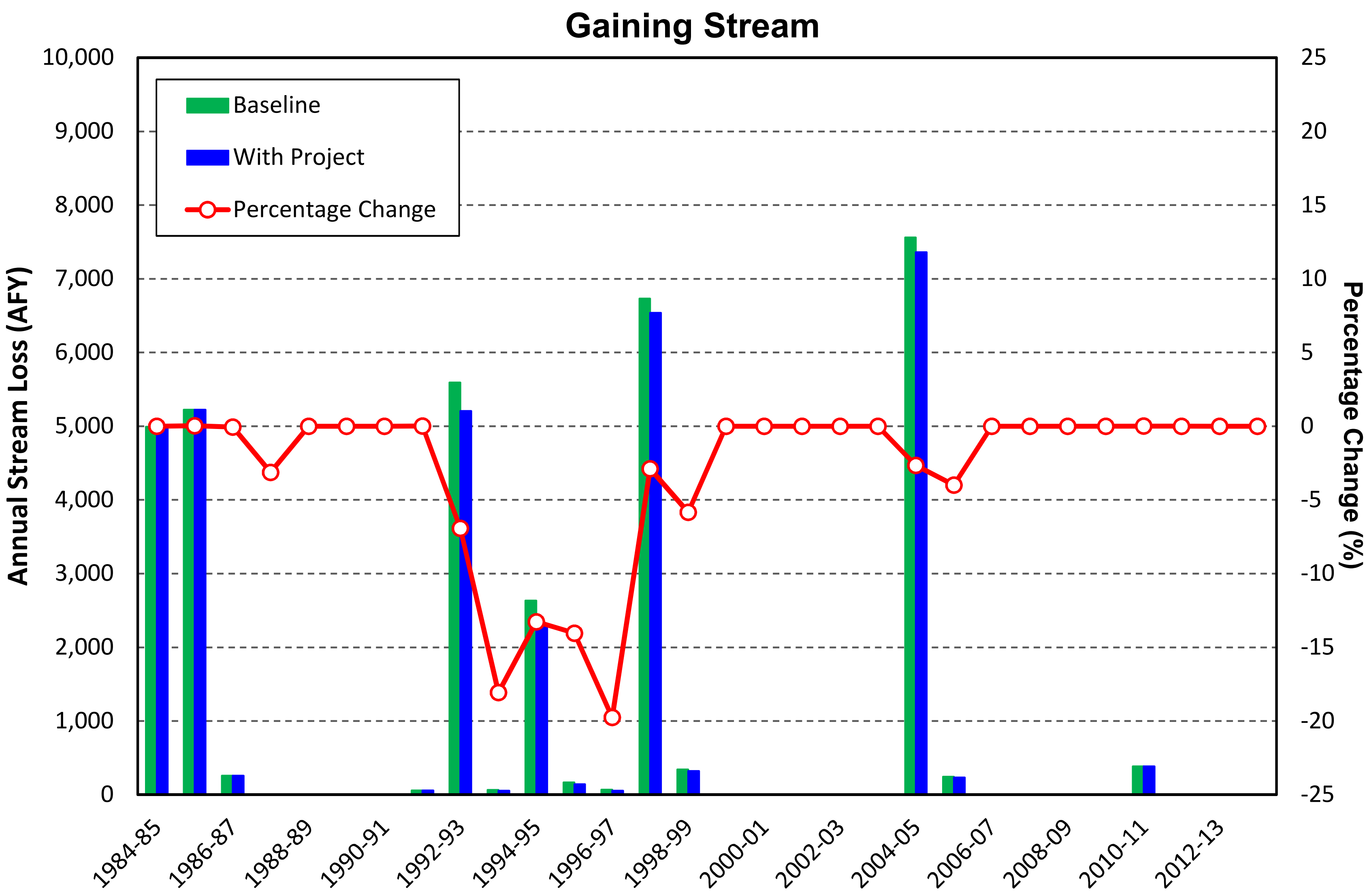
FIGURE 11

*Annual rainfall determined as the average of rainfall at San Dimas (station 95), Pomona... (station 356C), El Monte (station 108D), and Pasadena (station 610B).

J:\1205\1205-103\Report\Scenario-2\Table 2 and Figure 11- Storage Comparison .xlsx



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MAIN SAN GABRIEL BASIN WATERMASTER

Comparison of Simulated Rising Water Baseline Condition and With Project Condition

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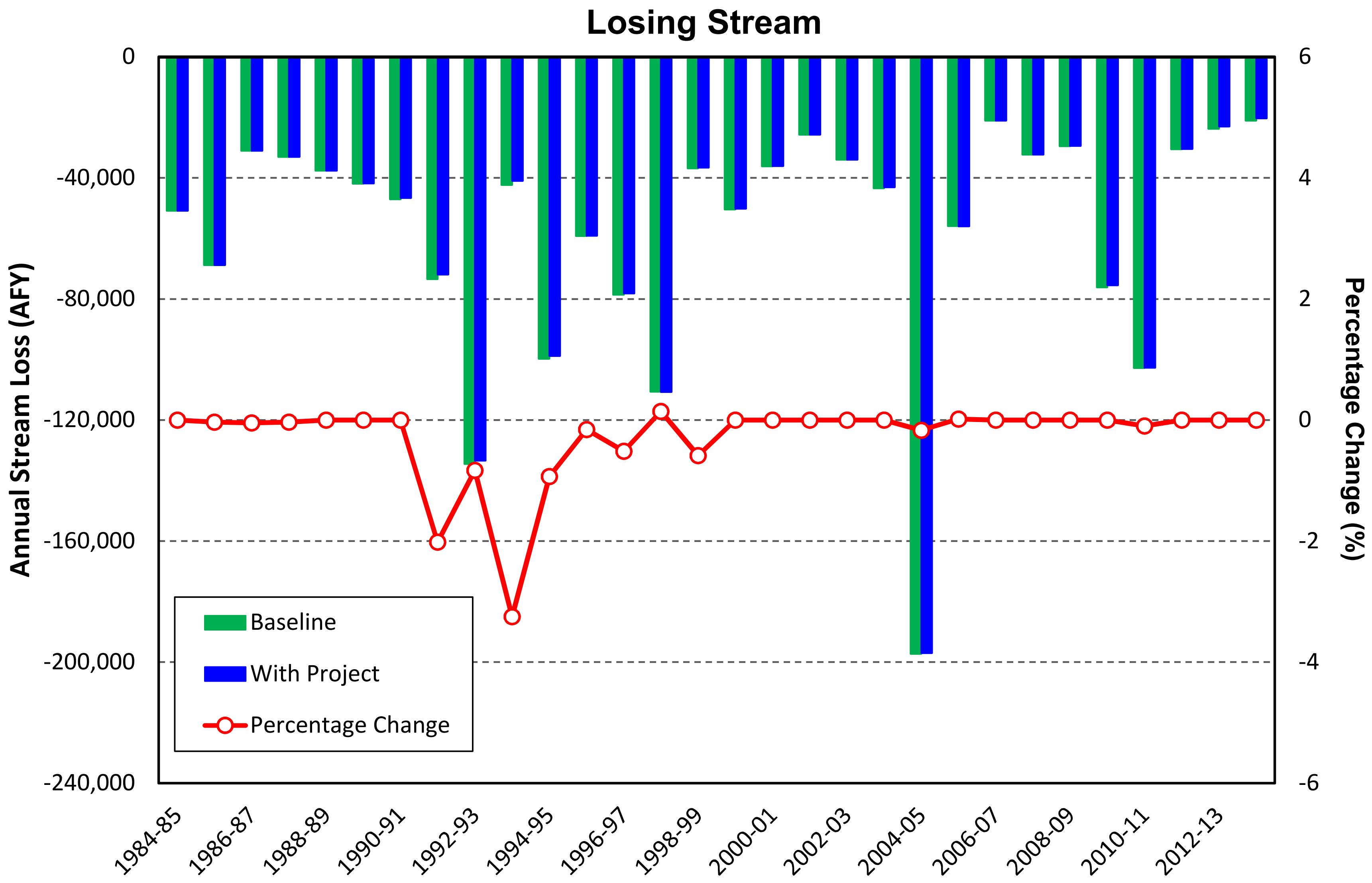
FIGURE 12

J:\1205\1205-103\Report\Scenario-2\Table 3, Figures 12 & 13 - Stream Leakage Comparison.xlsx

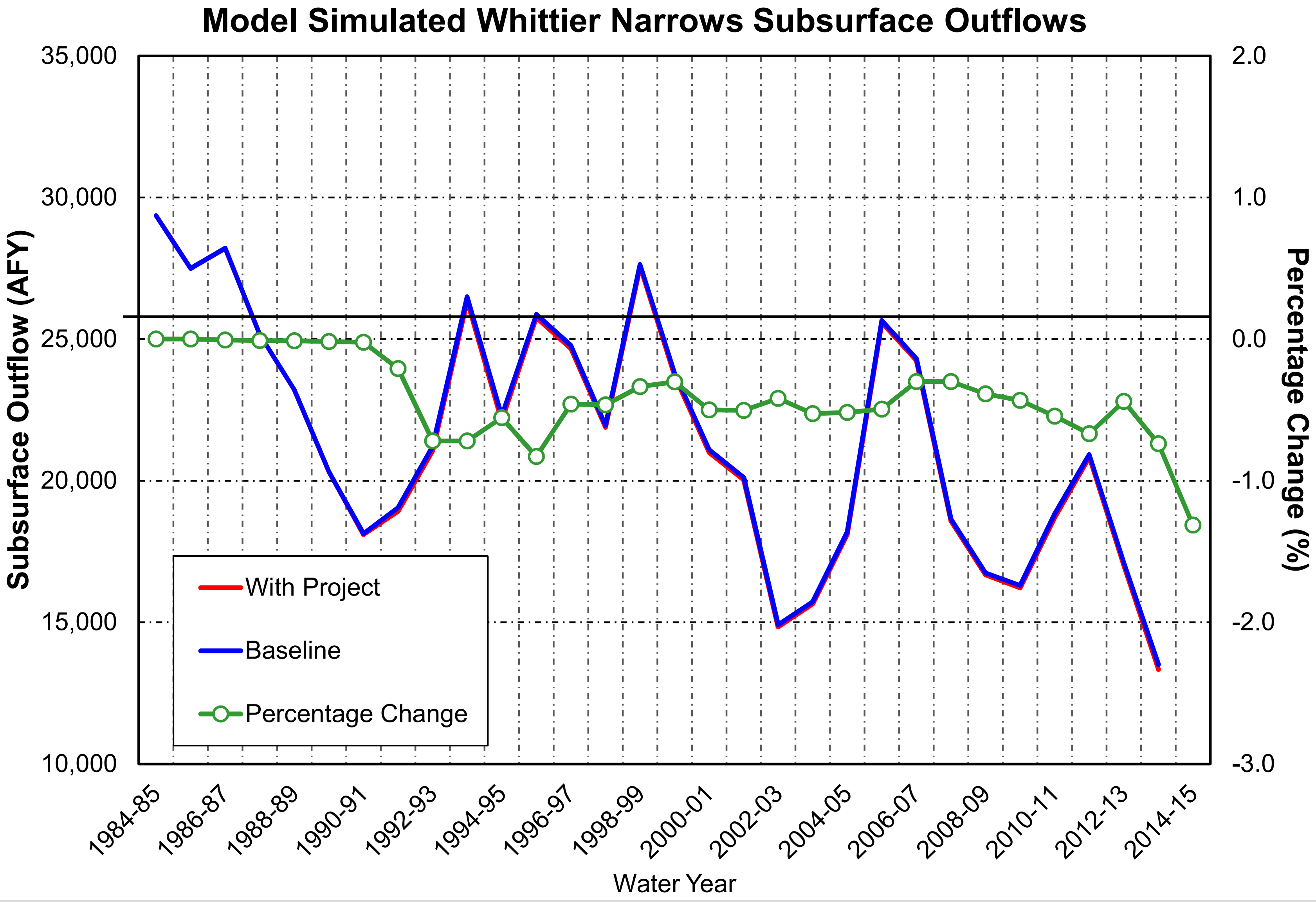


MAIN SAN GABRIEL BASIN WATERMASTER

Comparison of Simulated Stream Leakage Baseline Condition and With Project Condition

FIGURE 13

J:\1205\1205-103\Report\Scenario-2\Table 3, Figures 12 & 13 - Stream Leakage Comparison.xlsx



Model Simulated Whittier Narrows Subsurface Outflows

STETSON ENGINEERS INC.

MAIN SAN GABRIEL BASIN WATERMASTER

Whittier Narrows Subsurface Outflow
(WY 1984-85 to WY 2014-15)

MainSanGabrielBasin WATERMASTER

FIGURE 14

J:\1205\1205-103\Report\Scenario-2\Table 4 and Figure 14 - WN Outflow Comparison.xlsx

Table 1

Stream Flow Data at the Gaging Station Within the Study Area (unit: cubic feet per day).

Year/ Quarter	Segment 03 (E281)	Segment 04 (F274B & F304)	(1) Segment 06 (F312B-AF)	(2) Segment 07 (G44B*-AF) [1]	(3) Historical Pomona WRP Recycled Water Discharge	(4) Historical San Jose WRP Recycled Water Discharge	(5) Proposed Pomona WRP Recycled Water Discharge	(6) Proposed San Jose WRP Recycled Water Discharge	(1) - (3) Adjusted Segment 06 (F312B-AF)	(2) - (3) - ((4 - (6)) Adjusted Segment 07 (G44B*-AF) [2]
1985/Q1	4,227,076.8	6,168,296.6	3,247,501.4	NA	0.00	0.00	0.00	0.00	3,247,501.4	NA
1985/Q2	2,322,853.8	8,716,525.5	2,757,775.5	NA	0.00	0.00	0.00	0.00	2,757,775.5	NA
1985/Q3	788,871.6	232,245.8	1,277,969.9	NA	0.00	0.00	0.00	0.00	1,277,969.9	NA
1985/Q4	1,620,659.3	1,158,604.6	4,134,617.7	NA	0.00	0.00	0.00	0.00	4,134,617.7	NA
1986/Q1	4,227,076.8	9,051,585.6	10,107,660.0	NA	738,882.09	0.00	0.00	0.00	9,368,777.9	NA
1986/Q2	2,322,853.8	6,748,693.4	2,068,098.6	NA	366,079.03	0.00	0.00	0.00	1,702,019.6	NA
1986/Q3	788,871.6	1,093,143.9	1,754,110.5	NA	86,572.68	0.00	0.00	0.00	1,667,537.9	NA
1986/Q4	1,620,659.3	6,902,138.8	2,060,360.1	NA	404,732.38	0.00	0.00	0.00	1,655,627.7	NA
1987/Q1	4,227,076.8	11,669,128.5	4,346,205.2	NA	601,696.14	0.00	0.00	0.00	3,744,509.1	NA
1987/Q2	2,322,853.8	5,509,566.0	964,832.0	NA	219,103.88	2,313,290.44	0.00	1,055,883.82	745,728.1	NA
1987/Q3	788,871.6	269,058.3	6,153,935.2	NA	46,381.34	2,017,704.42	0.00	920,965.83	6,107,553.9	NA
1987/Q4	1,620,659.3	5,091,306.1	5,417,000.9	NA	434,592.55	1,561,446.90	0.00	712,710.56	4,982,408.3	NA
1988/Q1	4,274,044.3	5,815,583.8	3,329,573.5	NA	181,981.82	612,286.28	0.00	301,226.00	3,147,591.6	NA
1988/Q2	2,322,853.8	7,952,977.5	2,334,984.0	NA	96,705.39	1,875,640.90	0.00	922,757.58	2,238,278.6	NA
1988/Q3	788,871.6	297,985.9	1,151,752.9	NA	38,389.57	1,198,329.85	0.00	589,541.40	1,113,363.3	NA
1988/Q4	1,620,659.3	2,966,526.4	6,663,035.6	NA	351,812.32	1,736,452.17	0.00	854,281.01	6,311,223.3	NA
1989/Q1	4,227,076.8	9,671,481.8	6,699,798.0	NA	623,114.73	1,501,232.53	0.00	498,139.06	6,076,683.2	NA
1989/Q2	2,322,853.8	8,467,579.6	1,571,435.1	NA	175,356.56	2,847,836.34	0.00	944,969.20	1,396,078.6	NA
1989/Q3	788,871.6	431,248.3	5,220,063.3	NA	103,573.36	2,108,084.09	0.00	699,504.57	5,116,489.9	NA
1989/Q4	1,620,659.3	4,866,761.4	4,222,881.6	NA	314,962.99	1,638,313.22	0.00	543,625.18	3,907,918.6	NA
1990/Q1	4,227,076.8	6,314,508.8	7,144,256.5	NA	572,227.01	1,103,607.18	0.00	217,033.40	6,572,029.4	NA
1990/Q2	2,322,853.8	6,185,955.1	2,261,285.8	NA	240,419.32	3,377,416.97	0.00	664,196.75	2,020,866.4	NA
1990/Q3	788,871.6	2,690,329.0	1,563,467.8	NA	67,421.49	3,508,053.61	0.00	689,887.52	1,496,046.3	NA
1990/Q4	1,620,659.3	1,917,795.8	4,222,881.6	NA	206,812.52	5,648,874.91	0.00	1,110,897.58	4,016,069.1	NA
1991/Q1	4,227,076.8	7,905,124.2	7,144,256.5	NA	484,265.21	1,606,840.17	0.00	1,020,109.77	6,659,991.2	NA
1991/Q2	2,322,853.8	333,162.7	2,261,285.8	NA	394,078.50	940,317.78	0.00	596,965.01	1,867,207.3	NA
1991/Q3	788,871.6	41,134.4	1,563,467.8	NA	323,405.21	1,092,257.25	0.00	693,424.47	1,240,062.6	NA
1991/Q4	1,620,659.3	1,468,894.3	11,086,903.5	557,843.6	507,143.31	523,243.09	0.00	332,183.25	10,579,760.2	0.0
1992/Q1	4,274,044.3	10,974,623.0	15,339,936.2	5,202,306.9	743,587.02	880,117.46	0.00	288,202.38	14,596,349.2	3,866,804.8
1992/Q2	2,322,853.8	294,234.4	1,204,002.7	0.0	329,632.72	149,487.17	0.00	48,950.92	874,370.0	0.0
1992/Q3	788,871.6	588,743.7	1,099,062.4	0.0	361,983.67	5,322,665.32	0.00	1,742,954.61	737,078.7	0.0
1992/Q4	1,620,659.3	6,068,754.6	9,897,402.5	6,986,754.6	820,580.60	1,775,335.78	0.00	581,349.66	9,076,821.9	4,972,187.9
1993/Q1	4,227,076.8	28,861,777.5	29,437,049.6	102,002,322.8	1,206,971.95	323,209.85	0.00	76,788.79	28,230,077.6	100,548,929.8
1993/Q2	2,322,853.8	1,335,782.7	2,597,602.9	5,601,758.1	586,842.91	1,156,189.82	0.00	274,689.71	2,010,760.0	4,133,415.1
1993/Q3	788,871.6	624,425.5	1,729,857.6	0.0	518,418.97	3,892,428.78	0.00	924,770.42	1,211,438.6	0.0
1993/Q4	1,620,659.3	1,511,718.1	2,199,830.7	885,599.9	945,818.93	5,856,225.06	0.00	1,391,332.77	1,254,011.7	0.0
1994/Q1	4,227,076.8	1,951,311.8	895,330.3	4,933,534.8	662,387.11	3,713,199.97	0.00	1,038,403.07	232,943.2	1,596,350.7
1994/Q2	2,322,853.8	800,861.6	303,634.7	838,364.9	507,060.60	2,671,422.09	0.00	747,068.01	0.0	0.0
1994/Q3	788,871.6	158,243.5	452,403.7	0.0	334,303.08	1,685,973.24	0.00	471,485.46	118,100.7	0.0
1994/Q4	1,620,659.3	760,883.8	4,222,881.6	322,121.9	458,233.66	1,507,684.07	0.00	421,626.57	3,764,647.9	0.0
1995/Q1	4,227,076.8	13,153,400.1	7,144,256.5	37,898,837.6	828,284.66	2,322,476.69	0.00	545,893.71	6,315,971.8	35,293,969.9
1995/Q2	2,322,853.8	896,376.7	2,261,285.8	469,977.9	500,729.13	3,168,522.75	0.00	744,755.22	1,760,556.6	0.0
1995/Q3	788,871.6	552,960.1	1,563,467.8	0.0	243,109.70	3,457,821.70	0.00	812,754.39	1,320,358.1	0.0
1995/Q4	1,620,659.3	531,171.6	1,949,515.5	0.0	502,711.51	2,437,301.50	0.00	572,883.06	1,446,804.0	0.0
1996/Q1	4,274,044.3	8,640,767.3	5,829,424.7	11,845,343.9	673,999.69	3,229,780.76	0.00	669,214.87	5,155,425.1	8,610,778.3
1996/Q2	2,322,853.8	751,423.9	5,051,134.8	78,804.3	176,252.66	2,931,599.69	0.00	607,431.36	4,874,882.1	0.0

Table 1

Stream Flow Data at the Gaging Station Within the Study Area (unit: cubic feet per day).

Year/ Quarter	Segment 03 (E281)	Segment 04 (F274B & F304)	**(1)** Segment 06 (F312B-AF)	**(2)** Segment 07 (G44B*-AF) [1]	**(3)** Historical Pomona WRP Recycled Water Discharge	**(4)** Historical San Jose WRP Recycled Water Discharge	**(5)** Proposed Pomona WRP Recycled Water Discharge	**(6)** Proposed San Jose WRP Recycled Water Discharge	**(1) - (3)** Adjusted Segment 06 (F312B-AF)	**(2) - (3) - ((4 - (6))** Adjusted Segment 07 (G44B*-AF) [2]
1996/Q3	788,871.6	811,436.6	878,461.7	0.0	63,570.91	3,565,899.51	0.00	738,859.12	814,890.8	0.0
1996/Q4	1,620,659.3	3,551,086.5	5,435,257.7	4,667,769.3	540,824.99	3,181,974.79	0.00	659,309.41	4,894,432.7	1,604,279.0
1997/Q1	4,227,076.8	3,685,528.8	5,657,474.7	6,207,811.2	593,942.67	4,204,624.52	0.00	619,716.98	5,063,532.0	2,028,961.0
1997/Q2	2,322,853.8	7,404,213.9	1,405,539.5	0.0	173,887.54	5,226,336.44	0.00	770,306.47	1,231,652.0	0.0
1997/Q3	788,871.6	273,174.7	1,429,090.4	48,167.9	192,223.91	4,527,004.52	0.00	667,232.37	1,236,866.5	0.0
1997/Q4	1,620,659.3	1,945,341.8	3,884,254.2	2,662,716.7	436,699.47	4,200,024.81	0.00	619,039.03	3,447,554.7	0.0
1998/Q1	4,227,076.8	14,961,688.7	14,876,303.9	31,824,729.2	480,938.05	3,440,862.99	0.00	570,968.78	14,395,365.8	28,473,897.0
1998/Q2	2,322,853.8	3,831,009.1	3,813,254.4	0.0	256,945.76	3,421,634.38	0.00	567,778.03	3,556,308.6	0.0
1998/Q3	788,871.6	1,340,136.2	1,706,558.2	0.0	92,806.27	4,144,997.83	0.00	687,811.28	1,613,751.9	0.0
1998/Q4	0.0	962,842.7	2,450,577.2	642,252.4	343,835.08	5,056,321.36	0.00	839,034.18	2,106,742.1	0.0
1999/Q1	433,898.8	1,655,320.2	3,142,272.9	535,879.4	426,975.66	4,873,547.12	0.00	958,031.68	2,715,297.2	0.0
1999/Q2	0.0	1,162,556.1	2,359,880.2	315,018.3	318,159.70	3,914,048.87	0.00	769,415.52	2,041,720.5	0.0
1999/Q3	2,053,887.6	901,847.3	1,094,492.3	0.0	101,786.11	1,742,060.94	0.00	342,450.69	992,706.2	0.0
1999/Q4	72,266.0	1,949,231.4	3,970,248.3	0.0	361,547.76	3,085,550.43	0.00	606,551.04	3,608,700.5	0.0
2000/Q1	1,176,988.8	8,768,467.8	13,810,829.2	0.0	660,763.84	2,548,303.78	0.00	557,280.05	13,150,065.3	0.0
2000/Q2	1,334,006.3	2,793,255.3	9,167,561.5	0.0	546,371.49	2,495,712.97	0.00	545,779.14	8,621,190.0	0.0
2000/Q3	1,192.7	220,076.5	1,338,986.6	0.0	204,458.58	4,554,002.17	0.00	995,899.54	1,134,528.0	0.0
2000/Q4	20,059.9	3,217,235.5	7,440,562.7	951,292.2	282,574.52	2,615,053.03	0.00	571,877.22	7,157,988.2	0.0
2001/Q1	182,883.1	5,016,678.8	15,939,102.3	8,017,283.1	600,804.94	2,788,130.59	0.00	708,101.86	15,338,297.4	5,336,449.4
2001/Q2	89,371.7	3,295,628.5	4,160,674.6	817,344.0	452,545.37	2,627,777.60	0.00	667,376.99	3,708,129.2	0.0
2001/Q3	0.0	295,386.0	1,286,158.7	0.0	161,608.16	2,489,800.17	0.00	632,334.85	1,124,550.6	0.0
2001/Q4	1,037,260.2	8,255,971.3	13,469,394.0	1,054,737.2	408,684.68	2,614,471.81	0.00	663,997.72	13,060,709.4	0.0
2002/Q1	285,253.4	2,477,723.9	8,889,959.8	160,476.5	290,398.71	3,997,345.40	0.00	524,474.97	8,599,561.1	0.0
2002/Q2	0.0	148,634.4	2,104,082.0	0.0	245,663.71	5,492,977.72	0.00	720,710.63	1,858,418.3	0.0
2002/Q3	0.0	243,180.8	1,141,174.5	0.0	58,833.97	5,349,517.67	0.00	701,887.84	1,082,340.5	0.0
2002/Q4	154,374.3	7,085,168.9	7,322,120.2	5,775,402.1	416,211.47	5,548,323.89	0.00	727,972.37	6,905,908.7	538,839.1
2003/Q1	474,955.3	7,264,518.4	8,222,101.3	9,541,510.7	621,837.34	5,409,011.97	0.00	920,160.63	7,600,263.9	4,430,822.0
2003/Q2	28,535.6	2,213,178.8	4,310,225.1	1,554,215.5	74,699.51	3,613,194.19	0.00	614,662.91	4,235,525.6	0.0
2003/Q3	35,402.9	213,166.1	1,442,135.7	0.0	22,682.10	3,109,990.73	0.00	529,059.84	1,419,453.6	0.0
2003/Q4	140,306.3	1,855,468.0	2,719,203.2	2,420,681.3	342,614.52	3,556,047.84	0.00	604,941.39	2,376,588.6	0.0
2004/Q1	287,155.3	4,225,603.6	13,450,367.7	7,362,187.4	517,049.91	2,002,417.06	0.00	606,412.42	12,933,317.8	5,449,132.9
2004/Q2	3,323.0	4,718,740.9	1,506,503.5	165,839.1	277,203.51	1,980,572.78	0.00	599,797.09	1,229,299.9	0.0
2004/Q3	0.0	2,201,678.2	808,524.3	0.0	167,957.98	2,607,061.26	0.00	789,523.00	640,566.3	0.0
2004/Q4	3,524,050.4	12,509,151.7	13,428,865.2	12,581,201.4	586,610.58	2,227,670.06	0.00	674,628.09	12,842,254.7	10,441,548.8
2005/Q1	145,586,343.1	33,376,984.5	19,096,970.6	116,119,710.5	664,377.46	3,129,476.44	0.00	732,666.08	18,432,593.2	113,058,522.7
2005/Q2	3,881,795.3	791,386.1	3,526,903.4	709,714.0	204,501.86	2,834,615.19	0.00	663,633.82	3,322,401.5	0.0
2005/Q3	0.0	243,732.9	3,356,040.4	0.0	94,811.47	2,896,654.01	0.00	678,158.21	3,261,229.0	0.0
2005/Q4	2,707,478.9	1,390,652.5	6,886,043.9	20,191.5	400,431.36	2,561,435.51	0.00	599,677.60	6,485,612.5	0.0
2006/Q1	241,759.4	6,260,481.5	13,368,158.1	4,034,110.7	629,902.73	3,947,289.46	0.00	673,889.12	12,738,255.3	130,807.7
2006/Q2	1,702,242.9	3,729,926.0	7,878,132.4	1,920,102.3	277,820.49	3,955,328.25	0.00	675,261.52	7,600,311.9	0.0
2006/Q3	0.0	1,276,574.1	7,713,662.6	0.0	133,360.88	3,678,757.86	0.00	628,044.87	7,580,301.7	0.0
2006/Q4	0.0	4,380,975.5	8,348,052.9	0.0	309,455.93	4,119,249.79	0.00	703,246.53	8,038,597.0	0.0
2007/Q1	0.0	4,220,610.7	9,500,772.0	616,953.2	474,729.33	3,938,377.43	0.00	770,558.11	9,026,042.7	0.0
2007/Q2	0.0	2,892,576.9	4,712,217.9	556,378.0	460,698.42	3,646,247.08	0.00	713,401.72	4,251,519.5	0.0
2007/Q3	0.0	1,659,212.7	2,042,421.4	0.0	139,928.66	3,276,946.10	0.00	641,146.62	1,902,492.7	0.0
2007/Q4	14,556.6	1,485,778.6	3,548,316.6	1,416,255.9	605,936.14	2,793,778.11	0.00	546,613.02	2,942,380.5	0.0

Table 1

Stream Flow Data at the Gaging Station Within the Study Area (unit: cubic feet per day).

Year/ Quarter	Segment 03 (E281)	Segment 04 (F274B & F304)	(1) Segment 06 (F312B-AF)	(2) Segment 07 (G44B*-AF)[1]	(3) Historical Pomona WRP Recycled Water Discharge	(4) Historical San Jose WRP Recycled Water Discharge	(5) Proposed Pomona WRP Recycled Water Discharge	(6) Proposed San Jose WRP Recycled Water Discharge	(1) - (3) Adjusted Segment 06 (F312B-AF)	(2) - (3) - ((4 - (6)) Adjusted Segment 07 (G44B*-AF)[2]
2008/Q1	349,151.8	6,782,745.0	9,486,336.1	10,288,406.4	834,974.57	4,193,455.91	0.00	1,121,452.43	8,651,361.5	6,381,428.3
2008/Q2	8,345.8	433,196.1	1,988,254.1	467,604.6	415,335.17	3,113,434.61	0.00	832,623.23	1,572,918.9	0.0
2008/Q3	5,534,305.1	66,058.3	1,253,174.8	0.0	304,835.24	1,574,524.35	0.00	421,073.74	948,339.6	0.0
2008/Q4	268,206.0	2,500,321.7	4,005,296.1	3,448,007.9	589,080.76	1,137,011.17	0.00	304,069.95	3,416,215.3	2,025,985.9
2009/Q1	1,068,890.6	4,967,725.5	5,659,105.5	5,796,965.3	810,089.26	1,230,752.23	0.00	293,519.18	4,849,016.3	4,049,643.0
2009/Q2	0.0	219,713.3	1,624,168.1	0.0	465,428.65	1,058,632.41	0.00	252,470.73	1,158,739.5	0.0
2009/Q3	0.0	231,909.7	1,305,767.8	0.0	265,050.74	4,417,924.10	0.00	1,053,620.23	1,040,717.1	0.0
2009/Q4	1,643.4	1,486,239.7	7,258,444.5	2,059,231.3	621,890.62	4,475,784.52	0.00	1,067,419.23	6,636,553.8	0.0
2010/Q1	3,892.6	8,046,156.2	19,845,319.9	11,927,909.4	934,352.75	4,677,051.57	0.00	790,066.86	18,910,967.2	7,106,571.9
2010/Q2	5,547,545.0	4,241,869.9	5,627,762.9	424,214.6	509,264.12	4,409,166.36	0.00	744,814.58	5,118,498.8	0.0
2010/Q3	2,331,353.9	191,122.3	1,003,395.1	0.0	276,166.57	4,117,811.27	0.00	695,597.68	727,228.6	0.0
2010/Q4	2,751,483.0	11,058,533.2	17,555,616.1	19,156,664.3	811,048.59	2,627,520.20	0.00	443,851.56	16,744,567.5	16,161,947.1
2011/Q1	6,020,399.4	5,465,455.0	8,939,153.0	6,906,512.2	846,465.22	2,074,410.16	0.00	650,577.80	8,092,687.7	4,636,214.6
2011/Q2	7,838,169.6	1,466,245.9	4,605,594.5	73,297.6	597,419.83	2,103,911.45	0.00	659,830.02	4,008,174.7	0.0
2011/Q3	4,252,777.5	3,165,301.6	4,316,948.0	0.0	398,803.94	2,128,136.17	0.00	667,427.39	3,918,144.0	0.0
2011/Q4	61,700.8	1,355,437.6	2,498,115.3	1,216,549.8	741,723.60	2,220,404.81	0.00	696,364.74	1,756,391.7	0.0
2012/Q1	0.0	1,320,806.0	4,534,656.0	2,153,510.6	718,731.25	3,578,084.69	0.00	826,211.63	3,815,924.8	0.0
2012/Q2	0.0	1,137,479.4	2,287,340.4	648,474.8	478,502.90	2,335,164.10	0.00	539,210.19	1,808,837.5	0.0
2012/Q3	0.0	638,871.3	1,398,458.8	0.0	333,925.29	3,029,026.81	0.00	699,429.28	1,064,533.5	0.0
2012/Q4	0.0	1,204,340.7	3,024,563.5	391,429.7	721,061.24	2,636,994.08	0.00	608,905.42	2,303,502.3	0.0
2013/Q1	0.0	782,889.0	2,611,615.9	134,594.2	865,388.44	2,051,090.33	0.00	770,082.77	1,746,227.4	0.0
2013/Q2	0.0	220,339.4	1,469,606.7	0.0	445,743.83	1,826,384.76	0.00	685,716.96	1,023,862.9	0.0
2013/Q3	0.0	113,785.3	680,202.7	0.0	326,006.17	1,759,308.64	0.00	660,533.21	354,196.5	0.0
2013/Q4	0.0	286,650.8	1,619,633.7	0.0	663,404.24	1,486,077.23	0.00	557,948.35	956,229.5	0.0
2014/Q1	0.0	1,398,835.1	2,687,153.7	1,991,472.7	723,078.07	2,517,130.42	0.00	1,040,015.77	1,964,075.6	0.0
2014/Q2	0.0	258,877.6	1,126,675.1	3,171.3	383,854.14	1,542,071.21	0.00	637,145.52	742,821.0	0.0
2014/Q3	0.0	63,701.3	710,649.2	0.0	307,872.11	1,351,902.65	0.00	558,572.60	402,777.1	0.0
2014/Q4	0.0	1,614,750.3	3,444,100.8	2,245,000.5	560,993.32	1,028,976.94	0.00	425,147.72	2,883,107.4	1,080,177.9
2015/Q1	0.0	9,709,490.0	1,598,998.6	343,321.3	512,768.87	2,053,452.02	0.00	709,053.32	1,086,229.7	0.0
2015/Q2	0.0	3,190,172.6	1,987,351.8	30,477.2	379,447.09	1,434,965.18	0.00	495,490.92	1,607,904.7	0.0

Notes:

Segment 03	E281 Gauge - Inflow to San Gabriel River Segment 3 (Segment 3 discharge to Segment 5)
Segment 04	Combined F274B & F304 Gauges - Inflow to Walnut Creek Segment 4 (Segment 4 discharge to Segment 5)
Segment 06	F312B Gauge - Inflow to San Jose Creek Segment 6 (Segment 6 discharge to Segment 7)
Segment 07	G44B Gauge - Outflow to Central Basin. It is not needed in SFR package. (Inflow of Segment 7 is the combined flow from Segments 5 & 6)

1) Gaging station G44B started operations in 1991, Quarter 4. Data is not available prior to the 4th quarter of 1991.

2) Adjusted Segment 7 stream flow assumed to equal zero if calculated as negative.

Table 2. Annual Storage Budget, Cumullative Mean Change, and Percentage Change between WY 1984-85 and WY 2014-15 (Unit: acre-feet per year)

Water Year	Baseline Condition		With Project Condition		Storage Difference (1) - (3)	Percentage of Storage Change[1]
	(1) Annual Storage	(2) Cumulative Mean Change	(3) Annual Storage	(4) Cumulative Mean Change		
1984-85	105,463	76,171	105,463	76,045	0	0.00%
1985-86	-19,872	27,008	-19,849	26,778	22	0.11%
1986-87	130,853	128,569	130,869	128,229	16	0.01%
1987-88	70,464	169,741	70,474	169,285	10	0.01%
1988-89	100,645	241,094	100,668	240,536	23	0.02%
1989-90	114,644	326,446	114,657	325,775	14	0.01%
1990-91	31,386	328,540	31,757	328,114	371	1.18%
1991-92	-134,916	164,331	-133,601	165,095	1,315	0.98%
1992-93	-225,179	-90,139	-224,700	-89,023	478	0.21%
1993-94	108,426	-11,005	109,583	-8,858	1,158	1.07%
1994-95	-122,732	-163,029	-122,497	-160,772	235	0.19%
1995-96	61,833	-130,488	61,675	-128,515	-158	0.26%
1996-97	-26,924	-186,703	-26,758	-184,691	166	0.62%
1997-98	-135,918	-351,914	-136,504	-350,613	-585	0.43%
1998-99	166,713	-214,493	166,740	-213,291	28	0.02%
1999-00	94,454	-149,331	94,505	-148,204	51	0.05%
2000-01	95,147	-83,475	94,987	-82,635	-161	0.17%
2001-02	131,685	18,918	131,545	19,491	-141	0.11%
2002-03	-295	-10,669	-424	-10,351	-129	43.57%
2003-04	68,849	28,888	69,080	29,311	231	0.34%
2004-05	-417,959	-418,363	-418,028	-418,135	-69	0.02%
2005-06	1,319	-446,336	1,140	-446,412	-178	13.52%
2006-07	195,246	-280,382	195,126	-280,704	-120	0.06%
2007-08	93,721	-215,953	93,623	-216,499	-98	0.10%
2008-09	120,467	-124,778	120,400	-125,517	-68	0.06%
2009-10	-25,468	-179,538	-24,950	-179,885	519	2.04%
2010-11	-147,678	-356,507	-147,785	-357,088	-108	0.07%
2011-12	130,139	-255,660	130,062	-256,443	-76	0.06%
2012-13	159,659	-125,293	160,230	-125,632	571	0.36%
2013-14	154,585	0	155,050	0	465	0.30%
				Average Storage Difference :	126	
				Minimum Storage Difference :	-585	
				Maximum Storage Difference :	1,315	

Note:

1: Percentage of Storage Change is calculated as below

$$Percentage\ Change = \left| \frac{(3)(With\ Project) - (1)(Baseline)}{(1)(Baseline)} \right| x\ 100\%$$

Table 3. Comparison of Annual Steam Gain and Loss between WY 1984-85 and WY 2013-14 (unit: acre-foot per year).

Water Year	Stream Gain			Stream Loss			Recycled Water Discharge		
	Baseline	With Project	Percentage Change	Baseline	With Project	Percentage Change	Baseline	With Project	Reduction
1984-85	11,582	11,582	0.00%	-50,887	-50,887	0.00%	0	0	0
1985-86	4,991	4,991	0.00%	-68,809	-68,785	-0.03%	2,474	0	2,474
1986-87	5,224	5,226	0.03%	-31,040	-31,025	-0.05%	11,748	4,151	7,597
1987-88	258	258	-0.06%	-33,052	-33,041	-0.03%	12,607	5,307	7,300
1988-89	1	1	0.00%	-37,653	-37,633	-0.05%	19,786	6,285	13,501
1989-90	0	0	0.00%	-41,893	-41,872	-0.05%	22,697	4,441	18,256
1990-91	0	0	0.00%	-47,083	-46,669	-0.88%	22,465	7,166	15,300
1991-92	0	0	0.00%	-73,446	-71,966	-2.01%	18,575	5,087	13,488
1992-93	60	60	0.02%	-134,528	-133,408	-0.83%	21,601	3,913	17,688
1993-94	5,593	5,205	-6.93%	-42,344	-40,968	-3.25%	34,314	7,640	26,673
1994-95	67	55	-18.06%	-99,816	-98,883	-0.93%	26,144	5,291	20,853
1995-96	2,634	2,284	-13.28%	-59,209	-59,116	-0.16%	28,523	5,437	23,085
1996-97	167	144	-14.05%	-78,616	-78,209	-0.52%	39,026	5,691	33,334
1997-98	69	56	-19.76%	-110,619	-110,778	0.14%	34,531	5,126	29,405
1998-99	6,733	6,538	-2.89%	-36,851	-36,636	-0.59%	35,093	6,082	29,010
1999-00	343	323	0.00%	-50,415	-50,159	-0.51%	30,390	5,689	24,701
2000-01	0	0	0.00%	-36,142	-36,106	-0.10%	25,157	5,401	19,756
2001-02	0	0	0.00%	-25,732	-25,715	-0.07%	38,655	5,474	33,181
2002-03	0	0	0.00%	-34,016	-33,998	-0.05%	39,378	5,840	33,538
2003-04	0	0	0.00%	-43,476	-43,096	-0.87%	24,075	5,465	18,610
2004-05	0	0	0.00%	-197,307	-196,975	-0.17%	26,449	5,757	20,692
2005-06	7,562	7,361	-2.66%	-55,954	-55,962	0.01%	32,607	5,396	27,211
2006-07	244	234	0.00%	-21,082	-21,066	-0.08%	34,268	5,922	28,346
2007-08	0	0	0.00%	-32,331	-32,286	-0.14%	29,026	6,126	22,900
2008-09	0	0	0.00%	-29,481	-29,421	-0.20%	20,937	4,001	16,935
2009-10	0	0	0.00%	-76,181	-75,521	-0.87%	41,916	6,912	35,004
2010-11	0	0	0.00%	-102,815	-102,716	-0.10%	24,278	5,070	19,208
2011-12	387	387	0.00%	-30,569	-30,483	-0.28%	28,213	5,800	22,413
2012-13	0	0	0.00%	-23,774	-23,016	-3.19%	22,269	5,705	16,564
2013-14	0	0	0.00%	-21,050	-20,344	-3.35%	18,763	5,838	12,925

J:\1205\1205-103\Report\Scenario-2\Table 3, Figures 11 & 12 - Stream Leakage Comparison.xlsx

Table 4. Model Simulated Whittier Narrows Subsurface Outflow between WY 1984-85 and WY 2013-14 (unit: acre-feet per year)

Water Year	Baseline	With Project	Difference	Percentage Change (%)
1984-85	29,356	29,356	0	0.00
1985-86	27,498	27,496	-2	-0.01
1986-87	28,209	28,206	-3	-0.01
1987-88	25,157	25,154	-3	-0.01
1988-89	23,205	23,201	-4	-0.02
1989-90	20,319	20,314	-4	-0.02
1990-91	18,134	18,096	-38	-0.21
1991-92	19,055	18,918	-137	-0.72
1992-93	21,208	21,056	-153	-0.72
1993-94	26,502	26,355	-147	-0.55
1994-95	22,296	22,111	-185	-0.83
1995-96	25,873	25,754	-119	-0.46
1996-97	24,772	24,657	-115	-0.46
1997-98	21,954	21,880	-74	-0.34
1998-99	27,634	27,550	-83	-0.30
1999-00	23,801	23,682	-119	-0.50
2000-01	21,096	20,990	-106	-0.50
2001-02	20,110	20,026	-84	-0.42
2002-03	14,913	14,835	-78	-0.53
2003-04	15,731	15,649	-81	-0.52
2004-05	18,193	18,103	-90	-0.49
2005-06	25,658	25,582	-77	-0.30
2006-07	24,314	24,241	-73	-0.30
2007-08	18,649	18,577	-72	-0.39
2008-09	16,745	16,673	-72	-0.43
2009-10	16,300	16,211	-89	-0.54
2010-11	18,827	18,701	-126	-0.67
2011-12	20,924	20,832	-92	-0.44
2012-13	17,118	16,991	-126	-0.74
2013-14	13,513	13,335	-178	-1.31
Average	21,569	21,484	-84	-0.39

Appendix E4

SJC002 Discharge Observations and Monitoring Study, January 11, 2019

SJC002 Discharge Observations and Monitoring Study

Prepared by:

Planning Section
Facilities Planning Department
County Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90601

January 11, 2019

Objective: The goal of the Discharge Observation and Monitoring Study is to determine the time it takes for discharges from the Sanitation Districts' San Jose Creek Water Reclamation Plant's (SJCWRP) discharge point SJC002 to reach various sections of the San Gabriel River (SGR). The sections of the SGR between the SJC confluence with the SGR and the Zone 1 Ditch coincide with a series of four weir-controlled basins. The 4 weirs are identified in Figure 1. A USGS gauge station is located in the third basin for stream flow and surface water level measurement in this portion of the SGR.

Observations: Photos and observations were collected from 11/14/18 through 11/16/18 and during our course of the monitoring study, 11/28/2018 through 12/20/2018, in anticipation of discharges from discharge point SJC002. Photos from 11/14/18 through 11/16/18 in particular were selected to be representative because discharges happened after a long period of no discharges from SJC002 due to maintenance activities. Photos attached showing discharges began on 11/13/18 at 3:00 AM and continued until 11/14/18 at 5:45 AM, discharging an average of approximately 21.0 cubic feet per second (cfs). Discharges began again at 8:45 AM on 11/14/18 and continued until 11/15/18 at 3:15 PM, discharging an average of approximately 24.6 cfs. Photos were taken at the southernmost weir structures for each of the four weir-controlled basins after 12 hours from the beginning of discharge, 29 hours from the beginning of discharge, and 20 hours after discharge stopped. Additionally, photos were taken at the southernmost weir structures for each of the four weir-controlled basins during a stormy day on 12/6/18.

Field Measurements: Daily flow and surface water depth/width measurements in Table 1 were collected manually for 10 working days from three identified transect locations; from 12/7/18 to 12/20/18. Daily flow and surface water depth/width measurements were recorded daily for two (2) days prior to the start of the test; for 11/28/18 and 12/4/18. Each transect location consisted of a single transect across the width of the SGR or San Jose Creek (SJC) perpendicular to the direction of flow. These transects are identified as POM-RD, SJC Measurement and SGR Weir Measurement in Figure 1.

Figure 1 – Field measurement locations

Summary of Results:

Observations

- Visual observations showed that due to the weir-controlled basins, this reach of the SGR acts as a series of basins successively filling and spilling into the next basin for typical lower flow rates due to the weir structures.
- The Zone 1 Ditch diversion structure was closed during the observation period and no flows were diverted outside of the SGR.
- Observations were made after 12 hours from the beginning of discharge from SJC002, 29 hours of discharge, 20 hours after discharge stopped, and during rain and discharge together. No discharges from SJC002 ever went past the weir structure at the fourth and southernmost weir-controlled basin (past the Zone 1 Ditch) during the period of our study. Please see the attached photos titled "SGR Observations from SJC002 Discharge."
- During the 2 days of discharges from SJC002 in November 2018, a total of approximately 854.5 MG of recycled wastewater was discharged from SJC002.
- During rain events, the river flows bank to bank and completely over the weirs.

Field Measurements

- Surface velocity measurements in SGR Weir 1 reached as high as 60.4 cfs.
- The largest wetted perimeter in SGR Weir 1 of 142 feet occurred during the high flow of 60.4 cfs.
- In general, discharges from SJC002 began each morning between 9 and 11 AM. The SJC002 flows began filling and spilling into the next basin until they reached the third basin and were recorded at the USGS gauge as early as 3.6 hours after discharges from SJC002 began. The SJCWRP continued discharges from SJC002 until approximately 2 AM the next day (approximately 15 hours).
- Discharges from SJC002 went for 14 consecutive days. During this time flow reached but did not go past the weir structure at the fourth and southernmost weir-controlled basin (past the Zone 1 Ditch). The total volume discharge for this period was approximately 7,967 MG (from 12/7/18 to 12/20/18).

Table 1 – Field Measurement Log and Raw Flow Data

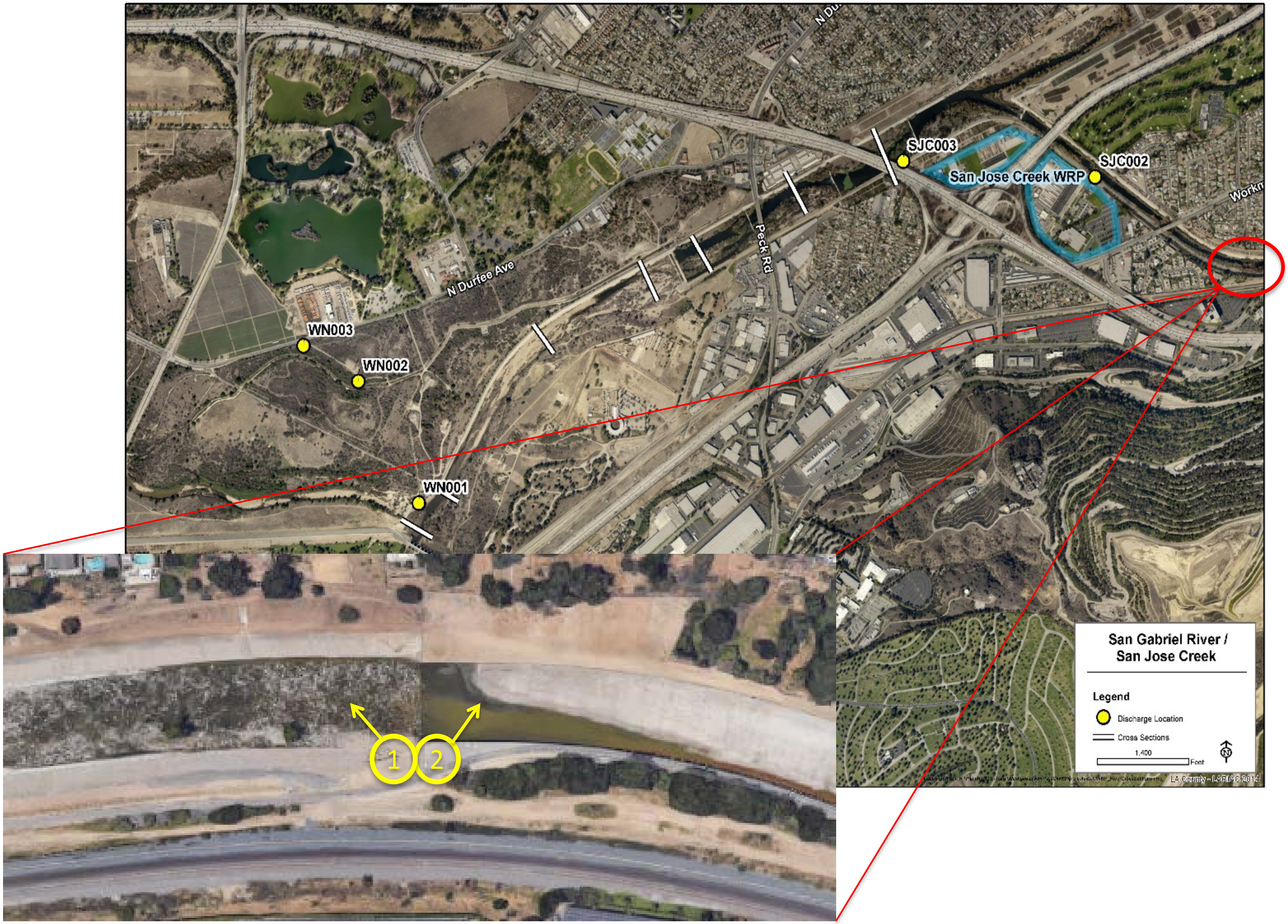
Field Measurement Log					Raw Discharge Flow Rate Data from WRP Flow Meters and USGS Flow Gauge			
Date	Time	Location	Wetted perimeter (ft)	Surface Water Velocity (cfs)	Hours after SJC002 Begins Discharges (hr)	SJC002 (cfs)	POM001 (cfs)	USGS 11087020 (cfs)
11/28/2018	9:18 AM	POM RD	13.50	9.69	-	0.00	7.46	0
12/4/2018	9:22 AM	POM RD	14.00	17.07	-	0.00	9.33	5.2
12/7/2018	11:22 AM	POM RD	30.00	31.75	-	55.43	11.65	179
12/10/2018	10:00 AM	POM RD	15.00	14.39	-	0.00	12.42	0
12/11/2018	8:52 AM	POM RD	14.00	11.15	-	0.00	10.62	0
12/12/2018	8:46 AM	POM RD	15.00	16.28	-	0.00	10.25	0
12/13/2018	8:57 AM	POM RD	14.50	13.19	-	0.00	10.27	0
12/14/2018	9:31 AM	POM RD	15.00	12.50	-	0.00	5.91	0
12/17/2018	8:51 AM	POM RD	15.00	15.59	-	0.00	9.62	0
12/18/2018	8:15 AM	POM RD	14.50	12.14	-	0.00	7.55	0
12/19/2018	8:31 AM	POM RD	14.00	15.07	-	0.00	9.51	0
12/20/2018	10:37 AM	POM RD	13.50	9.05	-	49.43	8.43	0
11/28/2018	10:23 AM	SJC	34.00	5.69	0	0.00	9.17	0
12/4/2018	10:15 AM	SJC	36.00	7.94	0	0.00	11.85	4.05
12/7/2018	12:17 PM	SJC	98.00	104.44	2.03	53.65	7.35	186
12/10/2018	10:46 AM	SJC	38.00	8.84	0	0.00	16.77	0
12/11/2018	9:34 AM	SJC	33.00	8.22	0	0.00	6.19	0
12/12/2018	9:35 AM	SJC	32.00	13.05	0	0.00	5.98	0
12/13/2018	9:37 AM	SJC	33.50	8.70	0	0.00	5.99	0
12/14/2018	10:48 AM	SJC	93.00	60.11	0.8	48.09	11.13	0
12/17/2018	9:38 AM	SJC	96.00	49.12	0.38	46.16	5.61	0
12/18/2018	2:12 PM	SJC	94.00	60.71	4.7	52.21	8.38	26.3
12/19/2018	9:12 AM	SJC	33.00	11.13	0	0.00	8.47	0
12/20/2018	11:15 AM	SJC	93.00	65.73	1.5	62.87	8.23	0
12/4/2018	1:39 PM	SGR Weir 1	34.00	3.17	0	0.00	13.62	0
12/10/2018	3:21 PM	SGR Weir 1	126.00	54.68	3.6	55.23	10.87	8.12
12/11/2018	10:59 AM	SGR Weir 1	85.00	16.71	0.48	60.29	15.70	0
12/12/2018	10:40 AM	SGR Weir 1	105.00	26.90	0.67	59.20	10.24	0
12/13/2018	10:42 AM	SGR Weir 1	58.00	8.59	0.2	50.87	10.26	0
12/14/2018	11:53 PM	SGR Weir 1	111.00	46.00	1.88	38.22	14.67	0
12/17/2018	10:45 AM	SGR Weir 1	132.00	41.29	1.5	53.74	10.56	0
12/19/2018	10:17 AM	SGR Weir 1	99.00	20.36	0.78	52.75	7.10	0
12/20/2018	1:36 PM	SGR Weir 1	142.00	60.36	3.85	62.82	3.44	8.97

🟦	Higher flows on this day due to rain weather
▨	The values are estimated due to malfunction of flow gage

SANITATION DISTRICTS OF LOS ANGELES COUNTY

SGR Observations from SJC002 Discharge

Upstream of SJC002

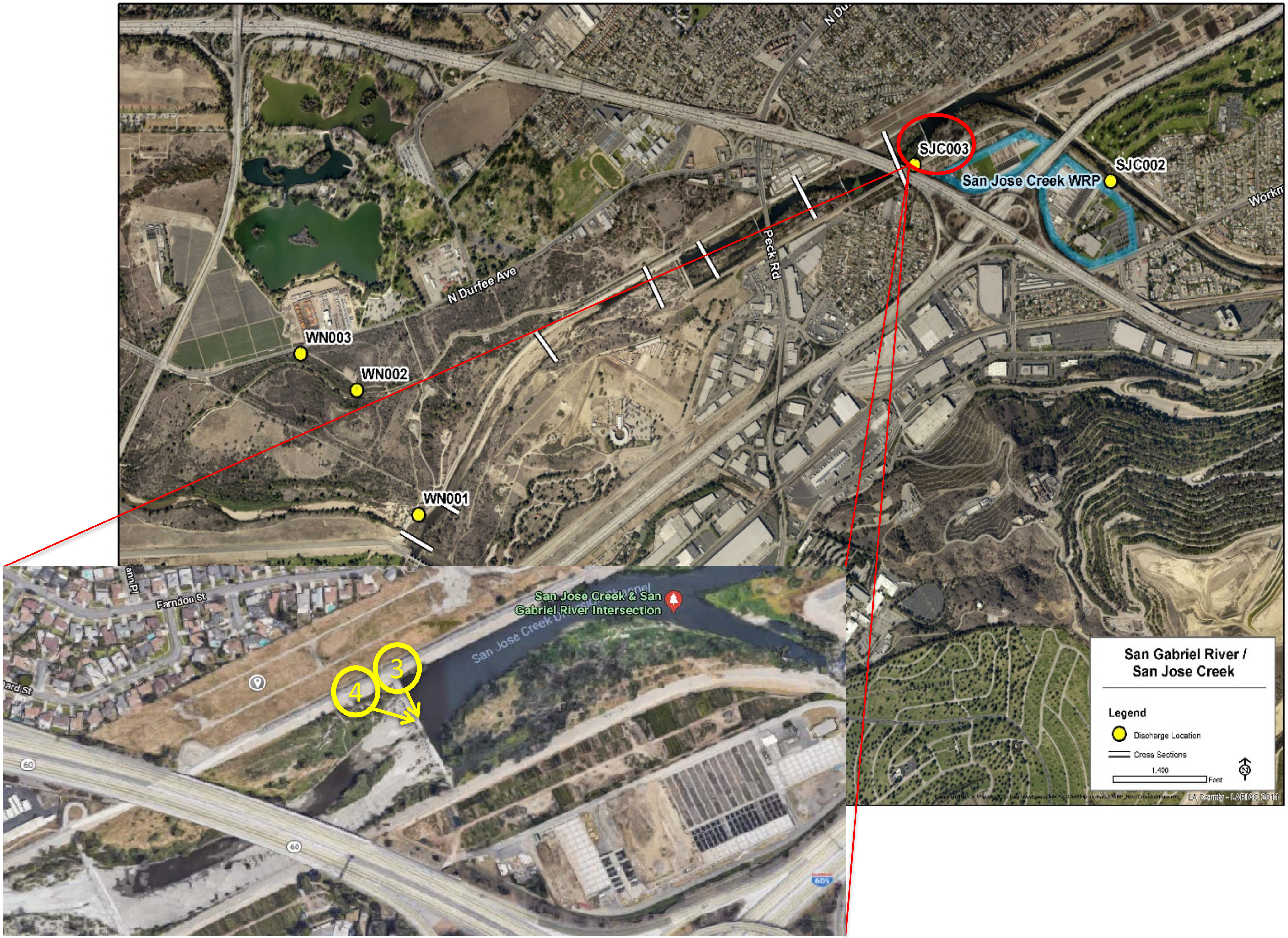


Upstream of SJC002

①

②

Weir South of Confluence



Weir South of Confluence

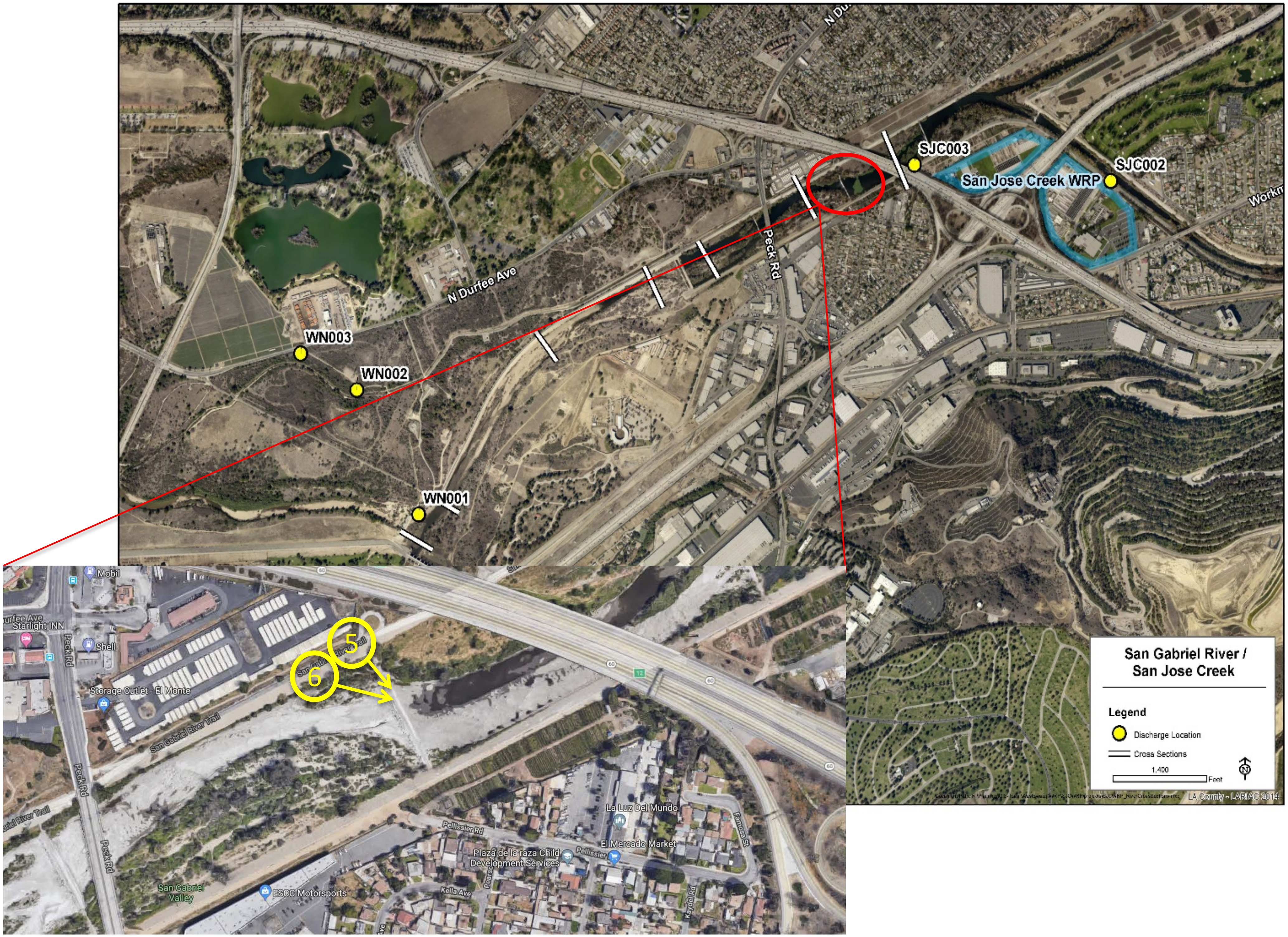
12 hours of Discharge

29 hours of Discharge

20 hours After Discharge Stops

During Rain & Discharge

Weir South of 60Fwy



Weir South of 60Fwy

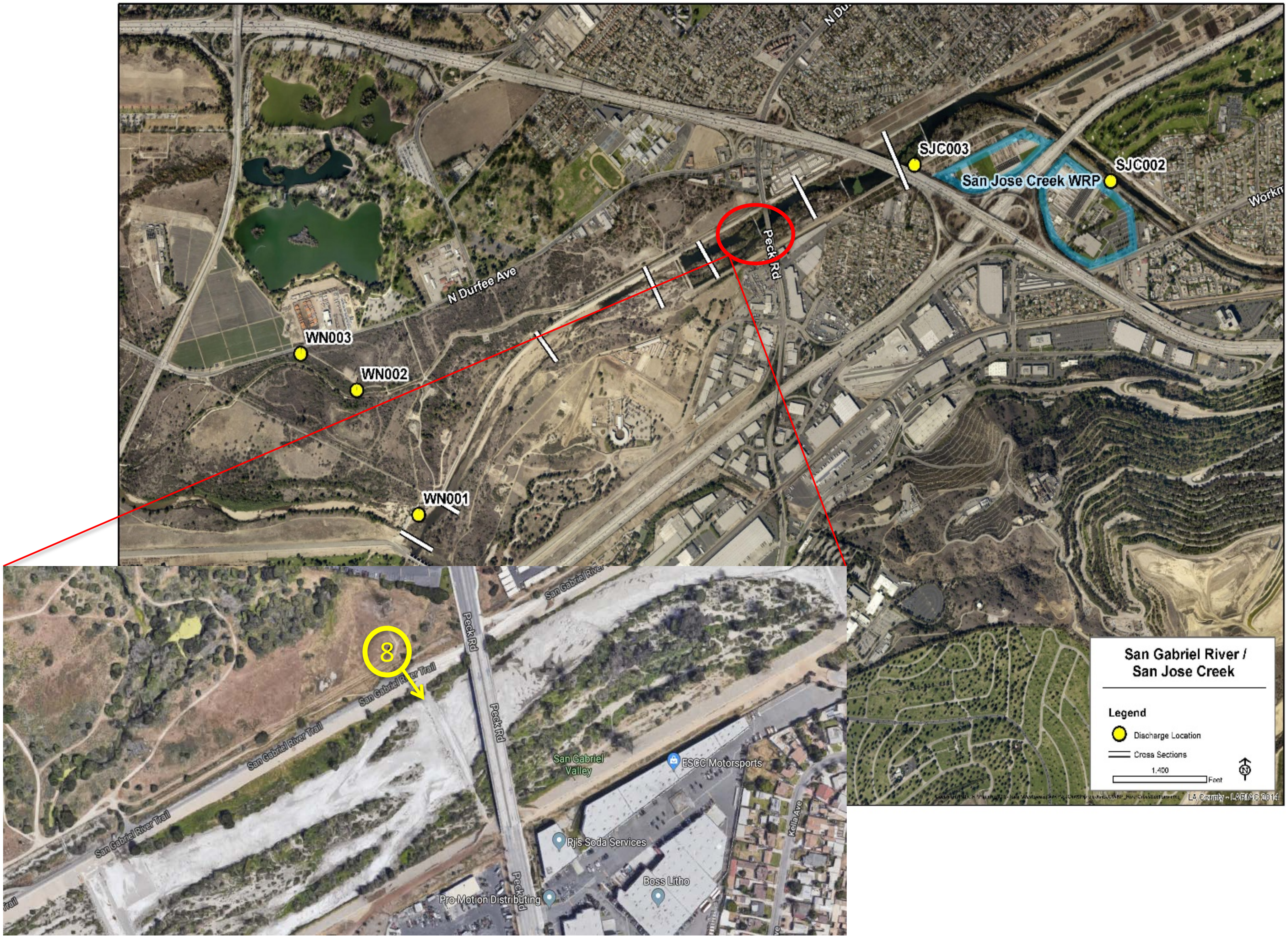
12 hours of Discharge

29 hours of Discharge

20 hours After Discharge Stops

During Rain & Discharge

Weir South of Peck Road



Weir South of Peck Road

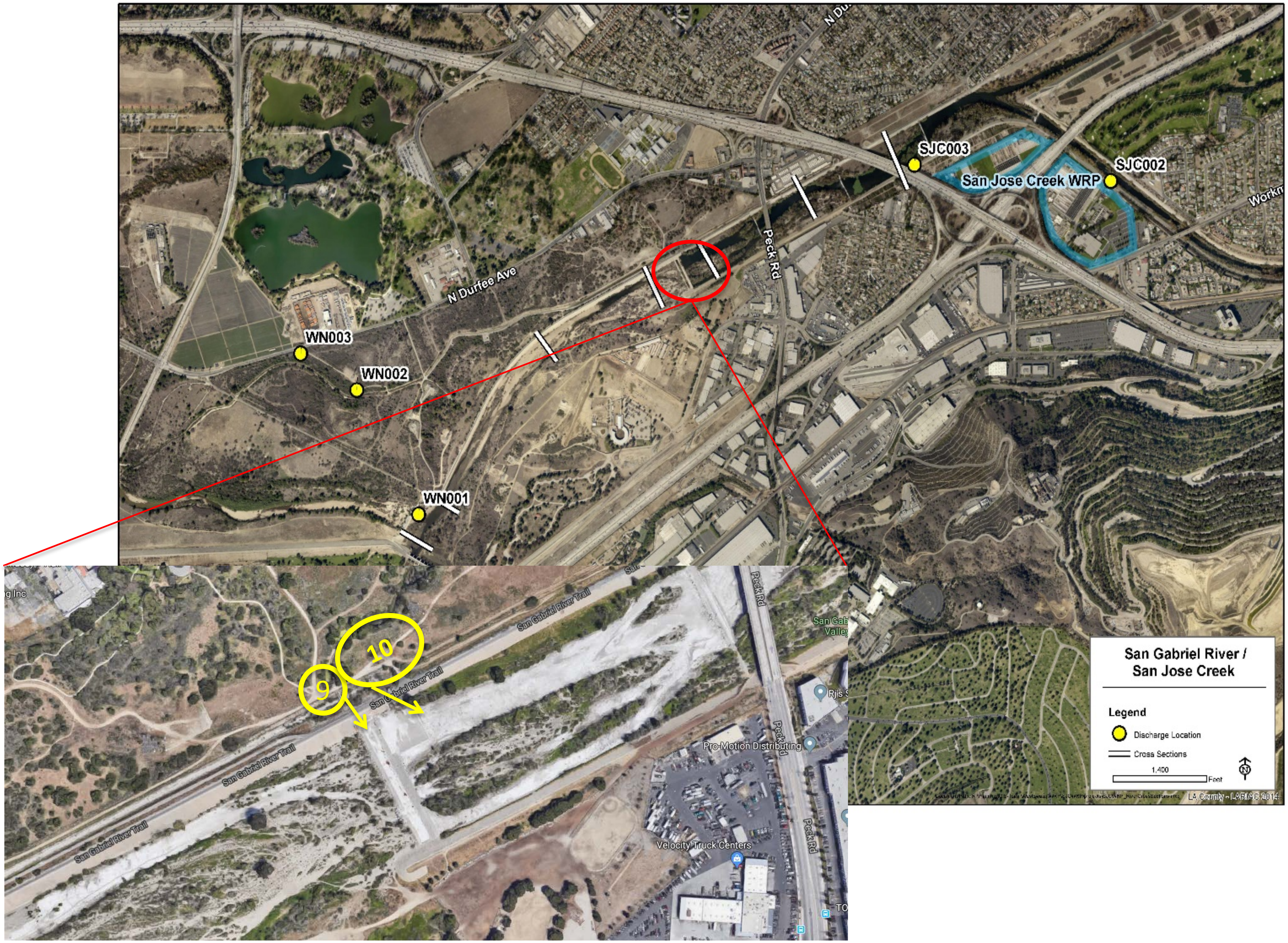
12 hours of Discharge

29 hours of Discharge

20 hours After Discharge Stops

During Rain & Discharge

Zone 1 Ditch Diversion



Zone 1 Ditch Diversion

12 hours of Discharge

29 hours of Discharge

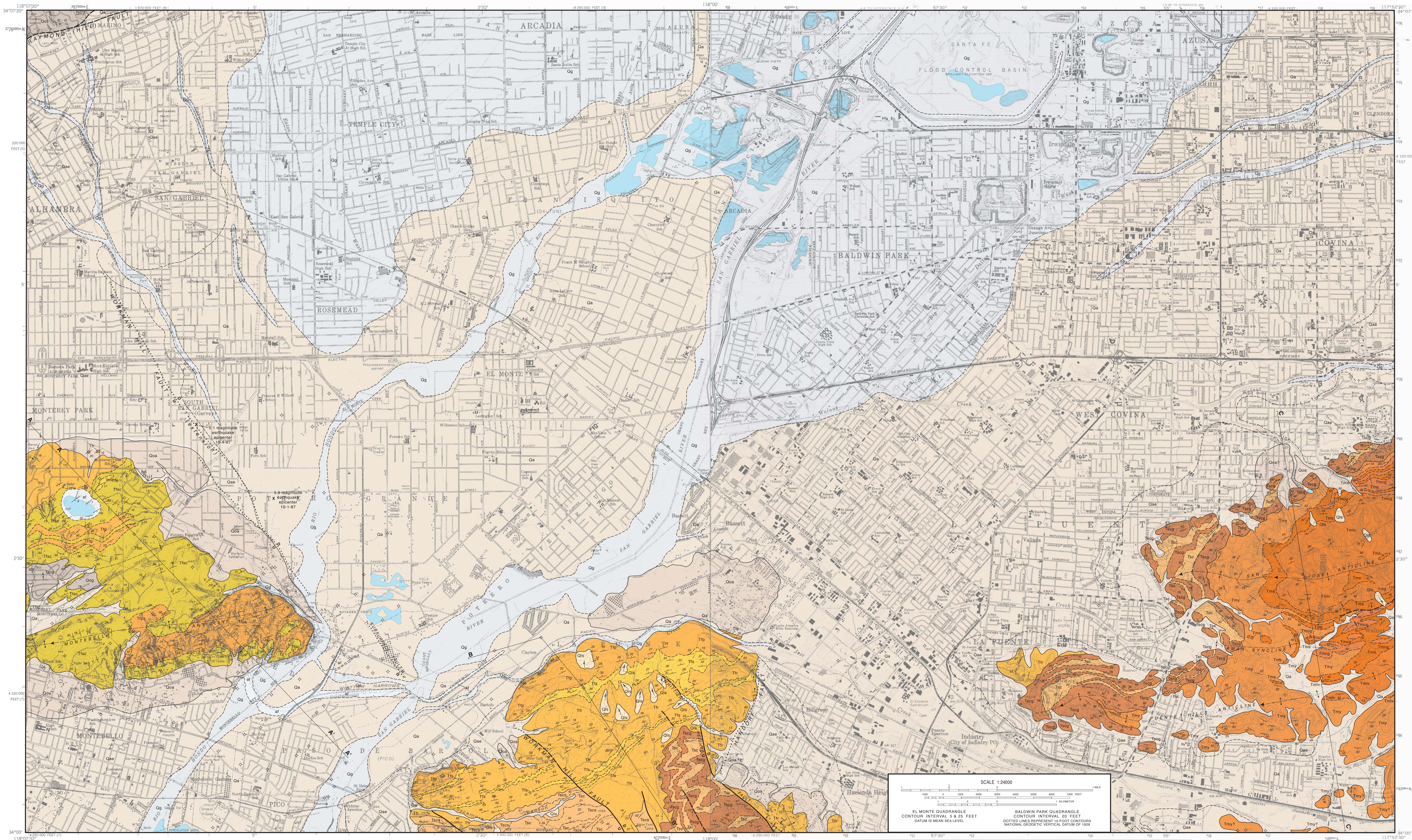
20 hours After Discharge Stops

During Rain & Discharge

12/06/2018 15:24

Appendix F

El Monte Dibblee Geologic Map



EL MONTE QUADRANGLE
CONTOUR INTERVAL 5 & 25 FEET
DATUM IS MEAN SEA LEVEL

BALDWIN PARK QUADRANGLE
CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

EL MONTE AND BALDWIN PARK MAP (DF-69)

LEGEND

af
Qg Qa

SURFICIAL SEDIMENTS

Undissected alluvial deposits

af *Artificial fill, and cut and fill areas*
Qg *Gravel and sand of major streams, and alluvial fan detritus from San Gabriel Mountains, grades southward into alluvium (***Qa***) as sizes of clasts decrease*
Qa *Alluvial gravel, sand and silt of valleys and floodplains*

Holocene

Qls

LANDSLIDE DEBRIS

Qof Qae Qoa Qog

OLDER DISSECTED SURFICIAL SEDIMENTS

Qof *Alluvial fan sediments derived from San Gabriel Mountains*
Qae *Slightly evelvated and locally dissected alluvial gravel and sand at base of hill areas; shown as* **Qa** *on adjacent Los Angeles (Dibblee, 1989) and on Mt. Wilson/Azusa (Dibblee, 1998) quadrangles*
Qoa *Uplifted remnants of alluvial sand and gravel, north of hill areas*
Qog *Uplifted remnants of alluvial gravel, south of Montebello Hills*

Pleistocene

QUATERNARY

— *UNCONFORMITY* —

Tfsc
Tfps
Tfp
Tfs
Tfr

FERNANDO FORMATION

(Of Daviess and Woodford, 1949; Yerkes, 1972); Marine to nonmarine clastic sediments, weakly indurated; early Pliocene to Pleistocene (?) age

Tfsc *Nonmarine sandstone and conglomerate: light gray to tan, crudely bedded; conglomerate composed of pebbles and cobbles of mostly granitic detritus in friable sandstone matix, probably nonmarine; sandstone may be in part marine; late (?) Pliocene to Pleistocene age; unit is lithologically similar to Saugus Formation of Ventura basin*
Tfps *"Pico" silty sandstone facies: at southwest end of Montebello Hills, composed of light gray, very fine-grained silty sandstone to siltstone; vaguely bedded, contains gray lenticular calcareous concretions and fossil shell fragments; deposited in shallow regressive sea*
Tfp *"Pico" claystone: gray micaceous silty claystone or siltstone, with spheroidal fracture, vaguely bedded, includes some silty sandstone; deposited in moderately deep sea; late (?) Pliocene age; probably equivalent to upper member of Fernando Fm. (of Yerkes, 1965 et al., in Puente Hills)*
Tfs *Sandstone facies of Fernando Formation: light to medium gray, weathered brown, fine to medium-grained, arkosic, bedded, locally pebbly; deposited in moderately deep sea*
Tfr *"Repetto" claystone member: lithologically similar to* **Tfp***; early Pliocene age (Repettian Stage); probably equivalent to lower member of Fernando Fm. (of Yerkes et al., 1965, in Puente Hills)*

Pliocene

Tsc Tscs Tscg

SYCAMORE CANYON FORMATION

(Named by Daviess and Woodford, 1949, as uppermost member of Puente Fm.; as so mapped by Durham and Yerkes, 1965, and Yerkes, 1972, in Puente Hills; equivalent to "Unnamed Shale" in Los Angeles quadrangle [Dibblee, 1989], and to Sisquoc Fm. in Ventura basin)
Marine clastic sediments, moderately indurated; late Miocene age

Tsc *Gray silty clay shale: micaceous, vaguely bedded to locally thin bedded, nodular, in places includes thin layers of fine-grained sandstone*
Tscs *Clay shale, light gray, vaguely bedded to locally thin bedded, includes thin layers of fine grained sandstone*
Tscg *Conglomerate and sandstone: gray to rusty brown conglomerate, crudely bedded, composed of cobbles and pebbles of mostly light-colored granitic rocks and others of gray quartz diorite, gneiss, a few of andesitic porphyry and quartzite, in arkosic sandstone matrix; sandstone rusty brown, lenticular, coarse to fine-grained, arkosic*

Tmy Tmcg Tms Tmlv

MONTEREY FORMATION

(Major part of Puente Fm. of Olmstead, 1950; Yerkes, 1972; Durham and Yerkes, 1965) Marine biogenic and clastic sediments, moderately lithified; middle Miocene age, Mohnian Stage

Tmy *Yorba Shale Member: interlayered thin-bedded gray shaly siltstone, fine-grained sandstone and white weathering semi-siliceous to siliceous shale; includes some thin, hard beds of yellowish-gray to gray dolomite; late Mohnian Stage (Yerkes, 1972)*
Tmcg *Conglomerate facies of cobbles & pebbles of plutonic rocks in sandstone matrix lenses in unit* **Tms***, deposited as submarine deltas*
Tms *Soquel Sandstone Member: mostly sandstone, light gray, weathering to tan, medium to locally coarse-grained, locally pebbly, bedded, arkosic, with minor biotite; in eastern exposures in San Jose Hills includes silty shale similar to that of unit* **Tmy**
Tmlv *La Vida Shale Member: thinly bedded shale similar to that of unit* **Tmy***, but containing somewhat more semi-siliceous shale; exposed only in San Jose Hills, base not exposed*

Miocene

Tgv

GLENDORA VOLCANICS

(Of Shelton, 1955)
Volcanic and volcaniclastic rocks; in subsurface only, known from exploratory well data; middle Miocene age

Tgv *Basaltic to mafic andesitic flows, andesite-dacite breccia, and extrusive (?) andesite porphyry, as reported from drilling records, see cross section C-C'*

TERTIARY

CENOZOIC

— *UNCONFORMITY* —

sms qd

BASEMENT COMPLEX

Metamorphic and crystalline basement rocks (in subsurface only), known from exploratory well data

sms *Slate (Santa Monica Slate ?) and schistose basement rocks; see cross-sections A,A',B & B'*
qd *quartz diorite, granodiorite and mylonitized rocks; see cross-sections C-C'*

MESOZOIC AND OLDER

Topographic base map from available
USGS 7.5-minute quadrangle

EL MONTE, CA 1953

BALDWIN PARK, CA 1966
PHOTOREVISED 1981
DMA 2452 III SW – Series V895

IMPORTANT DISCLAIMER: This map is a basic reference resource prepared primarily for regional academic and scientific purposes. It provides an overview of presumed conditions and should not be relied upon for commercial or institutional purposes where site-specific analysis is required. The data depicted herein is based on reconnaissance geologic field mapping, including the identification and interpretation of surface conditions, and data compilation by T.W. Dibblee, Jr., with strong emphasis on basic bedrock geology. No warranty as to actual conditions is expressed or implied. Site-specific conditions should be verified by the user through detailed surface mapping and/or subsurface exploration. Topographic and cultural changes associated with recent development may not be shown. Landslides, faults and other geologic hazards may not be shown. Information about such hazards may be available from other published sources. References cited are not intended to represent a complete bibliography on the geology of this area. This map does not show Alquist-Priolo Earthquake Fault Zones and/or Seismic Hazard Zones, if any exist in this area, which California law requires be disclosed and used to regulate development. For more information about these topics, please visit the California Geological Survey website at http://www.consrv.ca.gov/dmg.

GEOLOGIC SYMBOLS

not all symbols shown on each map

FORMATION CONTACT *dashed where inferred or indefinite dotted where concealed*

MEMBER CONTACT *between units of a formation*
Prominent bed

CONTACT BETWEEN SURFICIAL SEDIMENTS *located only approximately in places*

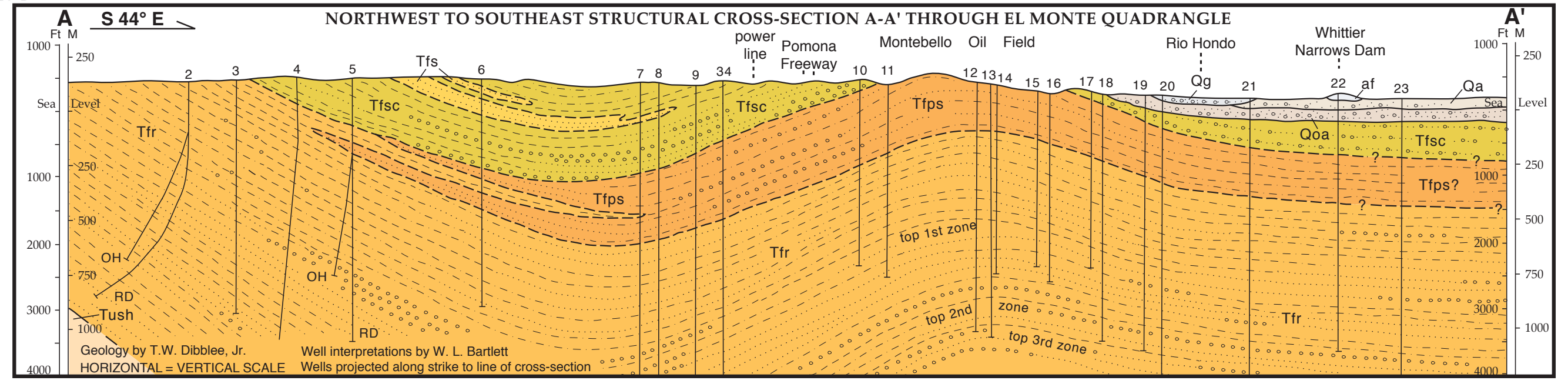
FAULT: *Dashed where indefinite or inferred, dotted where concealed, queried where existence is doubtful. Parallel arrows indicate inferred relative lateral movement. Relative vertical movement is shown by U/D (U=upthrown side, D=downthrown side). Short arrow indicates dip of fault plane. Sawteeth are on upper plate of low angle thrust fault.* U D 25 ?

FOLDS: *overturned* **ANTICLINE** **SYNCLINE**
arrow on axial trace of fold indicates direction of plunge; dotted where concealed by surficial sediments

Strike and dip of sedimentary rocks: 18 *inclined*; 20 *inclined (approximate)*; 80 *overturned*; *horizontal*; *vertical*

Strike and dip of metamorphic or igneous rock foliation or flow banding or compositional layers: 75 *inclined*; *inclined (approximate)*; *vertical*; 80 *overturned*

OTHER SYMBOLS: *Direction of landslide movement*; *outline of water bodies shown on map*; *water well*; *oil well*; *springs*



NORTHWEST TO SOUTHEAST STRUCTURAL CROSS-SECTION A-A' THROUGH EL MONTE QUADRANGLE

Geology by T.W. Dibblee, Jr.
HORIZONTAL = VERTICAL SCALE
Well interpretations by W. L. Bartlett
Wells projected along strike to line of cross-section

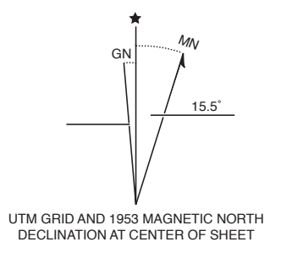
GEOLOGIC MAP OF THE EL MONTE & BALDWIN PARK QUADRANGLES

LOS ANGELES COUNTY, CALIFORNIA

BY THOMAS W. DIBBLEE, JR., 1999

EDITED BY HELMUT E. EHRENSPECK, 1999
EDITED BY JOHN A. MINCH, 2009

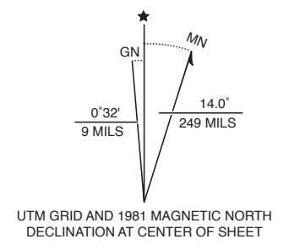
EL MONTE



UTM GRID AND 1953 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

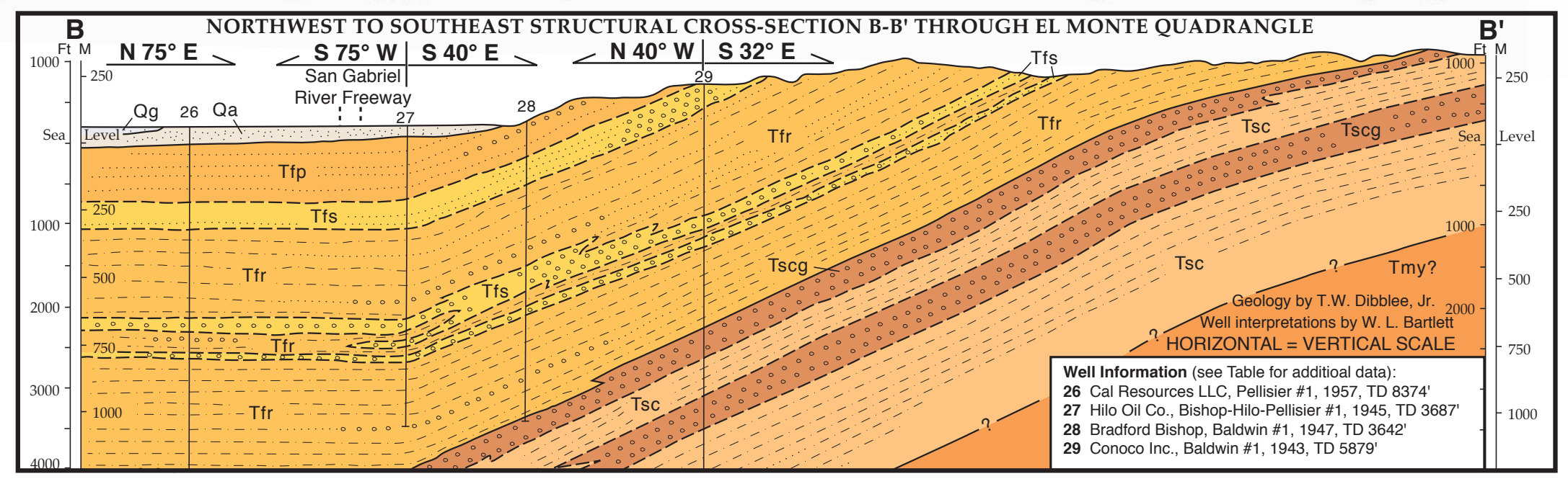
Dibblee Geology Center Map #DF-69: First Printing, 1999: Second Printing, 2009
PUBLISHED BY AND AVAILABLE FROM THE
SANTA BARBARA MUSEUM OF NATURAL HISTORY
2559 PUESTA DEL SOL ROAD, SANTA BARBARA, CA 93105
HTTP://WWW.SBNATURE.ORG/

BALDWIN PARK



UTM GRID AND 1981 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

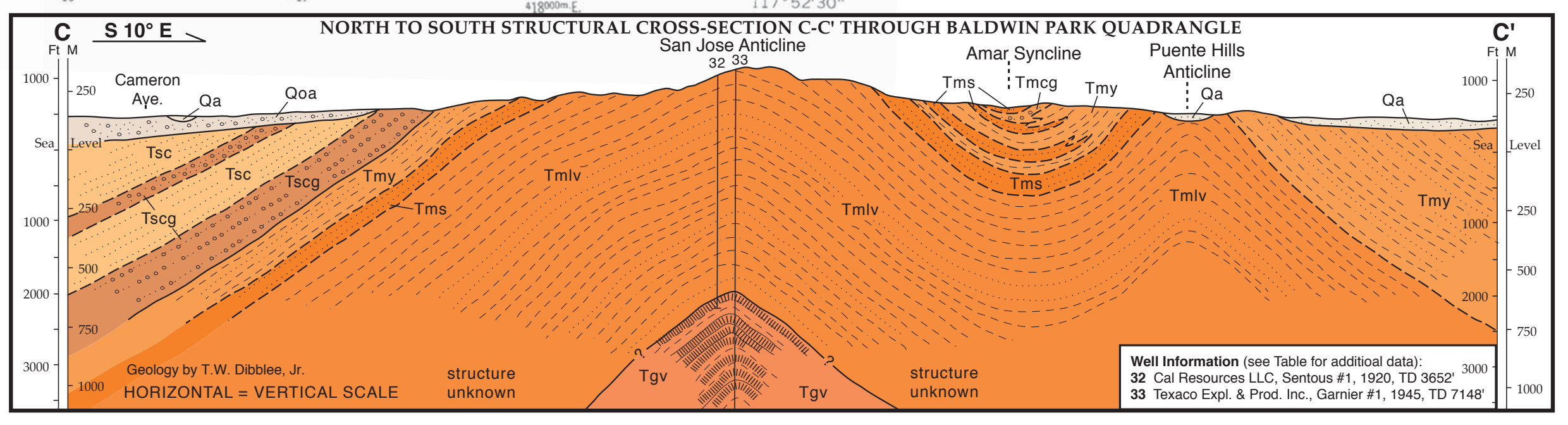
TED L. BEAR HONORARY MAP



NORTHWEST TO SOUTHEAST STRUCTURAL CROSS-SECTION B-B' THROUGH EL MONTE QUADRANGLE

Geology by T.W. Dibblee, Jr.
Well interpretations by W. L. Bartlett
HORIZONTAL = VERTICAL SCALE

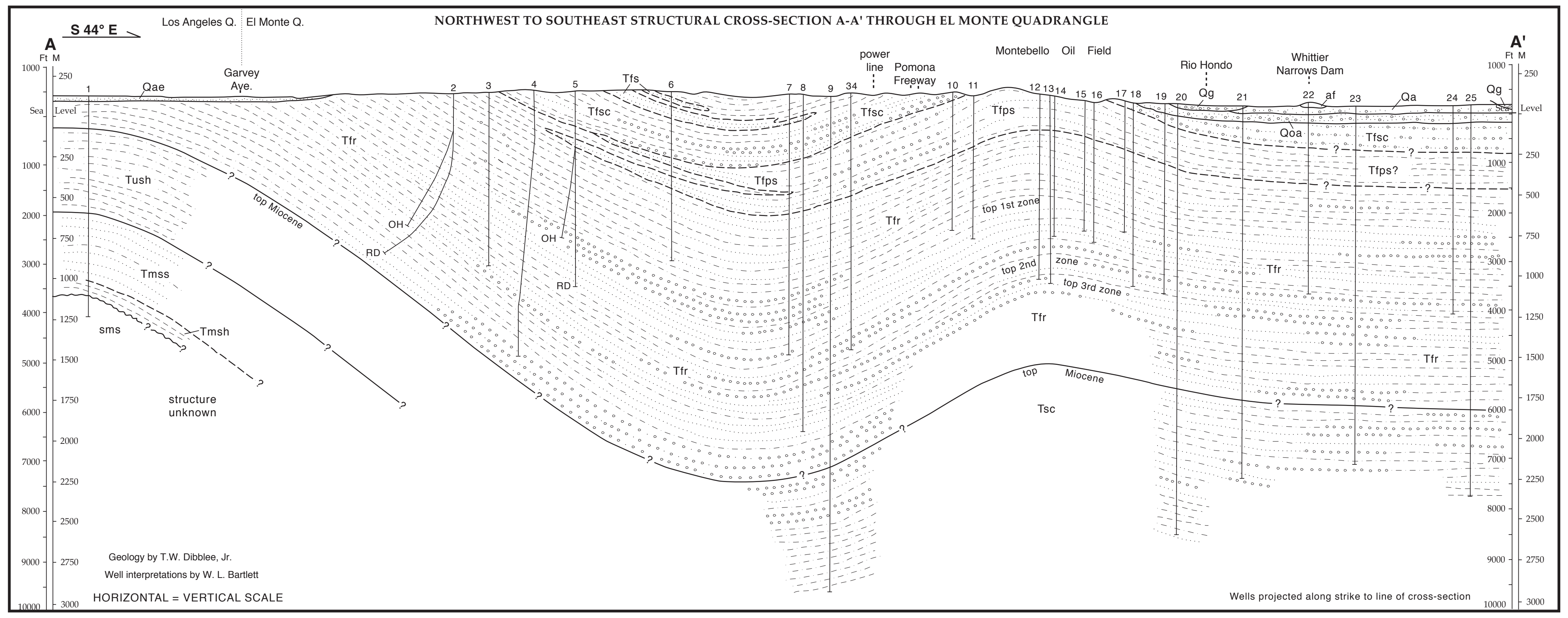
Well Information (see Table for additioal data):
26 Cal Resources LLC, Pellisier #1, 1957, TD 8374'
27 Hilo Oil Co., Bishop-Hilo-Pellisier #1, 1945, TD 3687'
28 Bradford Bishop, Baldwin #1, 1947, TD 3642'
29 Conoco Inc., Baldwin #1, 1943, TD 5879'

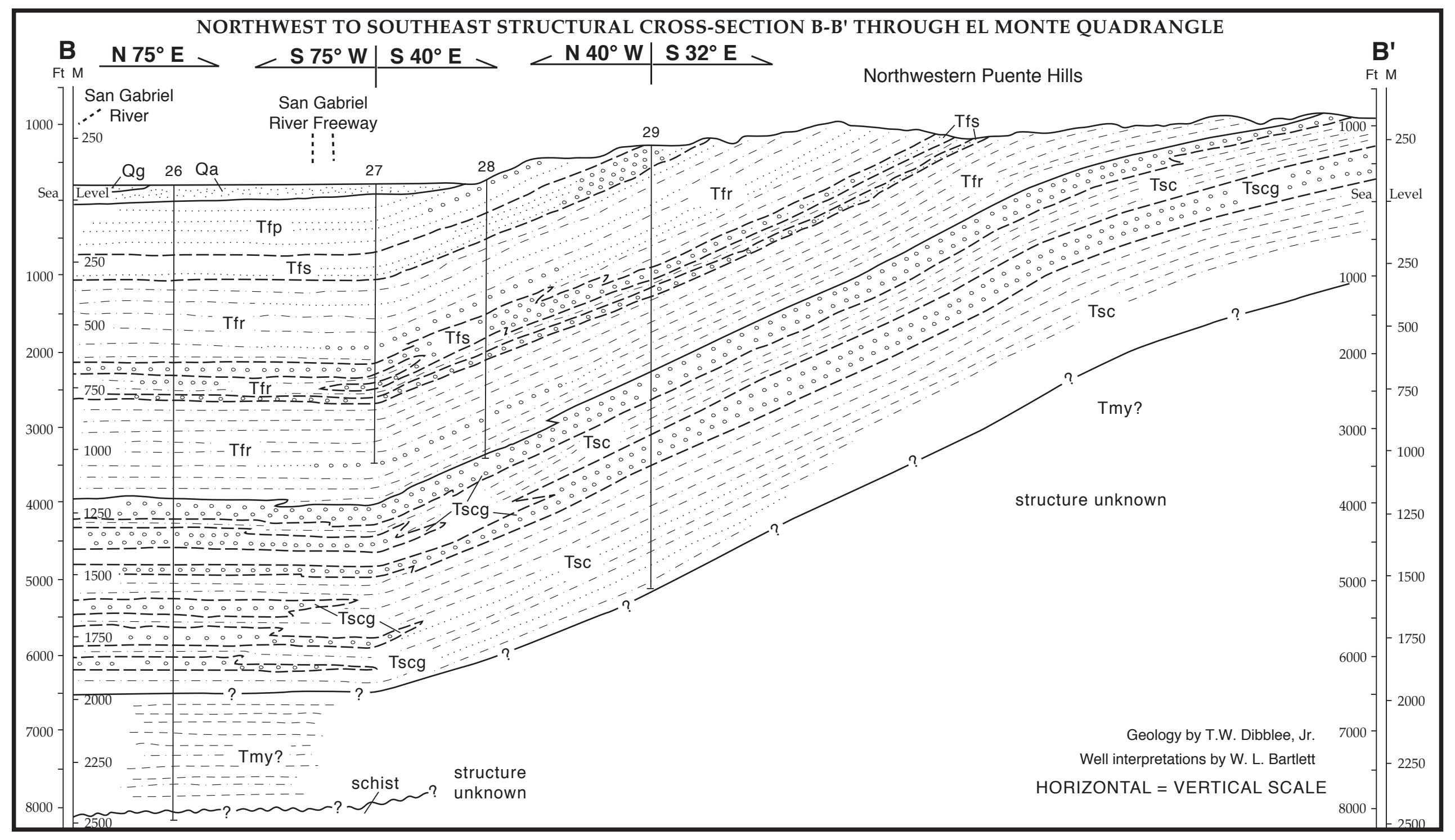


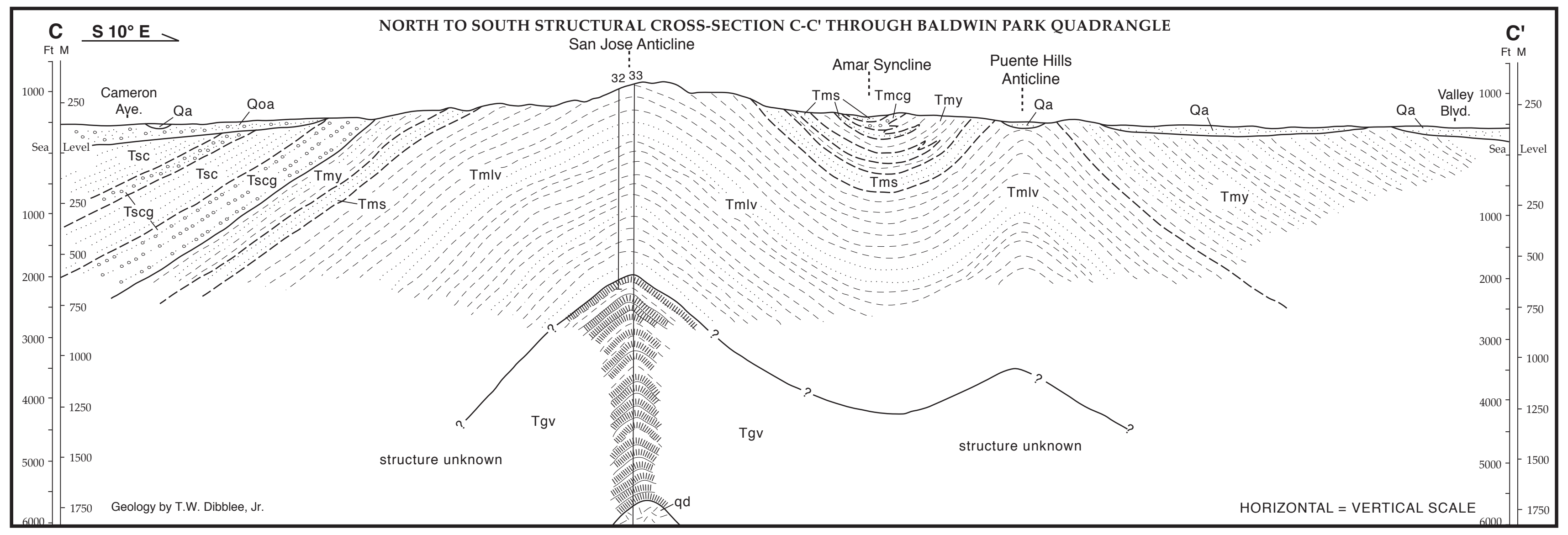
NORTH TO SOUTH STRUCTURAL CROSS-SECTION C-C' THROUGH BALDWIN PARK QUADRANGLE

Geology by T.W. Dibblee, Jr.
HORIZONTAL = VERTICAL SCALE

Well Information (see Table for additioal data):
32 Cal Resources LLC, Sentous #1, 1920, TD 3652'
33 Texaco Expl. & Prod. Inc., Garnier #1, 1945, TD 7148'


NORTHWEST TO SOUTHEAST STRUCTURAL CROSS-SECTION A-A' THROUGH EL MONTE QUADRANGLE


NORTHWEST TO SOUTHEAST STRUCTURAL CROSS-SECTION B-B' THROUGH EL MONTE QUADRANGLE


NORTH TO SOUTH STRUCTURAL CROSS-SECTION C-C' THROUGH BALDWIN PARK QUADRANGLE

LEGEND

af / **Qg** / **Qa**

SURFICIAL SEDIMENTS

Undissected alluvial deposits

af *Artificial fill, and cut and fill areas*

Qg *Gravel and sand of major streams, and alluvial fan detritus from San Gabriel Mountains, grades southward into alluvium (***Qa***) as sizes of clasts decrease*

Qa *Alluvial gravel, sand and silt of valleys and floodplains*

Qls

LANDSLIDE DEBRIS

Qof / **Qae** / **Qoa** / **Qog**

OLDER DISSECTED SURFICIAL SEDIMENTS

Qof *Alluvial fan sediments derived from San Gabriel Mountains*

Qae *Slightly evelvated and locally dissected alluvial gravel and sand at base of hill areas; shown as* **Qa** *on adjacent Los Angeles (Dibblee, 1989) and on Mt. Wilson/Azusa (Dibblee, 1998) quadrangles*

Qoa *Uplifted remnants of alluvial sand and gravel, north of hill areas*

Qog *Uplifted remnants of alluvial gravel, south of Montebello Hills*

— *UNCONFORMITY* —

Tfsc / **Tfps** / **Tfp** / **Tfs** / **Tfr**

FERNANDO FORMATION

(Of Daviess and Woodford, 1949; Yerkes, 1972); Marine to nonmarine clastic sediments, weakly indurated; early Pliocene to Pleistocene (?) age

Tfsc *Nonmarine sandstone and conglomerate: light gray to tan, crudely bedded; conglomerate composed of pebbles and cobbles of mostly granitic detritus in friable sandstone matix, probably nonmarine; sandstone may be in part marine; late (?) Pliocene to Pleistocene age; unit is lithologically similar to Saugus Formation of Ventura basin*

Tfps *"Pico" silty sandstone facies: at southwest end of Montebello Hills, composed of light gray, very fine-grained silty sandstone to siltstone; vaguely bedded, contains gray lenticular calcareous concretions and fossil shell fragments; deposited in shallow regressive sea*

Tfp *"Pico" claystone: gray micaceous silty claystone or siltstone, with spheroidal fracture, vaguely bedded, includes some silty sandstone; deposited in moderately deep sea; late (?) Pliocene age; probably equivalent to upper member of Fernando Fm. (of Yerkes, 1965 et al., in Puente Hills)*

Tfs *Sandstone facies of Fernando Formation: light to medium gray, weathered brown, fine to medium-grained, arkosic, bedded, locally pebbly; deposited in moderately deep sea*

Tfr *"Repetto" claystone member: lithologically similar to* **Tfp***; early Pliocene age (Repettian Stage); probably equivalent to lower member of Fernando Fm. (of Yerkes et al., 1965, in Puente Hills)*

Tsc / **Tscs** / **Tscg**

SYCAMORE CANYON FORMATION

(Named by Daviess and Woodford, 1949, as uppermost member of Puente Fm.; as so mapped by Durham and Yerkes, 1965, and Yerkes, 1972, in Puente Hills; equivalent to "Unnamed Shale" in Los Angeles quadrangle [Dibblee, 1989], and to Sisquoc Fm. in Ventura basin)

Marine clastic sediments, moderately indurated; late Miocene age

Tsc *Gray silty clay shale: micaceous, vaguely bedded to locally thin bedded, nodular, in places includes thin layers of fine-grained sandstone*

Tscs *Clay shale, light gray, vaguely bedded to locally thin bedded, includes thin layers of fine grained sandstone*

Tscg *Conglomerate and sandstone: gray to rusty brown conglomerate, crudely bedded, composed of cobbles and pebbles of mostly light-colored granitic rocks and others of gray quartz diorite, gneiss, a few of andesitic porphyry and quartzite, in arkosic sandstone matrix; sandstone rusty brown, lenticular, coarse to fine-grained, arkosic*

Tmy / **Tmcg** / **Tms** / **Tmlv**

MONTEREY FORMATION

(Major part of Puente Fm. of Olmstead, 1950; Yerkes, 1972; Durham and Yerkes, 1965)

Marine biogenic and clastic sediments, moderately lithified; middle Miocene age, Mohnian Stage

Tmy *Yorba Shale Member: interlayered thin-bedded gray shaly siltstone, fine-grained sandstone and white weathering semi-siliceous to siliceous shale; includes some thin, hard beds of yellowish-gray to gray dolomite; late Mohnian Stage (Yerkes, 1972)*

Tmcg *Conglomerate facies of cobbles & pebbles of plutonic rocks in sandstone matrix lenses in unit* **Tms***, deposited as submarine deltas*

Tms *Soquel Sandstone Member: mostly sandstone, light gray, weathering to tan, medium to locally coarse-grained, locally pebbly, bedded, arkosic, with minor biotite; in eastern exposures in San Jose Hills includes silty shale similar to that of unit* **Tmy**

Tmlv *La Vida Shale Member: thinly bedded shale similar to that of unit* **Tmy***, but containing somewhat more semi-siliceous shale; exposed only in San Jose Hills, base not exposed*

Tgv

GLENDORA VOLCANICS

(Of Shelton, 1955)

Volcanic and volcaniclastic rocks; in subsurface only, known from exploratory well data; middle Miocene age

Tgv *Basaltic to mafic andesitic flows, andesite-dacite breccia, and extrusive (?) andesite porphyry, as reported from drilling records, see cross section C-C'*

— *UNCONFORMITY* —

sms / **qd**

BASEMENT COMPLEX

Metamorphic and crystalline basement rocks (in subsurface only), known from exploratory well data

sms *Slate (Santa Monica Slate ?) and schistose basement rocks; see cross-sections A,A',B & B'*

qd *quartz diorite, granodiorite and mylonitized rocks; see cross-sections C-C'*

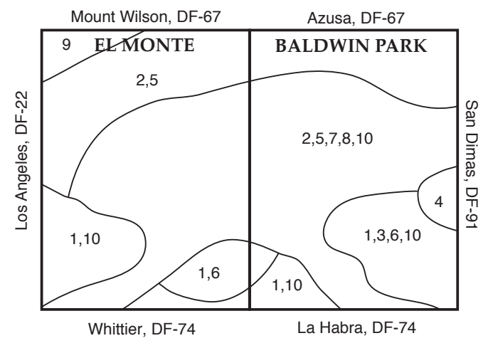
Holocene · Pleistocene · Pliocene · Miocene · QUATERNARY · TERTIARY · CENOZOIC · MESOZOIC AND OLDER

AGE CORRELATION CHART

AGE		ma	EPOCH		STAGE
CENOZOIC	QUAT.	.01	HOLOCENE		
			PLEISTOCENE		"HALLIAN"
					WHEELERIAN
	TERTIARY	1.6	PLIOCENE	LATE	VENTURIAN
				EARLY	REPETTIAN
		5.3	MIOCENE	LATE	"DELMONTIAN"
					MOHNIAN
		9.5		MIDDLE	LUISIAN
		16			RELIZIAN
				EARLY	SAUCESIAN
		24	OLIGOCENE		ZEMORRIAN
		38	EOCENE	LATE	REFUGIAN
					NARIZIAN
				MIDDLE	ULATISIAN
				EARLY	PENUTIAN
		56	PALEOCENE		BULITIAN
					YNEZIAN
MESOZOIC		65	CRETACEOUS		
		138	JURASSIC		
		205	TRIASSIC		
		250	PALEOZOIC		
		570	PRECAMBRIAN		
		4000+			

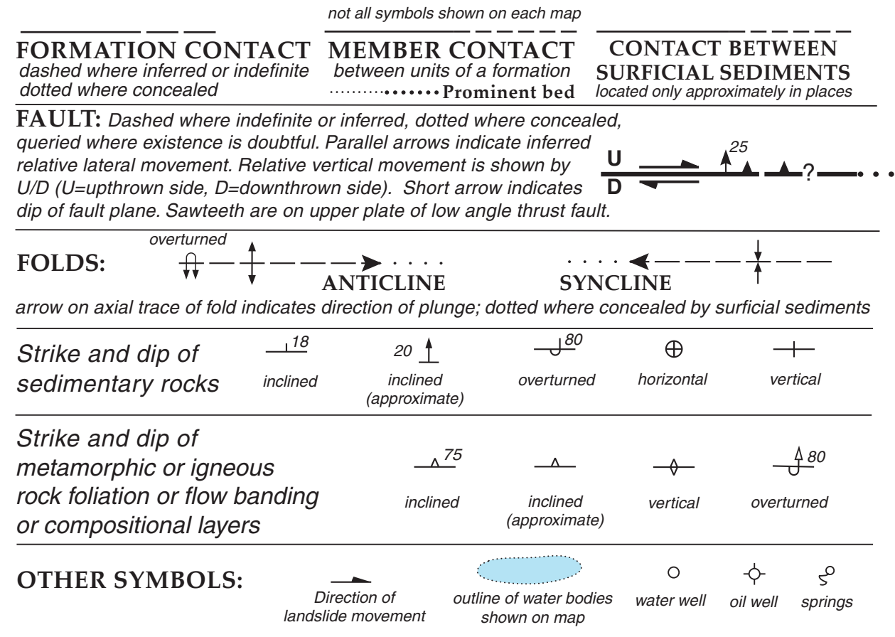
Radiometric ages, in millions of years (ma), are from current geological literature. Time relationships between California provincial microfaunal stages and epochs are subject to continued revision and refinement, as indicated by dashed and/or queried lines. (Neogene stages are adapted mostly from Micropaleo Consultants, Inc., 1989). Partitions between stages and epochs are diagrammatic and not to scale.

INDEX TO SOURCES OF GEOLOGY EL MONTE & BALDWIN PARK QUADRANGLES



1. T.W. Dibblee, Jr., field work, 1943
2. T.W. Dibblee, Jr., field reconnaissance, 1955-56
3. Olmstead, 1950
4. Shelton, 1955
5. Modified from Woodford and others, 1954 and Schoelhamer and others, 1965
6. Landslides compiled in part from Tan, 1988
7. Modified from Nelson and others, 1919
8. Modified from Jennings and Strand, 1969
9. Slightly modified from Crook and others, 1987
10. T.W. Dibblee, Jr., and H.E. Ehrenspeck, areas field checked December 1997

GEOLOGIC SYMBOLS


not all symbols shown on each map

FORMATION CONTACT *dashed where inferred or indefinite dotted where concealed*

MEMBER CONTACT *between units of a formation* **Prominent bed**

CONTACT BETWEEN SURFICIAL SEDIMENTS *located only approximately in places*

FAULT: *Dashed where indefinite or inferred, dotted where concealed, queried where existence is doubtful. Parallel arrows indicate inferred relative lateral movement. Relative vertical movement is shown by U/D (U=upthrown side, D=downthrown side). Short arrow indicates dip of fault plane. Sawteeth are on upper plate of low angle thrust fault.*

FOLDS: *overturned* **ANTICLINE** **SYNCLINE**

arrow on axial trace of fold indicates direction of plunge; dotted where concealed by surficial sediments

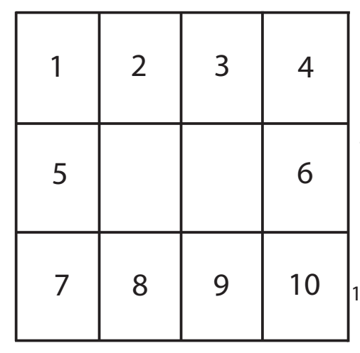
Strike and dip of sedimentary rocks: *inclined*, *inclined (approximate)*, *overturned*, *horizontal*, *vertical*

Strike and dip of metamorphic or igneous rock foliation or flow banding or compositional layers: *inclined*, *inclined (approximate)*, *vertical*, *overturned*

OTHER SYMBOLS: *Direction of landslide movement*, *outline of water bodies shown on map*, *water well*, *oil well*, *springs*

#	Operator	Well Name	Date	Location	El.	Total Depth
1	Conoco Inc.	Monterey Park Unit 1 #1	1956	22-1S-12W	424'	4427' in slate
2	ARCO Oil & Gas Co.	Garvey Hills #1	1944	27-1S-12W	474'	OH 2897' directional RD 3860' directional
3	Mobil Oil Corp.	Garvey #1	1919	26-1S-12W	463'	3500'
4	Monte Cristo Pet. Co.	Ramsay, Bass & Goodknight Garvey #1	1938	26-1S-12W	564'	5425' directional
5	G. Everett Miller	Garvey Hills South Unit #1	1953	26-1S-12W	423'	OH 2932' directional RD 3879' directional
6	Union Oil Co. of Cal.	Valley View #1	1917	35-1S-12W	488'	3422'
7	Lodico Oil Company	North Montebello #1	1946	35-1S-12W	405'	5219'
8	Delta Petroleum Co.	Wheeler #1	1969	35-1S-12W	387'	6779'
9	Cities Service Oil Co.	Resurrection Cemetary #1	1969	36-1S-12W	417'	10,018'
10	Chevron USA Inc.	Baldwin #100	1943	36-1S-12W	501'	2860'
11	Chevron USA Inc.	Baldwin #97	1942	1-2S-12W	406'	2900'
12	Chevron USA Inc.	Baldwin #168	1963	1-2S-12W	435'	3750'
13	Chevron USA Inc.	Baldwin # 130	1945	1-2S-12W	418'	3815'
14	Chevron USA Inc.	Baldwin #145	1950	1-2S-12W	404'	2850'
15	Chevron USA Inc.	Baldwin #30	1919	1-2S-12W	324'	2620'
16	Chevron USA Inc.	Baldwin #133	1948	1-2S-12W	286'±	2870'
17	Chevron USA Inc.	Baldwin #36	1919	1-2S-12W	305'	2618'
18	Chevron USA Inc.	Baldwin #35	1919	1-2S-12W	292'	3700'
19	Chevron USA Inc.	Baldwin #58	1920	1-2S-12W	243'	3850'
20	Aera Energy LLC	Scott Investment #2-1	1949	1-2S-12W	251'	8708'
21	Texaco E & P Inc.	Mullender #1	1951	6-2S-12W	205'	7530'
22	SWEPI	Sierra, Bishop-Durkee #1	1952	6-2S-12W	199'	3812'
23	Sun Oil Co.	Cipes #1	1947	7-2S-12W	200'±	7224'
24	Rothschild Oil Co.	Cate #1	1945	7-2S-12W	200'	4195'
25	Cal-Pico Oil Co.	Beach #1	1940	7-2S-12W	191'±	7788'
26	Cal Resources LLC	Pellisier #1	1957	4-2S-11W	241'	8374' in schist
27	Hilo Oil Co.	Bishop-Hilo-Pellisier #1	1943	4-2S-11W	236'	3657'
28	Bradford Biship	Baldwin #1	1947	3-2S-11W	259'	3642'
29	Conoco Inc.	Baldwin #1	1943	3-2S-11W	775'	5879'
30	Exxon Corp.	South San Gabriel Unit No. 1 #1	1959	24-1S-12W	310'	OH 5045± in schist RD-1 3889' in schist RD-2 4727' in schist
31	Chevron USA Inc.	Ferris #1	1965	21-1S-11W	300'	OH 12,189' in qtz. diort. RD 9997' in Miocene
32	Cal Resources LLC	Sentous #1	1920	35-1S-10W	1162'	3652' in volcanics
33	Texaco E & P Inc.	Garnier #1	1945	35-1S-10W	1162'	3652' in volcanics
34	Chevron USA Inc.	Stocker-Merced #3	1929	36-1S-12W	461'	5153' directional

INDEX TO ADJACENT 7.5 MINUTE QUADRANGLES



1 Pasadena, DF-23
2 Mount Wilson, DF-67
3 Azusa, DF-67
4 Glendora, DF-89
5 Los Angeles, DF-22
6 San Dimas, DF-91
7
8 Whittier, DF-74
9 La Habra, DF-74
10 Yorba Linda, DF-75

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GEOLOGIC MAP OF THE EL MONTE & BALDWIN PARK QUADRANGLES

LOS ANGELES COUNTY, CALIFORNIA

BY THOMAS W. DIBBLEE, JR., 1999
EDITED BY HELMUT E. EHRENSPECK, 1999
EDITED BY JOHN A. MINCH, 2009

Dibblee Geology Center Map #DF-69: First Printing, 1999: Second Printing, 2009
PUBLISHED BY AND AVAILABLE FROM THE
SANTA BARBARA MUSEUM OF NATURAL HISTORY
2559 PUESTA DEL SOL ROAD, SANTA BARBARA, CA 93105
HTTP://WWW.SBNATURE.ORG/

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TED L. BEAR HONORARY MAP

Map Dedication: This map is dedicated on behalf of the American Association of Petroleum Geologists [AAPG] Pacific Section, to Ted L. Bear, independent geologic consultant, for his diligent and successful work in deciphering the subsurface geology of the Los Angeles region.

ACKNOWLEDGMENTS

First Printing, 1999
Executive Committee: *Arthur O. Spaulding, President; Arthur R. Brown, Vice President; William E. Kennett, Vice President; John R. Powell, Secretary; Theodore Off, Treasurer; Dorothy L. Stout, Publicist; E.R. Jim Blakley, Map Sales; Thomas W. Dibblee, Jr., Director, and Helmut E. Ehrenspeck, Editor*

Production Management: *Helmut E. Ehrenspeck*

Graphics: *Final drafting by Wendy L. Bartlett, Santa Barbara; map design, geologic color scheme and color process by H. E. Ehrenspeck; laser scanning by Photolith, Santa Barbara; printing by Haagen Printing, Camarillo*

Second Edition, 2009

Dibblee Geological Foundation Advisory Committee: *John R. Powell, Arthur R. Brown, Donald D. Clarke.*

Editing and Production Management: *John A. Minch*
Graphics: *Map computer drafting, preparation, and map design by Jason I. Minch, Laguna Hills; technical review assistance by Susan Bartz; printing by Santa Barbara Museum of Natural History*

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Eugene F. Reid, Santa Barbara, California
Snyder and Smith Associates, Inc., Van Nuys, California
South Coast Geological Society, www.southcoastgeo.org
Southern California Earthquake Center [SCEC], University of Southern California, Los Angeles - www.scee.org

TED L. BEAR HONORARY MAP

Appendix G

Native American Tribal Consultation

WATER
RECLAMATION
SOLID WASTE MANAGEMENT

COUNTY SANITATION DISTRICTS
OF LOS ANGELES COUNTY

1955 Workman Mill Road, Whittier, CA 90601-1400
Mailing Address: P.O. Box 4998, Whittier, CA 90607-4998
Telephone: (562) 699-7411, FAX: (562) 699-5422
www.lacsd.org

GRACE ROBINSON HYDE
Chief Engineer and General Manager

March 23, 2018

Donna Yocum, Chairperson
San Fernando Band of Mission Indians
P.O. Box 221838
Newhall, CA 91322

Dear Ms. Yocum:

San Gabriel River Watershed Project to
Reduce River Discharge in Support of Increased Recycled Water Reuse

In conformance with the tribal consultation requirements of Assembly Bill (AB) 52, this letter is to inform you that the Sanitation Districts of Los Angeles County (Districts) is reviewing the proposed project described below. Per AB 52, the tribe has the right to consult on a proposed public or private project prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report. The project description is as follows:

In anticipation of increased future recycled water demands, the Districts are proposing to incrementally reduce discharges of tertiary-treated wastewater from five water reclamation plants (WRPs) including the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP, each of which currently discharge into the San Gabriel River or the San Jose Creek; refer to **Figure 1-1**, *LACSD Receiving Water Stations and Discharges to San Gabriel System* and **Figure 1-2**, *San Jose Creek WRP Discharge Points*. The diverted water would supply recycled water programs implemented by other agencies. The proposed reduction in wastewater discharges would occur over time, and would not involve any construction activities or other physical changes to the environment other than the decreased volume of discharge. The Districts will continue to maintain the ability to discharge treated water at the same points of diversion, but anticipate lesser quantities.

You have 30 calendar days from receipt of this letter to notify us in writing that you want to consult on this project. Please provide the lead contact person's contact information. Please mail your request to:

Winnie Siauw
Project Engineer, Wastewater Planning Section
Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90601
(562) 908-4288 x2740
winniesiauw@lacsd.org

Sincerely,

Jodie Lanza

Jodie Lanza
Supervising Engineer, Wastewater Planning
Facilities Planning Department

JL:VC:pb

Attachments:
Figure 1-1, LACSD Receiving Water Stations and Discharges to San Gabriel System;
Figure 1-2, San Jose Creek WRP Discharge Points

WATER
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GRACE ROBINSON HYDE
Chief Engineer and General Manager

March 23, 2018

Temet Aguilar, Chairperson
Pauma Band of Luiseno Indians - Pauma & Yuima Reservation
P.O. Box 369
Pauma Valley, CA 92061

Dear Mr. Aguilar:

San Gabriel River Watershed Project to
Reduce River Discharge in Support of Increased Recycled Water Reuse

In conformance with the tribal consultation requirements of Assembly Bill (AB) 52, this letter is to inform you that the Sanitation Districts of Los Angeles County (Districts) is reviewing the proposed project described below. Per AB 52, the tribe has the right to consult on a proposed public or private project prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report. The project description is as follows:

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(562) 908-4288 x2740
winniesiauw@lacsd.org

Sincerely,

Jodie Lanza

Jodie Lanza
Supervising Engineer, Wastewater Planning
Facilities Planning Department

JL:VC:pb

Attachments:
Figure 1-1, LACSD Receiving Water Stations and Discharges to San Gabriel System;
Figure 1-2, San Jose Creek WRP Discharge Points

WATER RECLAMATION
SOLID WASTE MANAGEMENT

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www.lacsd.org

GRACE ROBINSON HYDE
Chief Engineer and General Manager

March 23, 2018

Charles Alvarez, Councilperson
Gabrielino-Tongva Tribe
23454 Vanowen Street
West Hills, CA 91307

Dear Mr. Alvarez:

San Gabriel River Watershed Project to
<u>Reduce River Discharge in Support of Increased Recycled Water Reuse</u>

In conformance with the tribal consultation requirements of <u>Assembly Bill (AB) 52</u>, this letter is to inform you that the Sanitation Districts of Los Angeles County (Districts) is reviewing the proposed project described below. Per AB 52, the tribe has the right to consult on a proposed public or private project prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report. The project description is as follows:

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1955 Workman Mill Road
Whittier, CA 90601
(562) 908-4288 x2740
winniesiauw@lacsd.org

Sincerely,

Jodie Lanza

Jodie Lanza
Supervising Engineer, Wastewater Planning
Facilities Planning Department

JL:VC:pb

Attachments:
Figure 1-1, LACSD Receiving Water Stations and Discharges to San Gabriel System;
Figure 1-2, San Jose Creek WRP Discharge Points

COUNTY SANITATION DISTRICTS
OF LOS ANGELES COUNTY

1955 Workman Mill Road, Whittier, CA 90601-1400
Mailing Address: P.O. Box 4998, Whittier, CA 90607-4998
Telephone: (562) 699-7411, FAX: (562) 699-5422
www.lacsd.org

GRACE ROBINSON HYDE
Chief Engineer and General Manager

March 23, 2018

Robert Dorame, Chairperson
Gabrielino Tongva Indians of California Tribal Council
P.O. Box 490
Bellflower, CA 90707

Dear Mr. Dorame:

San Gabriel River Watershed Project to
Reduce River Discharge in Support of Increased Recycled Water Reuse

In conformance with the tribal consultation requirements of Assembly Bill (AB) 52, this letter is to inform you that the Sanitation Districts of Los Angeles County (Districts) is reviewing the proposed project described below. Per AB 52, the tribe has the right to consult on a proposed public or private project prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report. The project description is as follows:

In anticipation of increased future recycled water demands, the Districts are proposing to incrementally reduce discharges of tertiary-treated wastewater from five water reclamation plants (WRPs) including the San Jose Creek WRP, the Pomona WRP, the Whittier Narrows WRP, the Los Coyotes WRP, and the Long Beach WRP, each of which currently discharge into the San Gabriel River or the San Jose Creek; refer to **Figure 1-1**, *LACSD Receiving Water Stations and Discharges to San Gabriel System* and **Figure 1-2**, *San Jose Creek WRP Discharge Points*. The diverted water would supply recycled water programs implemented by other agencies. The proposed reduction in wastewater discharges would occur over time, and would not involve any construction activities or other physical changes to the environment other than the decreased volume of discharge. The Districts will continue to maintain the ability to discharge treated water at the same points of diversion, but anticipate lesser quantities.

You have 30 calendar days from receipt of this letter to notify us in writing that you want to consult on this project. Please provide the lead contact person's contact information. Please mail your request to:

Winnie Siauw
Project Engineer, Wastewater Planning Section
Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90601
(562) 908-4288 x2740
winniesiauw@lacsd.org

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WATER RECLAMATION
SOLID WASTE MANAGEMENT

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GRACE ROBINSON HYDE
Chief Engineer and General Manager

March 23, 2018

Sandonne Goad, Chairperson
Gabrielino /Tongva Nation
106 1/2 Judge John Aiso St #231
Los Angeles, CA 90012

Dear Ms. Goad:

San Gabriel River Watershed Project to
<u>Reduce River Discharge in Support of Increased Recycled Water Reuse</u>

In conformance with the tribal consultation requirements of <u>Assembly Bill (AB) 52</u>, this letter is to inform you that the Sanitation Districts of Los Angeles County (Districts) is reviewing the proposed project described below. Per AB 52, the tribe has the right to consult on a proposed public or private project prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report. The project description is as follows:

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winniesiauw@lacsd.org

Sincerely,

Jodie Lanza

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GRACE ROBINSON HYDE
Chief Engineer and General Manager

March 23, 2018

Anthony Morales, Chairperson
Gabrieleno/Tongva San Gabriel Band of Mission Indians
P.O. Box 693
San Gabriel, CA 91778

Dear Mr. Morales:

San Gabriel River Watershed Project to
Reduce River Discharge in Support of Increased Recycled Water Reuse

In conformance with the tribal consultation requirements of Assembly Bill (AB) 52, this letter is to inform you that the Sanitation Districts of Los Angeles County (Districts) is reviewing the proposed project described below. Per AB 52, the tribe has the right to consult on a proposed public or private project prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report. The project description is as follows:

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Winnie Siauw
Project Engineer, Wastewater Planning Section
Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90601
(562) 908-4288 x2740
winniesiauw@lacsd.org

Sincerely,

Jodie Lanza

Jodie Lanza
Supervising Engineer, Wastewater Planning
Facilities Planning Department

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GRACE ROBINSON HYDE
Chief Engineer and General Manager

March 23, 2018

Andrew Salas, Chairperson
Gabrieleno Band of Mission Indians - Kizh Nation
P.O. Box 393
Covina, CA 91723

Dear Mr. Salas:

San Gabriel River Watershed Project to
<u>Reduce River Discharge in Support of Increased Recycled Water Reuse</u>

In conformance with the tribal consultation requirements of Assembly Bill (AB) 52, this letter is to inform you that the Sanitation Districts of Los Angeles County (Districts) is reviewing the proposed project described below. Per AB 52, the tribe has the right to consult on a proposed public or private project prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report. The project description is as follows:

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Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90601
(562) 908-4288 x2740
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Sincerely,

Jodie Lanza

Jodie Lanza
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Facilities Planning Department

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www.lacsd.org

GRACE ROBINSON HYDE
Chief Engineer and General Manager

March 27, 2018

Matias Belardes, Chairperson
Juaneno Band of Mission Indians Acjachemen Nation
32161 Avenida Los Amigos
San Juan Capistrano, CA 92675

Dear Mr. Salas:

San Gabriel River Watershed Project to
Reduce River Discharge in Support of Increased Recycled Water Reuse

In conformance with the tribal consultation requirements of Assembly Bill (AB) 52, this letter is to inform you that the Sanitation Districts of Los Angeles County (Districts) is reviewing the proposed project described below. Per AB 52, the tribe has the right to consult on a proposed public or private project prior to the release of a negative declaration, mitigated negative declaration, or environmental impact report. The project description is as follows:

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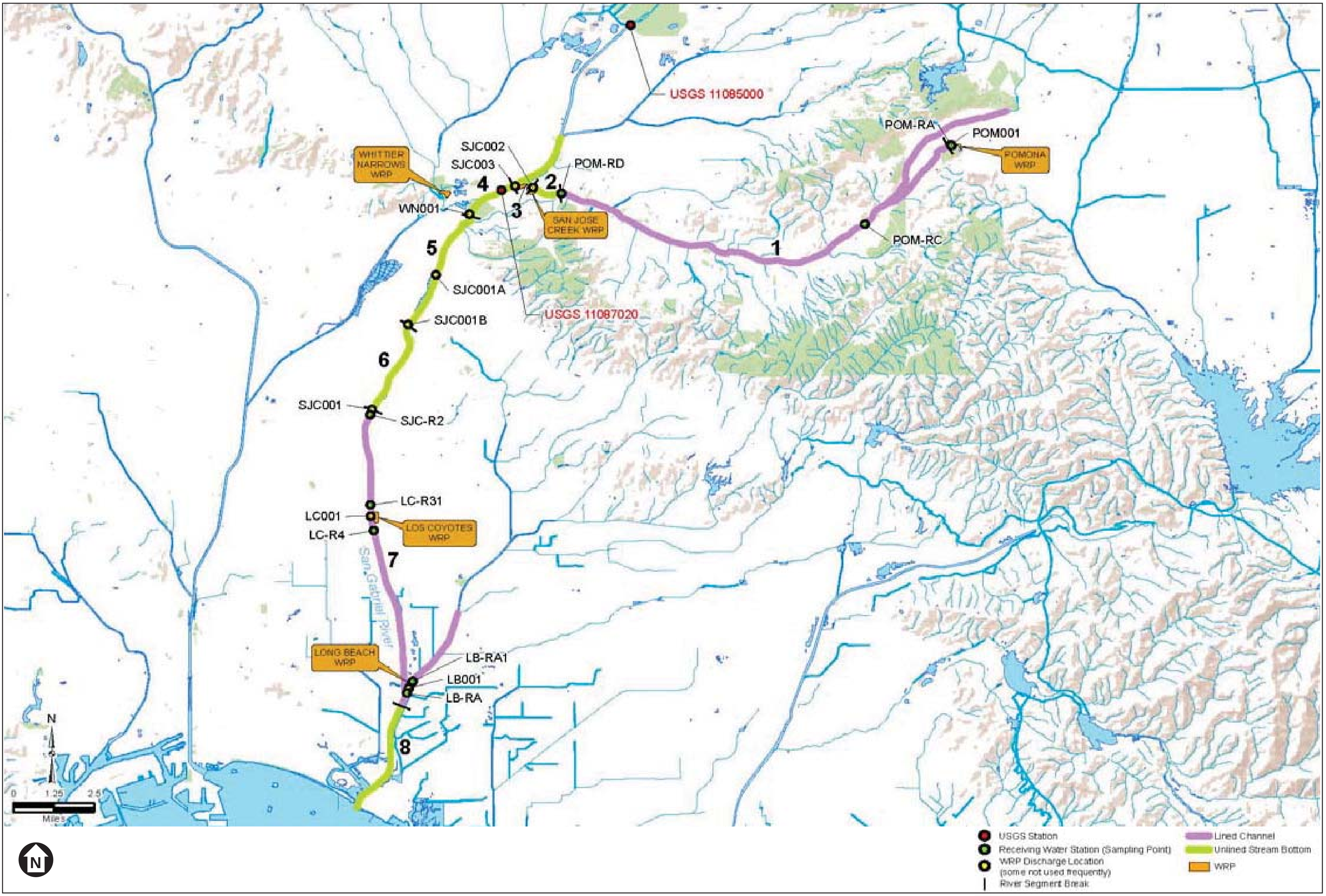

SOURCE: Clearwater EIR Segment Map, prepared by Chambers Group, Inc., 2015

LACSD San Gabriel River Wastewater Diversion Program

Figure 1-1
LACSD Receiving Water Stations and Discharges to San Gabriel System

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SOURCE: Amec, Foster, Wheeler, 2017

LACSD San Gabriel River Wastewater Diversion Program

Figure 1-2
SJCWRP Discharge Points

GABRIELEÑO BAND OF MISSION INDIANS - KIZH NATION
Historically known as The San Gabriel Band of Mission Indians
recognized by the State of California as the aboriginal tribe of the Los Angeles basin

County Station District
1955 Workman Mill Road
Whittier, CA 90607-4998

March 29, 2018

Re: AB52 Consultation request for San Gabriel River Watershed Project

Dear Jodie Lanza,

Please find this letter as a written request for consultation regarding the above-mentioned project pursuant to Public Resources Code § 21080.3.1, subd. (d). Your project lies within our ancestral tribal territory, meaning belonging to or inherited from, which is a higher degree of kinship than traditional or cultural affiliation. Your project is located within a sensitive area and may cause a substantial adverse change in the significance of our tribal cultural resources. Most often, a records search for our tribal cultural resources will result in a "no records found" for the project area. The Native American Heritage Commission (NAHC), ethnographers, historians, and professional archaeologists can only provide limited information that has been previously documented about California Native Tribes. This is the reason the NAHC will always refer the lead agency to the respective Native American Tribe of the area because the NAHC is only aware of general information and are not the experts on each California Tribe. Our Elder Committee & tribal historians are the experts for our Tribe and are able to provide a more complete history (both written and oral) regarding the location of historic villages, trade routes, cemeteries and sacred/religious sites in the project area. Therefore, to avoid adverse effects to our tribal cultural resources, we would like to consult with you and your staff to provide you with a more complete understanding of the prehistoric use(s) of the project area and the potential risks for causing a substantial adverse change to the significance of our tribal cultural resources.

Consultation appointments are available on Wednesdays and Thursdays at our offices at 910 N. Citrus Ave. Covina, CA 91722 or over the phone. Please call toll free 1-844-390-0787 or email gabrielenoindians@yahoo.com to schedule an appointment.

** Prior to the first consultation with our Tribe, we ask all those individuals participating in the consultation to view a video produced and provided by CalEPA and the NAHC for sensitivity and understanding of AB52. You can view their videos at: http://calepa.ca.gov/Tribal/Training/ or http://nahc.ca.gov/2015/12/ab-52-tribal-training/

With Respect,

Andrew Salas, Chairman

Andrew Salas, Chairman
Nadine Salas, Vice-Chairman
Christina Swindall Martinez, secretary
Albert Perez, treasurer I
Martha Gonzalez Lemos, treasurer II
Richard Gradias, Chairman of the Council of Elders
PO Box 393, Covina, CA 91723
www.gabrielenoindians.org
gabrielenoindians@yahoo.com

Appendix H

Draft Adaptive Management Plan for Los Angeles County Sanitation Districts San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse, July 2019

DRAFT ADAPTIVE MANAGEMENT PLAN for LOS ANGELES COUNTY SANITATION DISTRICTS SAN GABRIEL RIVER WATERSHED PROJECT TO REDUCE RIVER DISCHARGE IN SUPPORT OF INCREASED RECYCLED WATER REUSE

Prepared for:
Los Angeles County Sanitation Districts
1955 Workman Mill Road
Whittier, CA 90601

Submitted by:
Wood Environment & Infrastructure Solutions, Inc.
3120 Chicago Suite 110
Riverside, California 92507

July 2019

Wood Project Number 1655502001

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ACRONYMS AND ABBREVIATIONS

%	percent
AF	acre-feet
AF/acre/year	acre-feet per acre per year
AF/d	acre-feet per day
AMP	Adaptive Management Plan
BOR	United States Bureau of Reclamation
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CIMIS	California Irrigation Management Information System
CNPS	California Native Plant Society
CNRA	California Natural Resources Agency
CV	canopy volume
ET	evapotranspiration
gal/day	gallon(s) per day
gal/mo	gallon(s) per month
GPS	Global Positioning System
HAA	Habitat Assessment Area
HMC	Habitat Management Committee
ITP	Incidental Take Permit
LACDRP	Los Angeles County Department of Regional Planning
LBV	Least Bell’s Vireo
LCRMSCP	Lower Colorado River Multi-Species Conservation Program
MCV2	Manual of California Vegetation Version 2
mgd	million gallons per day
NA	not applicable
NPDS	National Pollutant Discharge System
NRCS	Natural Resources Conservation Service
PCE	Primary Constituent Element
PomWRP	Pomona Water Reclamation Plan
Project	San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse
PSHB	polyphagous shot-hole borer
Sanitation Districts	Sanitation Districts of Los Angeles County
SD	standard deviation
SGR	San Gabriel River
SJC	San Jose Creek
SJCWRP	San Jose Creek Water Reclamation Plant
SWP	stem water potential

UCNAR	University of California Agricultural and Natural Resources
USFWS	United States Fish and Wildlife Service
U.S. 60	United States Route 60
USGS	United States Geological Survey
WNCC	Whittier Narrows Dam Cross Channel
WND	Whittier Narrows Dam
Wood	Wood Environment & Infrastructure Solutions, Inc.
WRP	Water Reclamation Plant
WY	water year
Z1D	Zone 1 Ditch

1.0 Introduction and Problem Statement

The Sanitation Districts of Los Angeles County (Sanitation Districts) propose the "San Gabriel River Watershed Project to Reduce River Discharge in Support of Increased Recycled Water Reuse" (Project) for the potential reduction of flow in portions of the San Jose Creek (SJC) and San Gabriel River (SGR) as well as in some off-channel watercourses (Figure 1) generally located within the Whittier Narrows Dam (WND) area. When the Project is implemented, reduced discharge from the San Jose Creek and Pomona Water Reclamation Plants (WRPs) into the SJC and SGR and associated channels has the potential to adversely affect the downstream riparian habitat. Because this type of habitat has historically been occupied by the sensitive riparian bird species Least Bell's Vireo (LBV; *Vireo bellii pusillus*), changes in that habitat could affect its suitability for occupation by this species.

This Adaptive Management Plan (AMP) is designed to ensure continuation of the pre-Project conditions (overall quality and quantity) of the habitat influenced by treatment plant discharges. This objective will be accomplished by mapping and monitoring the riparian vegetation annually. Data on the vegetation will be collected through field measurements and observations. Although other portions of the SGR may include riparian habitat, they would not be affected by the Project.

The riparian habitat potentially impacted by the Project includes portions of the SGR above and below the confluence with the SJC, a portion of the SGR just downstream of the dam, and other off-channel areas that receive water from the SGR known as the Zone 1 Ditch (Z1D) and the Whittier Narrows Dam Cross Channel (WNCC). The habitat can be defined in Groups 1 through 5 (Figure 2), which all contain similar manmade elements, including lining along the banks/sides and weirs spanning the channels, and will experience similar Project-related surface flow conditions. Group 1 is the northernmost habitat area, extending from the large drop structure upstream of the confluence of the SGR and SJC down to below United States Route 60 (U.S. 60; Figure 3); a small portion of the SJC is in Group 1. Group 2 is entirely within the SGR channel, extending from U.S. 60 to the weir southwest of Peck Road (Figure 4). Group 3 is also entirely within the SGR channel, extending downstream from Group 2 to the area where the channel begins to constrict above WND (Figure 5). Group 4 includes habitat just above and extending downstream of the WND (Figure 6). Group 5 is the area off the main channel, composed of the habitat along the Z1D and the WNCC that receives water from the SGR at the downstream end of Group 2 (Figure 7).

Vegetative and soil conditions within the Project area are subject to natural changes from the seasonal rainfall patterns of the region. Such changes range from seasonal drought, which results in ephemeral flows in portions of the channels, to major storm events that may cause flooding of the Project area and scouring of vegetation. Such natural changes are independent of discharges from the WRPs. As a result, the amount of water that is available to vegetation is variable in both space and timing. The water availability issue is described in Section 2.0.

Because water availability has the potential to affect riparian vegetation, the goal of this AMP is to ensure, through monitoring, that baseline riparian vegetation conditions (extent and condition of vegetation prior to implementation of the Project) are maintained over the life of the Project in the Project area.

This AMP defines the parameters that characterize riparian vegetation, describes monitoring strategies to evaluate these parameters numerically within the Project area, defines triggers for implementation of adaptive management strategies necessary after Project implementation, and describes the tools available for management.

2.0 Water Availability

The amount of water used by vegetation that comprises riparian habitat and other area vegetation has been calculated, as has the volume of open water present in Groups 1 through 5 of the Project area. Sufficient water must be available to support that vegetation; an amount of water equal to the vegetation demand must be present in the soil in the habitat areas in order to support the vegetation. Because emergent aquatic vegetation is not considered part of the riparian vegetation, soil storage only (not the extent of ponded water) is important for this evaluation.

For the water demand calculations, a number of sources were consulted, including data from the United States Geological Survey (USGS, 2006) and United States Bureau of Reclamation (BOR, 2011), a publication from California State Polytechnic University, Pomona (Perry 2010) regarding water use by cottonwoods and willows in southern California, site management information from BOR for stands of willow and cottonwood established along the Lower Colorado River (BOR et al. 2004, Iglitz and Raulston 2017, and Lower Colorado River Multi-Species Conservation Program [LCRMSCP] 2004), and water management information from the Imperial Irrigation District for managed cottonwood-willow stands (K. Bishop, personal communication, December 5, 2016). These sources varied considerably in the reported or estimated ranges for evapotranspiration (ET) of willow/cottonwood vegetation. For this analysis, the highest value reported (8.0 acre-feet per acre per year [AF/acre/year]) was selected for the 166.25 acres of vegetation dominated by trees or mulefat in the entire Project area, and the lowest value reported from the same sources (4.0 AF/acre/year) was selected for the remaining 129.62 acres of vegetation and open water in the Project area. The annual water demand for the entire vegetated area is 1,945 AF, or 633,735,460 gallons per year. We then evaluated the annual proportion of ET from each month of the year, based on California Irrigation Management Information System (CIMIS) reports from the Long Beach Station #174, which is the station nearest the Project site. The resulting water demand is shown in Tables 1 and 2.

Table 1. Water Demand per Month in Groups 1, 2, 3, and 4 of the San Gabriel River

Month	ET (inches)	%	ET		MGD	AF/d
			gal/mo	gal/day		
Jan	1.75	4%	14,434,785	465,638	0.47	1.43
Feb	1.76	4%	14,517,270	468,299	0.47	1.44
Mar	4.28	9%	35,303,360	1,138,818	1.14	3.50
Apr	5.55	12%	45,778,890	1,476,738	1.48	4.53
May	5.31	11%	43,799,262	1,412,879	1.41	4.34
Jun	5.22	11%	43,056,902	1,388,932	1.39	4.26
Jul	6.4	13%	52,790,071	1,702,906	1.70	5.23
Aug	5.98	12%	49,325,723	1,591,152	1.59	4.88
Sep	4.63	10%	38,190,317	1,231,946	1.23	3.78
Oct	3.26	7%	26,889,943	867,418	0.87	2.66
Nov	2.34	5%	19,301,370	622,625	0.62	1.91
Dec	1.48	3%	12,207,704	393,797	0.39	1.21
Total	47.96	100%	395,595,596		1.06	3.26

AF/d = acre-feet per day; ET = evapotranspiration; gal/day = gallons per day; gal/mo = gallons per month;
MGD = million gallons per day

Table 2. Water Demand per Month in Group 5

Month	ET (inches)	%	ET		MGD	AF/d
			gal/mo	gal/day		
Jan	1.75	4%	8,688,108	280,262	0.28	0.86
Feb	1.76	4%	8,737,755	281,863	0.28	0.86
Mar	4.28	9%	21,248,631	685,440	0.68	2.10
Apr	5.55	12%	27,553,715	888,830	0.89	2.73
May	5.31	11%	26,362,203	850,394	0.85	2.61
Jun	5.22	11%	25,915,386	835,980	0.84	2.57
Jul	6.4	13%	31,773,654	1,024,957	1.02	3.15
Aug	5.98	12%	29,688,508	957,694	0.96	2.94
Sep	4.63	10%	22,986,253	741,492	0.74	2.28
Oct	3.26	7%	16,184,705	522,087	0.52	1.60
Nov	2.34	5%	11,617,242	374,750	0.37	1.15
Dec	1.48	3%	7,347,657	237,021	0.24	0.73
Total	47.96	100%	238,103,818		0.64	1.96

AF/d = acre-feet per day; ET = evapotranspiration; gal/day = gallon(s) per day; gal/mo = gallon(s) per month;
MGD = million gallons per day

Based on this analysis, the Sanitation Districts would need to supply a sufficient amount of water that could be either (1) consumed by vegetation directly from surface flow, or (2) stored in the soil to provide for the future needs of the vegetation. Although possibly present in some areas, water from other sources has not been quantified.

Historically (based on Sanitation Districts data from water year [WY] 2014 through WY 2018), the volume of discharge from the Sanitation Districts' San Jose Creek Water Reclamation Plant (SJCWRP) to the Project area is far greater than the calculated water demand by the vegetation in the Project area, although yearly discharge flow rates are highly variable. The historical average monthly discharges from the SJCWRP to the Project area range from 5.3 million gallons per day (MGD) to 8.2 MGD when water demand is highest, between May and September. Discharge to the Z1D, which would also support vegetation in the WNCC, is also variable, ranging from a low monthly average of 0.0 MGD in April, May, and December to a high of 2.44 MGD in February (WY 2014 through WY 2018). As shown in Tables 3 and 4, the water flows in these areas are higher than the vegetation water demand in the SGR segments in all months (Table 3), and for most, but not all, months in the Z1D and WNCC (Table 4).

The Sanitation Districts propose a modified water discharge schedule as part of the Project to more efficiently provide water both in volume and time. The proposed Project is designed to minimize the lengths of dry periods over the course of the year, while targeting an average discharge rate of 5 MGD. Details of proposed schedules that yield a 5-MGD monthly average are provided in Section 10.0.

Riparian plant species require soil water, but they cannot survive in continuously saturated soils. The amount of water that can be stored in the soil volume from which the vegetation takes water can be evaluated (Table 5). The Natural Resources Conservation Service (NRCS) soils map (website accessed October 17, 2017) shows that the soils in the Project area are largely sandy (xeropsamment soil). This soil type has a water capacity (pore volume) of about 0.25 (Plant and Soil Sciences e-library accessed October 17, 2017). That is, in a given volume of soil, about 25 percent of the volume can be occupied with water if the soil is totally saturated. In practice, totally saturated soil would be lethal to cottonwood, willow, mulefat, and other riparian species that require some air in the root area. Soil that is drained so that the water in it is optimally available to plants is said to be at "field capacity." The field capacity in sandy soils is about 17.5 percent. So, a given volume of this type of soil would contain a field capacity volume equal to about 17.5 percent of the soil pore volume, in effect limiting the amount of water than can be usefully stored in the soil at any given time. Some portion of the soil column can be saturated, which would allow for more storage. However, complete saturation throughout the year would not be desirable.

To satisfy the needs of riparian vegetation in July (the month with the highest transpirative demand), a soil volume about 19 feet deep at field capacity would be required if no other water source (such as a saturated zone, groundwater, or continually delivered surface water) was available (Tables 5 and 6). Therefore, even if a water source flow is reduced to zero at the height of summer, the vegetation may survive on water stored in the soil that had been replenished during periods of higher flow. As demonstrated by the healthy vegetation currently supported by the existing flow regime, sufficient water is provided in the Project area even during periods of low flow and high ET, and even when the actual water delivery is below the demand (as occurs in June and July for the Group 5 areas). As discussed above, it is the Sanitation Districts' intent to modify the discharge schedule to more efficiently manage the volume and timing of treatment-plant-related surface flows throughout the year to support the existing riparian habitat.

Table 3. Water Demand and Water Delivery for San Gabriel River Groups 1, 2, 3, and 4

Month	**ET inches (CIMIS)**	**% of Annual demand**	**Rank (demand)**	**5-year Average MGD Delivered**	**5-year Average AF/d Delivered**	**Rank (volume delivered)**	**MGD Required**	**AF/d Required**	**Proportion Needed**
Jan	1.75	4%	10	12.8	39.41	3	0.46	1.43	3.63%
Feb	1.76	4%	11	16.0	49.09	1	0.46	1.44	2.93%
Mar	4.28	9%	7	9.8	30.21	6	1.13	3.5	11.59%
Apr	5.55	12%	3	10.1	31.10	5	1.46	4.53	14.56%
May	5.31	11%	4	5.3	16.25	11	1.40	4.34	26.71%
Jun	5.22	11%	5	7.8	23.98	8	1.37	4.26	17.77%
Jul	6.4	13%	1	7.1	21.79	9	1.69	5.23	24.00%
Aug	5.98	12%	2	8.2	25.23	7	1.57	4.88	19.34%
Sep	4.63	10%	6	6.6	20.14	10	1.22	3.78	18.77%
Oct	3.26	7%	8	13.5	41.29	2	0.86	2.66	6.44%
Nov	2.34	5%	9	11.5	35.41	4	0.62	1.91	5.39%
Dec	1.48	3%	12	5.0	15.24	12	0.39	1.21	7.94%
	Total			**Average**	**Average**		**Average**	**Average**	
Total	47.96	100%		9.48	29.09		1.05	3.26	13.26%

Note:
Data are from the Sanitation Districts. The 5-year average is for water years 2014–2018. The water year runs from October 1 of the previous year to September 30 of the labeled year.
AF/d = acre-feet per day; CIMIS = California Irrigation Management Information System; ET = evapotranspiration; MGD = million gallons per day

Table 4. Water Demand and Water Delivery for Group 5

Month	ET inches (CIMIS)	% of Annual Demand	Rank (Demand)	5-year Average MGD Delivered	5-year Average AF/d Delivered	Rank (volume delivered)	MGD Required	AF/d Required	Proportion Needed
Jan	1.75	4%	10	0.3	1.06	9	0.28	0.86	81.46%
Feb	1.76	4%	11	2.4	7.22	1	0.28	0.86	11.90%
Mar	4.28	9%	7	0.8	2.31	7	0.68	2.1	90.99%
Apr	5.55	12%	3	0	0.00	10	0.88	2.73	NA
May	5.31	11%	4	0	0.00	11	0.84	2.61	NA
Jun	5.22	11%	5	0.4	1.09	8	0.83	2.57	236.55%
Jul	6.4	13%	1	1.5	4.63	5	1.02	3.15	67.97%
Aug	5.98	12%	2	1.3	3.85	6	0.95	2.94	76.39%
Sept	4.63	10%	6	1.6	4.81	4	0.74	2.28	47.38%
Oct	3.26	7%	8	1	6.19	2	0.52	1.6	25.83%
Nov	2.34	5%	9	2	5.51	3	0.37	1.15	20.89%
Dec	1.48	3%	12	1.8	0.00	12	0.24	0.73	NA
	Total			**Average**	**Average**			**Average**	
Total	**47.96**	**100%**		1.09	3.06		0.63	1.96	63%

Note:
Data are from the Sanitation Districts. The 5-year average is for water years 2014–2018. The water year runs from October 1 of the previous year to September 30 of the labeled year.
AF/d = acre-feet per day; CIMIS = California Irrigation Management Information System; ET = evapotranspiration; MGD = million gallons per day; NA = not applicable

Table 5. Soil Water Holding Capacity and Peak Summer Demand for Groups 1, 2, 3, and 4

Soil Volume	Number	Units
Xeropsamment volumetric water content	0.25	proportion of volume
Depth saturation July	4.27	feet
Field capacity	0.175	proportion of volume
Depth field capacity July	24.40	feet
Water needs July (all vegetation/all areas)	121.67	AF
	3.925	AF/d
	1.28	MGD

Table 6. Soil Water Holding Capacity and Peak Summer Demand for Group 5

Soil Volume	Number	Units
Xeropsamment volumetric water content	0.25	proportion of volume
depth saturation July	1.90	feet
field capacity	0.175	proportion of volume
depth field capacity July	18.88	feet
water needs July (all veg. all areas)	97.52	AF/mo
	3.146	AF/day
	1.02	MGD

3.0 Significance Criteria and Thresholds

For this AMP, *significance criteria* are limited to habitat characteristics that represent riparian habitat. Of special concern is LBV, a species that was listed as a state endangered species by the California Fish and Game Commission in 1980, and as a federal endangered species in 1986.

Neither California Department of Fish and Wildlife (CDFW) nor United States Fish and Wildlife Service (USFWS) specifies criteria for designating habitat as “critical” to or “suitable for” survival and occupation of or by LBV. The Federal Register (1994) and expert biologists describe LBV as a migratory songbird that nests primarily in willows (*Salix* spp.), but also uses a variety of other shrub and tree species for nest placement (Gray and Greaves 1984, Salata 1987). LBV forages in riparian and adjoining upland habitats (Salata 1983, Kus and Miner 1987), with a large percentage of the foraging potentially occurring in the adjacent chaparral community. These habitat characteristics can be considered as Primary Constituent Elements (PCEs) for LBV, and are interpreted to consist of riparian vegetation, including riparian understory species. LBV does not use aquatic resources, nor do the species forage or nest in emergent aquatic vegetation.

In accordance with California Environmental Quality Act (CEQA) Guidelines (California Natural Resources Agency [CNRA] 2014), the following biological resource significance criteria apply to the Project:

a. Would the project:
   i. Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations, or by the CDFW or USFWS?
   ii. 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?

b. In accordance with the County of Los Angeles CEQA Threshold Guidelines (Los Angeles County Department of Regional Planning [LACDRP] 1987), the Project would have a significant impact on biological resources if it could:
   i. Substantially affect a rare or endangered species of animal or plant or the habitat of the species.

Wood Environment & Infrastructure Solutions, Inc. (Wood) biologists informally evaluated the WNCC and WND areas and concluded that these areas also could be affected by reduced discharges. Therefore, thresholds must be established to determine when the impacts of reduced discharges are sufficiently severe to merit adaptive management actions. This AMP focuses on direct evaluation of riparian vegetation for early detection of deteriorating conditions and recommends thresholds for management actions implemented to arrest or reverse any detected stress in vegetation alliances that define the riparian vegetation.

CDFW has recommended that the Sanitation Districts seek appropriate take authorization under the California Endangered Species Act (CESA) prior to implementing the Project. Appropriate authorization from CDFW may include an Incidental Take Permit (ITP) or a consistency determination in certain circumstances, among other options (Fish and Game Code Sections 2080.1, 2081, subds. (b),(c)). However, the AMP is designed to prevent any take, so no ITP is needed. Therefore, no advance mitigation measures are proposed. If impacts on riparian habitat, defined as alliances dominated by riparian trees, are detected through monitoring, adaptive management tools and/or other response measures will be discussed and implemented as needed.

4.0 Habitat Considerations to Guide Vegetation Monitoring

Habitat considerations for monitoring for this Project focus on the riparian habitat criteria known to be important for occupation by sensitive riparian birds, particularly LBV—the PCEs described above. These criteria are presented by Kus (2002) and are summarized as follows:

a. **Tree height for nests and surrounding vegetation.** LBVs place their nests in a variety of plants that provide concealment in the form of dense foliage. The most frequently used species include willows (*Salix* sp.), mulefat (*Baccharis salicifolia*), California wild rose (*Rosa californica*), poison oak (*Toxicodendron diversilobum*), mugwort (*Artemisia douglasiana*), and cottonwood (*Populus fremontii*). Nests are typically placed within 1 meter of the ground. Average host heights range from 2.0 to 8.5 meters. The canopy of suitable riparian habitat is mainly dominated by willows (black willow [*Salix goodingii*] and arroyo willow [*Salix lasiolepis*]). Cottonwood may also be present. Top canopy height averages 7 to 8 meters. Elderberry (*Sambucus mexicana*) can also be suitable habitat for LBV if it is close to other preferred species.

b. **Understory shrub/subshrub cover.** Early to mid-successional riparian habitat is typically used for nesting by the LBV because it supports the dense shrub cover required for nest concealment as well as a structurally diverse canopy for foraging. Vegetation characteristics of riparian stands between five to ten years old are most suitable for nesting LBV. Nests are normally found in areas with dense understory. Species of importance may include mugwort, mulefat, and willow shrubs (*Salix* spp.), although non-native species can provide suitable habitat if they provide sufficiently dense understory. In addition, LBV prefer to nest in areas with low herbaceous cover. Patch size may be a habitat criterion, but patch size is inherently limited by the configuration of the channels.

These vegetation descriptions are relevant to vegetation alliances that will be mapped and monitored in the AMP Groups. Mapping is described in Section 5.1.1. Alliances that are considered as suitable riparian habitat include black willow thicket, arroyo willow thicket, mulefat thicket, and sandbar willow thicket; elderberry thicket could qualify as habitat as well, depending on adjacent vegetation. Any or all of these alliances may contain cottonwood as well. Monitoring will focus on condition and structure of riparian trees, shrubs/subshrubs, and associated herbaceous understory habitat in the AMP area, because they are the criteria that affect habitat suitability for LBV (Kus 2002). Recruitment of these and other plant species important to riparian habitat health will also be monitored and documented.

5.0 Baseline Conditions

Baseline conditions will be assessed during the two summer seasons prior to Project start using existing information and the monitoring strategies described in Section 6.0. A vegetation map will be prepared using a current year aerial photograph, with vegetation mapped to the level of the alliance (Sawyer et al. [2009] Manual of California Vegetation Version 2 [MCV2]). July through September is the optimal period for baseline monitoring to detect vegetation stress (Williams and Cooper 2005). Data from the two summer seasons prior to implementation of the Project, supplemented by a partial data set from a single spring season, will describe baseline conditions. All data collected during baseline assessments will be averaged to determine pre-Project conditions. The AMP assumes, based on available data, that deep groundwater is not available to the plants in the subject habitat, so groundwater monitoring well data are not directly important to the AMP. Furthermore, because the AMP uses multiple types of data to characterize the habitat, including mapping of the vegetation, direct measurements of the plants' ability to obtain water (SWP), and numerical evaluations of habitat characteristics, including species richness, canopy structure (including understory), and recruitment, a pre-Project baseline data set of at least two years will provide sufficient information for evaluating existing habitat conditions.

5.1 Habitat Conditions

5.1.1 Vegetation Map

To comply with the standard specifications of the typical map units used in MCV2, the baseline vegetation in the areas potentially impacted has been mapped on an aerial photograph obtained from the year prior to Project initiation, using MCV2 alliance vegetation types (Figure 8). The alliance level is the appropriate mapping level for describing riparian habitat, because it is based on the following guidance from the MCV2: “diagnostic species, including some from the primary layer, which has moderately similar composition that reflects regional to subregional climate, substrate, hydrology, moisture/nutrient factors, and disturbance regimes.” Classification and mapping at any lower level do not provide any additional information that relates to riparian habitat. No minimum mapping unit is proposed, which is a conservative application of the guidance for fine-scale vegetation mapping of rare vegetation, including riparian vegetation, as described by California Native Plant Society (CNPS, 2011). The map shows grayed-out areas that are not listed as a vegetation community, such as barren or disturbed areas; these areas will not be included in a numerical analysis for the vegetation mapping. Selected map colors are dynamic and clearly show the differences in vegetation mapping polygons. The baseline map allows for numerical summing of the total acreage of each vegetation alliance mapped. In subsequent mapping efforts, any changes in the quantity of any vegetation alliance present in the Project area will be readily detected.

5.1.2 Definition of Vegetation Groups

For comparative analyses, the vegetation within the AMP area has been grouped in subareas that exhibit similar physical conditions and that are expected to experience similar surface flow conditions under the proposed Project. These subareas are identified as Groups 1, 2, 3, 4, and 5 (Figures 2 through 7). The vegetation in each Group is listed in Table 7.

As the Groups only include vegetation in SJC that could be affected by changes in discharges from SJC002 and does not include vegetation farther upstream in SJC, the acreages of habitat shown in Table 7 differ from the acres of total vegetation shown in other related documents.

Table 7. Acres of Each Mapped Vegetation Alliance, by Habitat Group

Vegetation	Group 1	Group 2	Group 3	Group 4	Group 5	Grand Total
Annual brome grassland	11.50	1.23	10.47			23.20
Arroyo willow thickets	0.55	0.34			0.59	1.48
Arroyo willow thickets - Disturbed	2.27					2.27
Barren		0.60	0.34	2.09	7.83	10.86
Basket bush patches			0.11		4.03	4.14
Black cottonwood forest					0.76	0.76
Black willow thickets	12.12	7.90	9.41	19.27	17.97	66.67
Blue elderberry stands			7.15	1.61	32.29	41.05
Box-elder forest			0.10			0.10
California buckwheat scrub			0.06			0.06
California coffee berry scrub					0.21	0.21
California sycamore woodlands			0.14		0.22	0.36
California walnut groves			0.20	0.05	1.38	1.64
California yerba santa scrub					0.11	0.11
Cattail marshes	1.07	0.67		0.09		1.84
Coast prickly pear scrub			0.25			0.25
Developed	12.34	4.06	6.88	4.60	4.49	32.36
Eucalyptus semi-natural stands	1.38	0.61	0.14	0.67	0.36	3.15
Giant reed breaks	0.03	0.04	2.42	1.19	8.96	12.64
Mulefat thickets	0.02	0.39	1.27	0.43	4.72	6.82
Mulefat thickets - Disturbed	3.92	6.78			1.03	11.74
Non-native woodland		0.06	0.81	8.84	5.80	15.51
Open Water	15.58	0.02				15.60
Perennial pepper weed patches				2.34		2.34
Poison hemlock patches			0.84			0.84
Poison oak scrub			0.22			0.22
Sandbar willow thickets	0.90			0.11		1.01
Sandbar willow thickets - Disturbed	3.21					3.21
Scalebroom scrub			0.03			0.03
Smartweed - cocklebur patches	0.49	0.71	5.36	4.38		10.94
Sugarbush chaparral					0.08	0.08
Unvegetated streambed	1.24	10.07	19.28	3.46	13.61	47.66
Upland mustards			8.17	23.01	39.04	70.21
White alder groves				0.12		0.12
Wild grape shrubland			0.02	0.01		0.03
Grand Total	**66.64**	**33.48**	**73.66**	**72.26**	**143.48**	**389.52**

Note:
Highlights are for habitats important for this AMP as potential habitat for LBV.

5.2 Numerical Statement of Baseline Conditions

Baseline conditions that focus on the PCEs will be measured using the following metrics:

a. Vegetation mapping to alliance level, with quantitative summaries of each alliance type present in each Group area.
b. Direct assessment of stem water potential (SWP) in the species that form the upper habitat canopy level
c. Numerical evaluation of canopy condition interpreted as canopy volume (CV) of the tree sampled for SWP
d. Numerical representation of habitat structure, including the understory
e. Numerical summary of recruitment expressed as juvenile tree and shrub/subshrub species
f. Plant species richness

This monitoring program includes proposed methods for evaluating the aerial extent (in acres) of the habitat, species composition, species richness, and structural diversity, as well as SWP and CV. The monitoring strategies described in Section 6.0 will be implemented for baseline evaluation for these metrics and for ongoing monitoring.

6.0 Monitoring Strategies

6.1 Rationale for the Methods Selected

The monitoring described in this AMP will focus on the PCEs or vegetation characteristics that support suitable habitat for riparian birds, specifically LBV. Hendricks and Rieger (1989) learned that nest plots of LBV vary widely in vegetation structure. They concluded that this high variability, and the similarity between areas occupied and not occupied by LBV, indicates that the LBV is a generalist nester with respect to species frequency, cover, and plant density. The monitoring methods selected for this Project allow evaluation of the condition of the plant species and associated vegetation that define suitable habitat. It is not necessary to survey or document the characteristics of the water channel itself, because LBV does not occupy or forage in open water.

The monitoring will allow (1) direct assessment of the condition of the tree species that provide upper-canopy habitat for LBV as it relates to water availability for these species using SWP; (2) numerical evaluation of the visible condition of the important habitat plant species using canopy condition assessment (CV); (3) quantifiable descriptions of habitat structure, including detailed data on understory; and (4) evaluation of sustainability by numerical reporting of recruitment and species richness in the monitored habitats. All methods have been used widely to detect moisture stress in woody plants of all types (Snyder et al. 1998) and to evaluate the condition of riparian vegetation (Scott et al. 1999, Michaels 2006, Kus 1998).

6.2 Stem Water Potential

Measuring SWP is a well-established method for determining how well a plant species acquires water from the soil. Water within a plant mainly moves through xylem cells to carry water from the roots to the leaves. The water in the xylem is under tension. As the soil dries or humidity, wind, or heat load increases, it becomes increasingly difficult for the roots to keep pace with evaporation from the leaves. This condition causes the tension to increase. The higher the stress, the higher the water deficit the plant experiences. This deficit is called the “water potential” of the plant. SWP is a reading of conditions within the xylem of the plant, and the SWPs at different canopy heights are significantly correlated, so a single measurement at an accessible point in the canopy is indicative of the water stress for that plant (Deb et al. 2012). The relationship of soil dryness to SWP is straightforward—as the soil becomes dryer, SWP becomes more negative. Peer-reviewed research in field systems under different systems of irrigation has shown high correlation between transpiration and SWP (Naor 1998).

Scholander et al. (1965) used a pressure chamber to measure water potential (effective soil dryness) of tissues throughout the root system of a plant. This method consists of placing a leaf attached to a stem inside a sealed chamber and slowly adding pressurized gas to the chamber. As the pressure increases, at some point sap is forced out of the xylem and is visible at the cut end of the stem. The pressure required to produce this sap is equal to and opposite of the water potential of the leaf and stem. Because tension is measured directly, negative values are typically reported.

This measurement is quantifiable and repeatable. Pressure chambers are very durable and mechanically simple. Measurements taken from individual trees and shrubs at a variety of locations in the five Groups will indicate the water stress in the plants and any issues related to soil drying that can be correlated with direct soil moisture measurements taken at the same time. Water potential measurements have been taken for cottonwood/willow habitats in the American southwest, and they provide an indication of the healthy water potential for the species, as well as for conditions of stress (Snyder et al. 1998, Williams and Cooper 2005). Detection of SWP stress during the annual sampling period will serve as an advance warning of stress for the entire area, and the warning will be provided in sufficient time for adaptive management to reverse the stress before the mortality of the vegetation is threatened (Lines 1999). Because the vegetation in these areas has experienced a variable schedule of water delivery under existing conditions, and presumably a concomitant variability in water table and soil moisture, the trees have developed root growth in areas other than those accessing the deep water table. This adaptation has conferred a resiliency in response to changes in water flow in a riparian area (Williams and Cooper 2005).

SWP monitoring will be conducted once per year, during the August/September period, as described above for the baseline monitoring. This schedule will allow for early detection of Project impacts that may be visible when trees and shrubs are experiencing the highest evapotranspiration rates in the summer season. Monitoring will be conducted at mid-day in the three-hour time period between noon and 3:00 PM to ensure comparability of measurements (McCutcheon and Schakel 1992, Naor 1988).

The individual trees selected for monitoring are in areas where the biologist determines, and CDFW concurs, that riparian habitat value is high. Such areas were selected only in the vegetation alliances described as suitable riparian habitat. At this time a total of 67 sites have been selected, with 26 in Group 1, 4 in Group 2, 6 in Group 3, 13 in Group 4, and 18 in Group 5 (Figure 9). The number of trees per Group varies widely because the number of available individuals is highly variable among these Groups. The number and location of trees can and will be adjusted as necessary as an adaptive management strategy. For long-term monitoring, at each site, at least one willow tree (of the dominant overstory species), or any small tree such as mulefat that forms an important portion of the canopy at that site, was selected, for a total of 67 trees. Each tree has a Global Positioning System (GPS) coordinate, and is visibly tagged or flagged so that the same individual can be sampled during each monitoring event.

For each tree selected, leaves chosen for SWP determinations should be fully expanded, mature leaves from an interior and shaded portion of the lower canopy to eliminate any temporary heating effects of direct sunlight. The targeted leaves are covered with foil-laminated plastic bags and allowed to remain on the plant for at least 30 minutes. The leaf is then cut from the stem to avoid any further transpiration, and, within 5 to 10 seconds, placed with its bag inside the pressure chamber. The pressure chamber and instructions for its use are provided in Appendix A.

6.3 Canopy Condition

In addition, the visible condition of the plants being monitored for water potential will be evaluated. This method uses estimates of CV, and has been implemented elsewhere to assess the condition of riparian vegetation (Scott et al. 1999). The data are collected by visual observation, using a scale such as those developed by Michaels (2006) and Cooper and Merritt (2012). Following a widely used method (Michaels 2006, Scott et al. 1999, Cooper and Merritt 2012), classes are assigned to riparian vegetation to provide a score for canopy condition. This method has the advantage of reliably predicting the probability of mortality. Scott et al. (1999) found that a 30 percent decline in canopy volume was associated with a 50 percent probability of mortality.

Canopy condition will be evaluated using the strategies implemented by Michaels (2006) and Cooper and Merritt (2012). Each tree monitored for SWP will also be monitored for CV. The visual guides developed in both studies will be used; they are shown in Figures 10 a and 10b. Scott and Merritt (2012) advise that, to obtain the percentage of maximum canopy, the observer should visualize a full canopy and then estimate the percentage of that maximum area that is occupied by canopy (to the nearest 5 percent; Michaels 2006). Michaels directs the assessor to visualize a circle around the outer boundary of the canopy crown (the uppermost part of the tree bearing branches). This circle is the total crown area. If all the branches were bearing foliage, the canopy health would be 100 percent. The proportion of dead crown to total crown area is estimated. The remainder is the proportion of healthy crown cover for this tree, expressed as a percentage (Michaels 2006). Absent or fallen branches do not necessarily correspond to reduced tree health and as such are not accounted for as part of the tree health component. In addition, sub-canopy foliage and branches (lower limbs that do not form part of the canopy) are not included in the assessment.

For this aspect of monitoring, the evaluations of two biologists in the field will be averaged. If only a single biologist is present, the biologist will take a photograph of the canopy area being scored to allow CDFW to render a second opinion as to the score. Together with the data from the SWP determinations, CV provides a good early warning of vegetation stress.

6.4 Habitat Structure

Habitat structure is to be assessed on transects in areas with vegetation alliances that characterize riparian habitat. A total of 21 such areas have been selected, with 7 areas selected in Group 1, 3 in Group 2, 2 in Group 3, 5 in Group 4, and 4 in Group 5 (Figure 11). Transect areas have been selected in the Groups at general locations that are evaluated for SWP and CV. These transects will form the basis for the evaluation of a series of “stacked cubes,” a method for evaluating habitat structure by vegetation strata (Kus 1998). A total of 21 transects, each a minimum of 40 meters long, will be established in the riparian vegetation of the Project area. Transects will be sampled for habitat structure every 20 meters, starting at the 0 point of the transect. An estimate of the canopy volume in each 1-meter height increment of a quadrat measuring 2 meters by 2 meters is recorded, up to a height of 5 meters, with an additional estimate of canopy volume greater than 5 meters in height. These estimates provide a quantitative evaluation of canopy structure, including understory, that can be compared with a data envelope that has been determined to represent acceptable habitat for LBV and that represents canopy complexity that would be sampled by other riparian birds.

6.5 Recruitment and Species Richness

Recruitment of individuals of suitable tree and shrub/subshrub species into a habitat area is an indication of habitat sustainability, as is species richness. These metrics will be collected during the baseline year and in alternate monitoring years thereafter. Recruitment will be evaluated by using the transects established for the habitat structure measurements. Each transect will consist of a belt 2 meters wide extending from the uppermost extent of the riparian canopy to the edge of the active channel of the riparian corridor. The entire length of each transect will be scored with a tally of tree saplings (all willow species, plus mulefat) less than 2 meters tall encountered on this belt transect. These individuals would be scored as T1, T2, or T3 for height (T 1 =< ½ meter, T2=1/2–1 meter, T3 = 1–2 meters), in a Combined Vegetation Rapid Assessment and Relevé sampling effort (CDFW/CNPS, 2019). The belt transect will be recorded as a tracklog in GPS by the first observer; and the same track will be revisited in subsequent monitoring years. In addition, a tally will be made of the most prevalent plant species that occur in all quadrats and in each transect belt to document relevant local species richness. This list will include species that have been identified in the canopy structure protocol, and any others that appear frequently and that are obvious to a trained botanical observer along the length of the transect. Annual species that do not occur frequently will not be listed.

6.6 Vegetation Mapping

The vegetation map at the level of alliance for the AMP area will be updated annually, using the most recent aerial photograph available that was taken during summer months. Mapping will be used to produce a table of the total area of each habitat type for each year of mapping. As noted by Rompre et al. (2010), for bird species, the threshold of significance of decline may generally be between 30 percent and 40 percent of the habitat still remaining, compared with the proportion observed under a natural disturbance regime. For this Project, the goal is no significant change in total area of suitable habitat alliances or in individual alliances of importance to riparian birds.

7.0 Triggers for Adaptive Management

A table of objectives (Table 8) has been prepared to guide evaluation of habitat conditions and to suggest triggers for implementing adaptive management. The overall objective is to more efficiently manage effluent to maintain the quantity and quality of riparian habitat in areas currently influenced by treatment plant discharge. The Habitat Management Committee (HMC) is a critical part of the AMP, and this committee will meet regularly to interpret the data collected during monitoring. The HMC will evaluate to data to determine whether there have been any impacts on habitat conditions caused by the Project, and will also determine the adaptive management actions that should be taken in response to any such impacts. The HMC will include staff from the Sanitation Districts, representatives from USFWS and CDFW, Los Angeles County Department of Public Works, Southern California Coastal Water Research Project, and water management and supply agencies. Invitations will be extended to the United States Army Corps of Engineers and environmental and other non-governmental organizations (such as Water Keepers).

7.1 SWP and CV

The baseline measurements will be taken from existing riparian vegetation before the Project begins. The first monitoring events will be conducted in the two summers before Project start to provide baseline data. The number of samples specified in Section 6.0 has been established as sufficient, based on the first year of baseline monitoring (Wood 2019). Proposed triggers for adaptive management are described below. It is acknowledged that the triggers may be revised during ongoing discussions of the HMC. A mean and standard deviation for each species sampled for SWP and CV will be calculated for the entire Project area, as well as for each AMP Group. The variation exhibited for each metric will be evaluated by a biostatistician to help determine the importance of any changes in tree conditions during the ongoing monitoring. The expected range of SWP measurements for willows that are not stressed is -5.0 to -7.1 bar, based on measurements in April 2019, in a cool and wet environment that followed a season of high rainfall (Wood 2018). The baseline data for willows for late summer was measured at between means of -9.2 and -10.1 bar (Wood 2019), making it possible to determine an acceptable range. The expected range for baseline CV is between 75 to 100 percent.

Table 8. Objectives Matrix for San Gabriel River Flow Management

Objective	Parameter (What?)	Methods (How?)	Location (Where?)	Monitoring (When?)	Basis of Comparison	Trigger
More efficiently manage effluent	Water Stress	Modify existing random effluent flow to an intentional discharge cycle of reduced flow	SJC002 and SJC003	Continuous logging	5-WY average baseline flow	NA
		Stem water potential	67 Selected Trees	Spring (single baseline) and fall (ongoing)	Pre-Project conditions per AMP Grouping	Significant Δ within group or species
Maintain quantity and quality of riparian habitat in areas Influenced by treatment plant discharge	Alliance – Acreage	Vegetation mapping	Aerial Photographs and Ground Truthing	Fall	Pre-Project conditions per overall Project area	+/- 10% Δ in any mapped alliance except the key alliances listed below
	Arroyo Willow					+/- 5% Δ
	Black Willow					+/- 5% Δ
	Structure – Canopy Cover	Transects with quadrats of "stacked cubes" every 20 meters (Kus 1998)	21 Transects (see map)	Fall	Pre-Project conditions per AMP Grouping	Mean for any stratum if Group falls outside baseline range
	Structure – Understory	Transects with quadrats of "stacked cubes" every 20 meters (Kus 1998)	21 Transects (see map)	Fall	Pre-Project conditions per AMP Grouping	Mean for any stratum if Group falls outside baseline range
	Species Richness	2-meter-wide belt transects	21 Transects (see map)	Fall	Pre-Project conditions per AMP Grouping	20% Δ
	Recruitment	2-meter-wide belt transects	21 Transects (see map)	Fall	Pre-Project conditions per AMP Grouping	20% Δ

Δ = delta; AMP = Adaptive Management Plan; WY = water year

The triggers for adaptive management are set as follows:

Significant downward difference between the late summer baseline means and annual measured late summer means for SWP or for CV for willows or for mulefat. Sufficient samples are not available for blue elderberry or sycamore to specify a trigger range for these species at this time. Significance is defined at the 90 percent confidence level (Wood 2019).

After Project implementation, if the data for any SWP or CV show a statistically significant decline for any species or any Group from the baseline data for that Group or species (based on a standard paired sample t-test of means for either of these monitored metrics), the significant decline will trigger an increase of discharge flow to baseline level until the HMC meets and provides direction.

Vegetation mapping will be to the level of alliance. Targeted riparian alliances are willow thickets (black, arroyo, and sandbar, including disturbed), and mulefat thickets (including disturbed). For the evaluation, a decrease in acreage for any of these identified alliances from the baseline conditions described in Table 7, would trigger an adaptive management response of returning flow to baseline level until the HMC meets. Although it is difficult to judge future significant decline of habitats, and this judgment inevitably relies heavily on expert opinion (OSPAR Commission 2003), a conservative level has been established for each evaluated alliance. This level can represent a reasonable trigger for either the return of flow to baseline level and/or HMC discussions (Table 8).

The goal for habitat is that the area generally remains undiminished. A detectable change of 10 percent in total habitat area mapped as alliances during an annual mapping exercise will trigger an appropriate response based on the alliance. If it is agreed that habitat changes are not detectable on an annual basis, or if suitable aerial photographs are not available, the frequency of mapping may be modified.

7.2 Habitat Structure (Canopy and Understory Strata)

The ranges of volume have been established for each of the strata sampled using the "stacked cube" method that is acceptable as habitat for LBV (Table 9, Kus 1998) and data collected for this Project will be compared with those ranges. Triggers, however, will be determined relative to the baseline data, not to the optimum canopy level conditions in Table 9. New tables of baseline conditions will be prepared, one for each AMP Group, including standard deviations for each stratum. Each AMP Group's monitoring data will be compared with the baseline values in these tables.

Table 9. Parameters for Optimal Canopy Strata Volume

	Canopy Height (meters)					
	0–1	**1–2**	**2–3**	**3–4**	**4–5**	**5+**
Average. % cover	39.8	33.4	26.6	21.1	17.6	NA
Standard deviation	6.6	7.4	5.9	5.9	5.6	NA
Range of optimal % cover at each height (+/- 1 standard deviation)						
High	46.4	40.8	32.5	27.0	23.2	NA
Low	33.2	26.0	20.7	15.2	12.0	NA

A trigger for adaptive management would be a decline of 1 standard deviation (SD) or more from the baseline mean in canopy volume measured as “stacked cubes” for increments 0–1 meter, 1-2 meters, or 2–3 meters in sampled quadrats reported as a mean for each stratum in each AMP Group (Figure 11). That is, all quadrats sampled in each Group would be combined to attain a single canopy volume mean and associated SD within each sampled stratum for that AMP Group. If the annually sampled mean of one of the strata is more than 1 SD higher or lower than the baseline mean for that stratum within that Group (falling outside the baseline range for that stratum in that Group), adaptive management discussions by the HMC would be triggered. The objective is to maintain vegetation in baseline state, or to improve it. Neither overly dense nor overly sparse vegetation is considered to characterize suitable habitat. If the deviation from the baseline range moves the stratum closer to the range for that stratum shown in Table 9 however, the change would be judged to be positive. For this analysis, there is no specified optimal range for canopy volume higher than 5 meters. The annual growth of a tree alone could be sufficient reason for the volume of canopy in the >5-meter stratum to increase.

7.3 Recruitment and Species Richness

Because recruitment is usually an episodic event in riparian systems (Stevens et al. 2005), recruitment and species richness will be evaluated every two years rather than annually. However, data for recruitment and species richness will be collected annually. If recruitment, defined as the presence of saplings in Section 6.5, declines by 10 percent from the baseline in any Group, discussions by the HMC occur. If species richness, sampled as described in Section 6.5, declines by over 10 percent from the baseline in any AMP Group, HMC discussions would occur.

There is no expected range for either recruitment or species richness.

7.4 Overall Trigger Points

The HMC will meet annually between the third week of October and the third week of November each monitoring year to review the monitoring data. If the data review indicates water stress in the vegetation, as measured using any of the methods described in Section 6.0, the HMC can recommend an adaptive management strategy and implement responsive measures. Trigger points for any individual parameter in any individual vegetation alliance or AMP Group alone, however, may not be cause for implementing the adaptive management actions of increasing water delivery. The trigger points summarized in Table 8 guide adaptive management considerations.

8.0 Evaluating the Nature of the Changes in Habitat

If increased water stress is detected from any of the parameters measured in Section 6.0 and if that stress meets the criteria for triggering a response, discharge flow up to baseline will be restored until the HMC can review the data and assess the potential cause of the stress. If the stress is attributed to the Project and/or can be addressed by adapting the discharge scheme, that adaptive strategy will be implemented. Significant data findings will be discussed by the HMC. It is reasonable to assume that only stresses that can be attributed to the Project, and that would be arrested by applying available adaptive management strategies, would be considered as triggers for such adaptive management actions. Habitat declines, as measured by vegetation mapping, SWP, CV, habitat structure, recruitment, or species richness, could be caused by a decline in water supply from WRPs, but also by regional drought or other factors such as human activity. Because it may be impossible to determine the cause of the decline with confidence, adaptive management discussions are the appropriate response.

Data that can be used during these discussions to determine the cause of habitat decline include rainfall records, which are measured by Los Angeles County Public Works at a weather station in Irwindale, California. A rolling 10-year average for monthly precipitation could be calculated, and that average compared with the current season monthly precipitation to help determine whether the vegetation decline is more likely attributable to drought or to a decrease in water releases. There are no published studies of the influence of precipitation or of other water-related phenomena or management actions on vegetation in this watershed, so the observed decline will need to be addressed in HMC discussions rather than by application of a numerical trigger.

The HMC will hold a scheduled annual meeting, however, if preliminary data review indicates water stress in the vegetation comprising the identified PCEs, a meeting will be scheduled immediately. The Sanitation Districts will increase water deliveries to pre-Project discharge levels. The duration of such delivery increases will be determined by the HMC once it meets. Discussions will be conducted in good faith by all parties, with the goal of protecting habitat reasonably observed to have been affected by Project activities. Adaptive management actions decided upon by the HMC will be implemented as soon as is feasible.

9.0 Tools for Adaptive Management

Adaptive management strategies that can be used by the Sanitation Districts to protect riparian habitat along the designated portions of the SJC and SGR are primarily related to water management. Under the conditions that this Project would implement, the Sanitation Districts would not be responsible for habitat losses from human disturbance, fire, earthquakes, or any “acts of God” or “natural disasters” not related to control of the flow of treated recycled water. Because the Project will reduce the discharge of water into the habitat from the baseline flows , restoring baseline flow as necessary is the only adaptive management strategy that is readily available and appropriate for addressing impacts from this Project.

Only four discharge points would potentially affect water flow in the AMP Groups of concern. The first is the Pomona WRP (PomWRP), which is upstream of Group 1 in the SJC. The next is SJC002, which is upstream of Group 1. The third is SJC003, which is upstream of Group 3. The fourth is WN001, which is upstream of the Group 4 area. These WRP discharge locations are shown in Figure 12. Releases from PomWRP and SJC002 would potentially augment flow in Groups 1, 2, 3, 4, and 5, while releases from SJC003 would affect only Groups 2, 3, 4, and 5. Depending on the AMP Group(s) that had been determined to be in decline, releases could be made from the appropriate WRP discharge location. Therefore, if the condition of vegetation significantly declines, as measured by vegetation mapping, SWP, CV, habitat structure, recruitment, and/or species richness, the adaptive management strategy under discussion would be to increase flows to an agreed-upon flow regime. The Sanitation Districts can release water from the appropriate WRP discharge location up to the amount that would have been released historically at that time of year.

Some potential stresses may not be corrected by adaptive management actions in the form of increased water releases. For example, a flood event that scours the banks and removes trees or shrubs would not be a stress attributable to the Project, and should not be reversed by adaptive management. Similarly, impacts on vegetation from disturbance by vehicles, human impacts such as trail development, temporary human occupation, fire, or herbicide application would not be stresses attributable to the Project, and should not be reversed by adaptive management. Finally, the polyphagous shot-hole borer (PSHB) may eventually stress vegetation; it has been affecting willows and cottonwoods throughout southern California and occurs upstream and downstream of this site (University of California Agricultural and Natural Resources [UCANR] 2017).

10.0 Rationale for Anticipating Success

The relationship between the water demands of the vegetation in the AMP area and potential patterns of water release from the SJCWRP were described in Section 2.0. This discussion shows that the water volume that has been sufficient to grow and sustain riparian habitat is, in most cases, not delivered or supplied in a manner that specifically supports riparian vegetation. In spite of this condition, the reduced supply during the months of peak demand that is the current delivery pattern continues to support the vegetation, as the soil water-holding capacity buffers the vegetation from experiencing drought stress. This pattern is well known in the American southwest, where riparian vegetation is often found where surface water disappears during the summer months (Levick et al. 2008). From what is known about the depth to groundwater in the AMP area, it can reasonably be assumed that the depth to water varies over the course of the year, but remains mostly below the root zones for riparian plant species. This condition pre-adapts the vegetation to develop resilience during periods when the water table is low (Williams and Cooper 2005).

It is the intention of the Sanitation Districts, however, to supply water in a manner that benefits riparian vegetation, even if the total amount of water delivered from the SJCWRP over a year is reduced. The proposed pattern of delivery will initially be scenario OS 1c or OS 2c, as shown in Table 10 (ESA 2019), to provide a discharge pattern that is more consistent than that of historical operations, thus actually reducing the time during which vegetation is not provided with any treatment plant recycled water in the identified Hydrological Assessment Areas (HAAs) (Table 11 and Figure 13, ESA 2019) that were delineated from a hydrological analysis conducted by ESA (2019). These patterns of water release are anticipated to provide overall benefits to riparian vegetation in all portions of the Project area by providing water that extends into portions of the Project area that have no other source of surface water during certain times of the year, thereby minimizing the dry periods over the course of a year.

Quantifying water stress using the measurements of SWP, CV, and habitat structure measured as canopy volume in both upper-canopy and understory vegetation strata and monitoring species richness and recruitment allow for early detection of conditions that could ultimately, but not immediately, prove lethal to the critical vegetation (Rood et al. 2003). Riparian tree species will often abort individual branches during times of water stress, allowing the tree as a whole to survive and recover (Scott et al. 1999). Woody plants do have a point of permanent wilting, experienced as cavitation of the xylem. Such cavitation causes the death of a stem (Rood et al. 2003).

No single value identifies the SWP that would induce cavitation, so for this Project, changes from baseline measurements will be monitored closely. In addition there is no firm percentage of canopy volume that reliably indicates significant stress on the vegetation. The metrics of habitat structure, recruitment, and species richness also provide information to assess changes in habitat condition, although there are also no known quantitative values for these metrics that allow for the defensible conclusion that the Project itself is occasioning the stress. With the information from monitoring, together with an evaluation of the current status of water supply, a fully informed and rational decision can be made during HMC discussions to determine the appropriate course of action regarding adaptive management strategies to address the observed stresses. Even preliminary indications that water stress is occurring will trigger immediate water release responses and HMC discussions so that adaptive management in the form of increased flows can be implemented before the stress is irreversible.

11.0 Additional Adaptive Management Strategies

Other adaptive management strategies could be explored but are not included as they would require permitting and approvals by other agencies such as the USACE. Control of nest parasitism by cowbirds (*Molothrus ater*) through trapping can be implemented on Sanitation District owned property adjacent to the SGR, which is limited to the AMP Group 1 area. However trapping on USACE, Los Angeles County or private property would require approvals the Sanitation Districts cannot guarantee. This is also true of efforts for removal of invasive plant species such as giant reed (*Arundo donax*) or other species that are of limited value to LBV.

Table 10. Operational Scenarios for Releasing Water from San Jose Creek WRP Under Project Conditions

		Week 1							Week 2							
Operational Scenario	**Description**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Average Release MGD**
Existing conditions	9.5 MGD long-term average, variable day to day	variable – 9.5 MGD average							variable – 9.5 MGD average							9.5
OS 1a	5 MGD every day from SJC002	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5.0
OS 1b	9 MGD 4 days per week from SJC002	0	0	0	9	9	9	9	9	9	9	9	0	0	0	5.1
OS 1c	15 MGD 2.5 days per week from SJC002	0	0	0	0	0	14	14	14	14	14	0	0	0	0	5.0
OS 2a	5 MGD every day alternating between SJC002 and SJC003	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5.0
OS 2b	9 MGD 4 days per week alternating between SJC002 and SJC003	0	0	0	9	9	9	9	9	9	9	9	0	0	0	5.1
OS 2c	15 MGD 2.5 days per week alternating between SJC002 and SJC003	0	0	0	0	0	14	14	14	14	14	0	0	0	0	5.0

🟦 Water released from SJC002
🟩 Water released from SJC003

Table 11. Duration of Dry Periods (Periods without Channel Wetting) Under Existing and Project Conditions

Duration of Longest Dry Period in Dry Season (average of 5 years) – Days											
Operational Scenario	**HAA1**	**HAA2**	**HAA3**	**HAA4**	**HAA5**	**HAA6**	**HAA7**	**HAA8**	**HAA9**	**HAA10**	**Mean**
Existing Conditions	4	13	25	35	49	58	64	65	35	37	39
OS1a	0	3	21	61	97	109	118	120	66	66	66
OS1b	1	6	8	20	59	105	112	112	66	66	56
OC1c	2	8	9	10	15	33	50	81	65	65	34
OS2a	2	3	6	73	109	122	129	132	66	66	71
OS2b	3	6	7	9	86	105	112	112	66	66	57
OS2c	4	9	9	10	11	12	70	88	65	65	34

>21	Longer than recommended watering interval for establishing plants
14–21	Within range of recommended watering interval
<14	More frequent than recommended watering interval

12.0 Other Monitoring, Mapping, and Reporting

Although habitat monitoring and mapping should be conducted annually, as described in Section 6.0, other monitoring efforts and frequencies may be considered by the HMC.

12.1 Monitoring for Presence of LBV

Although there are reasons that LBV may be absent from the AMP area in any given year that are unrelated to habitat condition, the presence of the species is an indication of good quality habitat. The United States Army Corps of Engineers performs annual LBV protocol surveys on portions of the SJC and within the SGR downstream of SJWRP to the WND, and the results of these surveys are reported to the USFWS. The presence of LBV is not intended to be used as a trigger to indicate that adaptive management is not required (regardless of the other monitoring results).

12.2 Control of Cowbird (*Molothrus ater*) in the Project Area Using Trapping

Trapping will be conducted on Sanitation Districts property in the AMP area for the first three years to reduce the level of LBV nest parasitism. Trapping may be continued or reinstated if the HMC determines that it is necessary to offset Project impacts.

12.3 Monitoring Following a "Natural Disaster"

In the event of a natural disaster that dramatically affected the condition or extent of habitat suitable for LBV, the monitoring would continue as specified, with a new post-disaster "baseline" condition from which recovery of the habitat would be anticipated. If the "natural disaster" affected the ability to identify the minimum 12 monitoring areas and 24 individual trees and shrubs/subshrubs, then new areas and individuals would be selected, and sampling for SWP would be continued.

12.4 Impact of Natural Conditions Such as Global Warming, Drought Conditions, or Variable Snow Melt

These conditions are beyond the control of the Sanitation Districts and cannot be subject to adaptive management strategies. Climate and weather data may be recorded and tabularized at the discretion of the Sanitation Districts. Precipitation data will be evaluated annually, with a rolling 10-year average, as described in Section 8.0.

12.5 Reporting

Monitoring will occur during the height of the growing season (August/September, as described in Section 6.0). A draft report with numerical findings and conclusions will be available within six weeks after the end of the monitoring period; by the end of October at the latest. Drafts will be made available to the resource agencies for review. The HMC will meet between the third week of October and the third week of November to determine whether the results trigger adaptive management actions. Final reports will be completed within four weeks after the conclusion of agency review.

Furthermore, other data will be provided on an annual basis to compare conditions in the Project area. These data sets include the following:

a. Flow data measured routinely at this time, as required under the conditions of the National Pollutant Discharge System (NPDS) permit, at existing weirs or monitoring points above, within, and below the segments monitored for the Project
b. Water quality data collected by the Sanitation Districts, including temperature, dissolved oxygen, and pH sampled from upstream water and downstream water at the segment outflow
c. Groundwater well depths from monitoring wells within the area
d. Existing maps that show where LBV has been detected in previous years

These data sets will be presented without summary or discussion, and can serve as a resource for evaluating factors that could contribute to habitat condition.

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1 inch = 5 miles

0 2.5 5 Miles

wood.

▭ Project Area

FIGURE 1

Regional Location
San Gabriel River AMP
Los Angeles County, California

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FIGURE 2

Project Overview
San Gabriel River AMP
Los Angeles County, California

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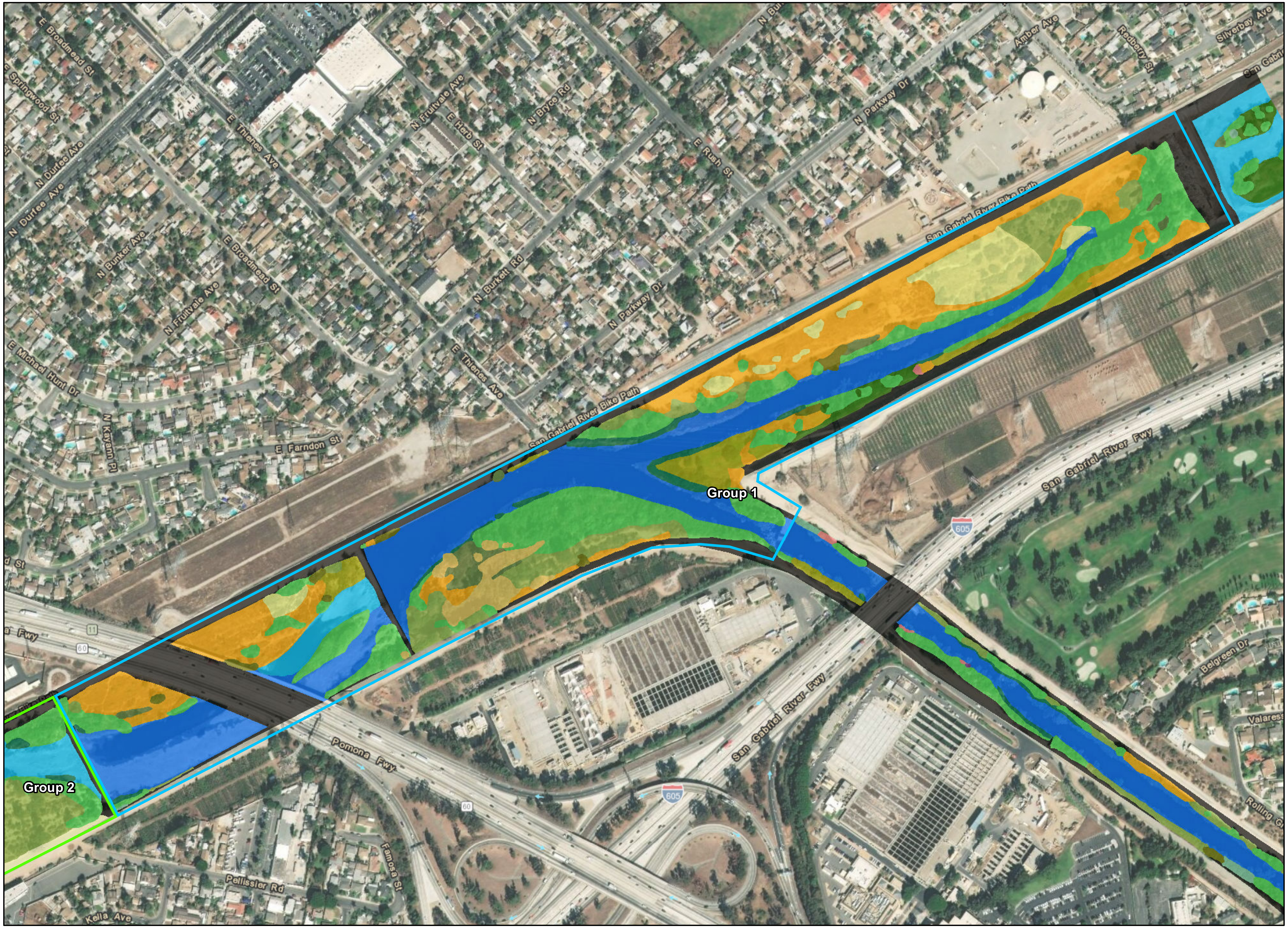

▭ Group 1

▭ Group 2

Vegetation Communities

🟧 Annual brome grassland

🟫 Arroyo willow thickets

🟨 Arroyo willow thickets - Disturbed

🟨 Barren

🟩 Black willow thickets

🟩 Cattail marshes

⬛ Developed

🟨 Eucalyptus semi-natural stands

🟥 Giant reed breaks

🟩 Mulefat thickets

🟩 Mulefat thickets - Disturbed

🟪 Non-native woodland

🟦 Open Water

🟩 Sandbar willow thickets

🟨 Sandbar willow thickets - Disturbed

🟩 Smartweed - cocklebur patches

🟦 Unvegetated streambed

1 inch = 400 feet

0 400 Feet

FIGURE 3

Vegetation Communities - Group 1
San Gabriel River AMP
Los Angeles County, California

wood.

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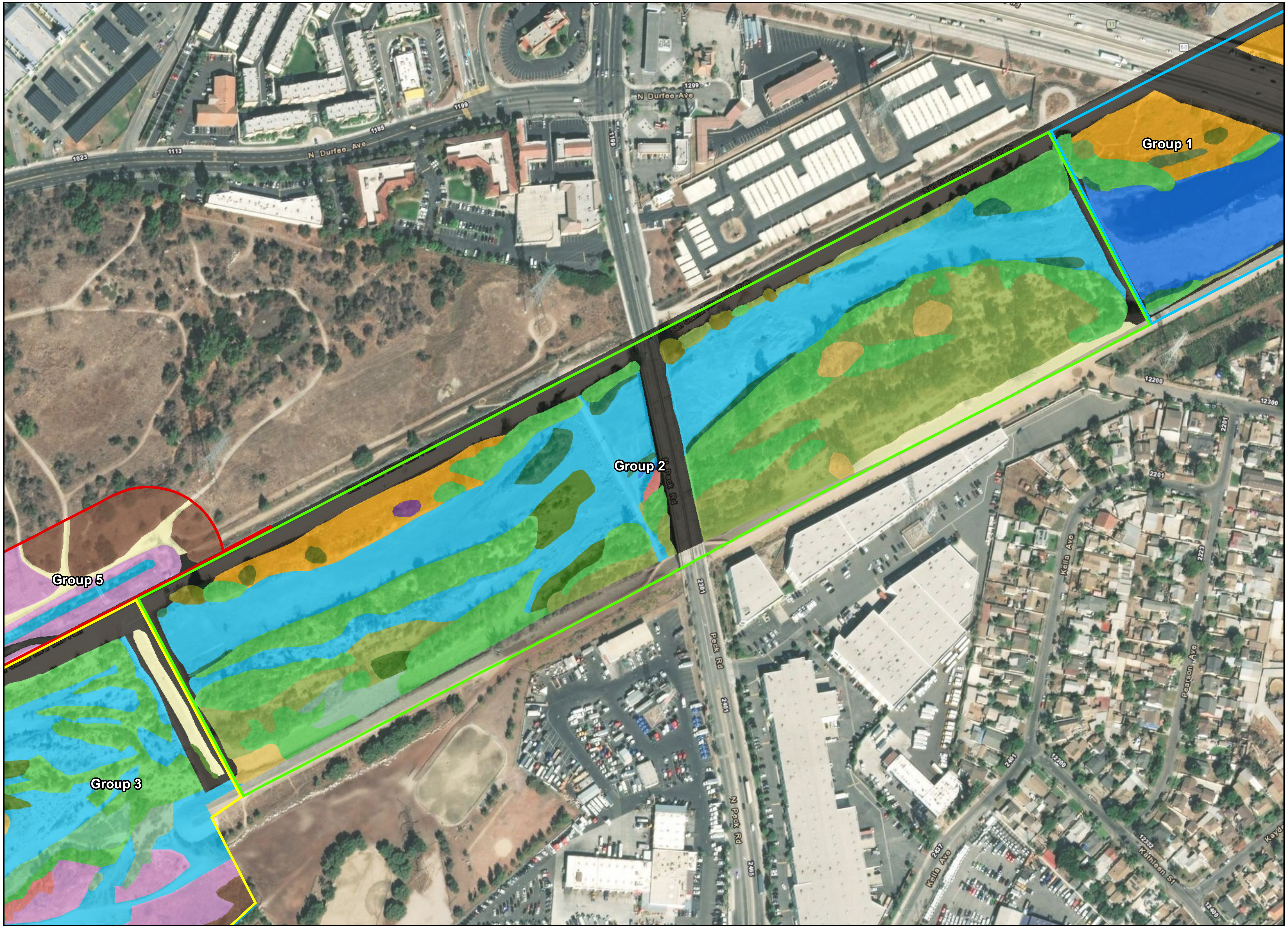

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- 🟦 Group 1
- 🟩 Group 2
- 🟨 Group 3
- 🟥 Group 5

Vegetation Communities

- 🟧 Annual brome grassland
- ■ Arroyo willow thickets
- ■ Barren
- 🟩 Black willow thickets
- 🟫 Blue elderberry stands
- ■ Cattail marshes
- ⬛ Developed
- 🟨 Eucalyptus semi-natural stands
- ■ Giant reed breaks
- ■ Mulefat thickets
- ■ Mulefat thickets - Disturbed
- 🟪 Non-native woodland
- 🟦 Open Water
- ■ Poison hemlock patches
- ■ Sandbar willow thickets
- ■ Smartweed - cocklebur patches
- 🟦 Unvegetated streambed
- ■ Mustard semi-natural stands

1 inch = 250 feet
0 250 Feet

FIGURE 4

Vegetation Communities - Group 2
San Gabriel River AMP
Los Angeles County, California

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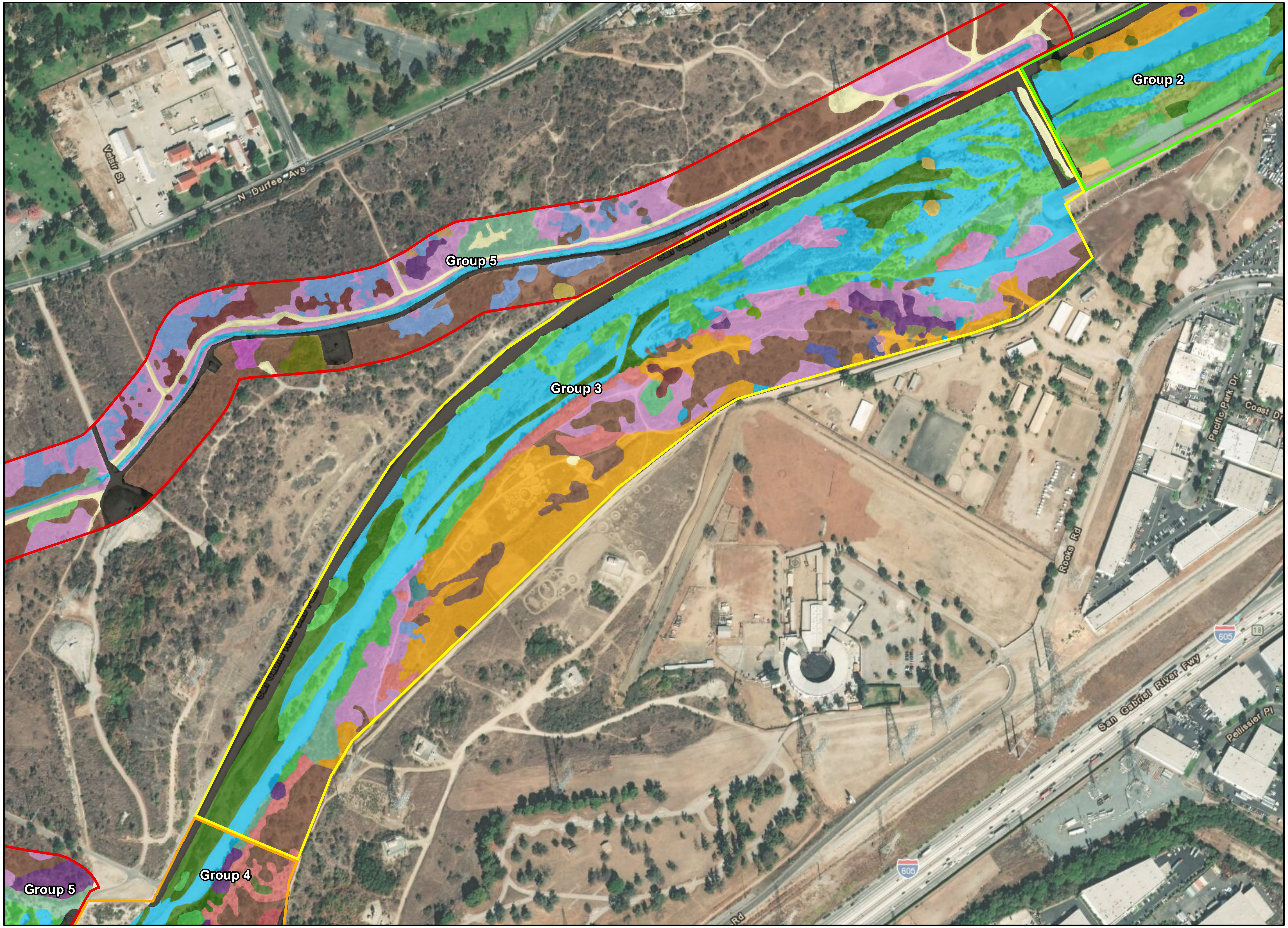

FIGURE 5

Vegetation Communities - Group 3
San Gabriel River AMP
Los Angeles County, California

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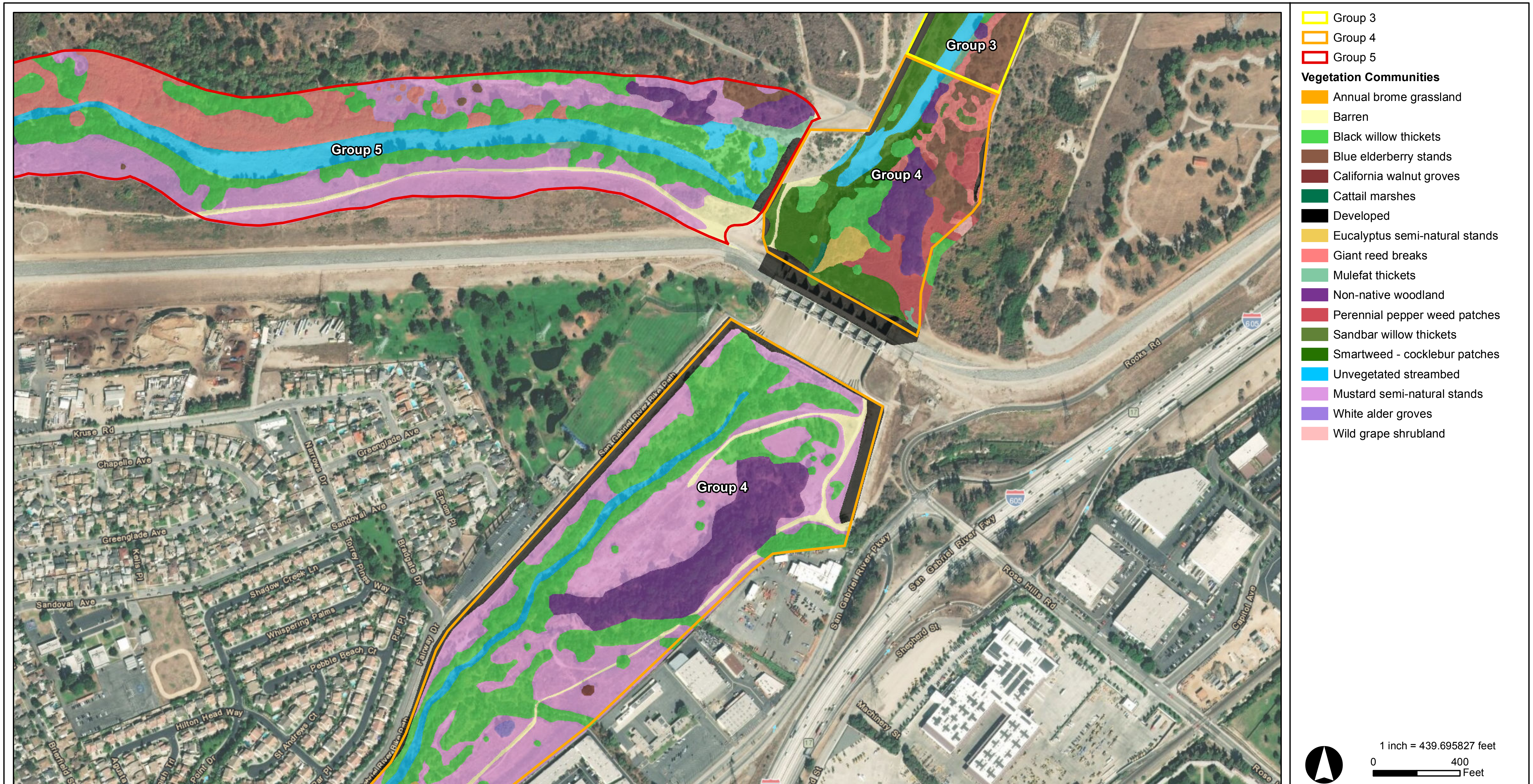

FIGURE 6

Vegetation Communities - Group 4
San Gabriel River AMP
Los Angeles County, California

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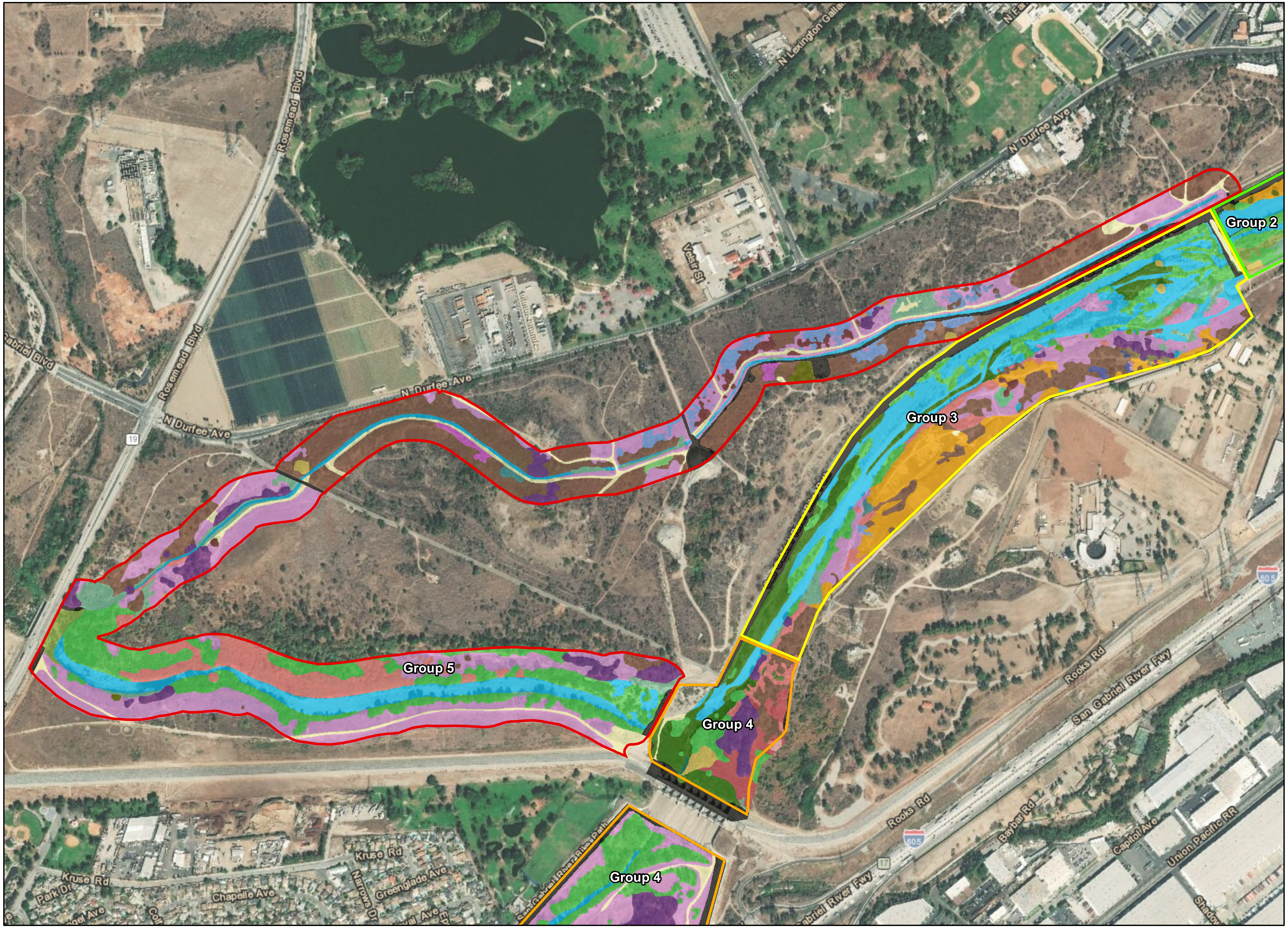

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Group 2
Group 3
Group 4
Group 5

Vegetation Communities

Annual brome grassland
Arroyo willow thickets
Barren
Basket bush patches
Black cottonwood forest
Black willow thickets
Blue elderberry stands
Box-elder forest
California buckwheat scrub
California coffee berry scrub
California sycamore woodlands
California walnut groves
California yerba santa scrub
Cattail marshes
Coast prickly pear scrub
Developed
Eucalyptus semi-natural stands
Giant reed breaks
Mulefat thickets
Mulefat thickets - Disturbed
Non-native woodland
Perennial pepper weed patches
Poison hemlock patches
Poison oak scrub
Sandbar willow thickets
Scalebroom scrub
Smartweed - cocklebur patches
Sugarbush chaparral
Unvegetated streambed
Mustard semi-natural stands
Wild grape shrubland

1 inch = 700 feet
0 400 Feet

FIGURE 7

Vegetation Communities - Group 5
San Gabriel River AMP
Los Angeles County, California

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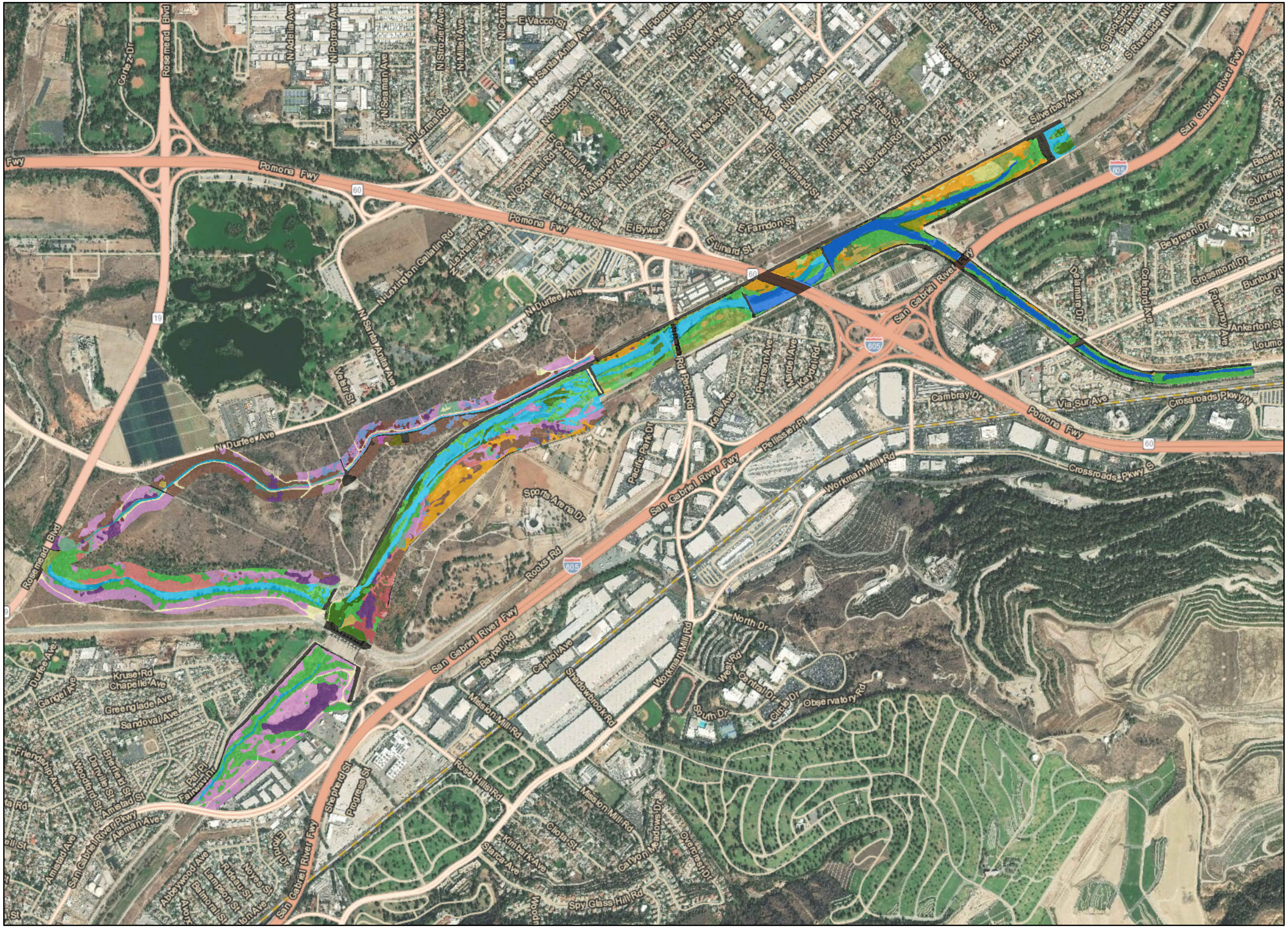

Vegetation Communities
- Annual brome grassland
- Arroyo willow thickets
- Arroyo willow thickets - Disturbed
- Barren
- Basket bush patches
- Black cottonwood forest
- Black willow thickets
- Blue elderberry stands
- Box-elder forest
- California buckwheat scrub
- California coffee berry scrub
- California sycamore woodlands
- California walnut groves
- California yerba santa scrub
- Cattail marshes
- Coast prickly pear scrub
- Developed
- Eucalyptus semi-natural stands
- Giant reed breaks
- Mulefat thickets
- Mulefat thickets - Disturbed
- Non-native woodland
- Open Water
- Perennial pepper weed patches
- Poison hemlock patches
- Poison oak scrub
- Sandbar willow thickets
- Sandbar willow thickets - Disturbed
- Scalebroom scrub
- Smartweed - cocklebur patches
- Sugarbush chaparral
- Unvegetated streambed
- Mustard semi-natural stands
- White alder groves
- Wild grape shrubland

1 inch = 1,500 feet
0 1,500
Feet

FIGURE 8

Vegetation Communities - Overview
San Gabriel River AMP
Los Angeles County, California

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FIGURE 9

Tree Locations
San Gabriel River AMP
Los Angeles County, California

wood.

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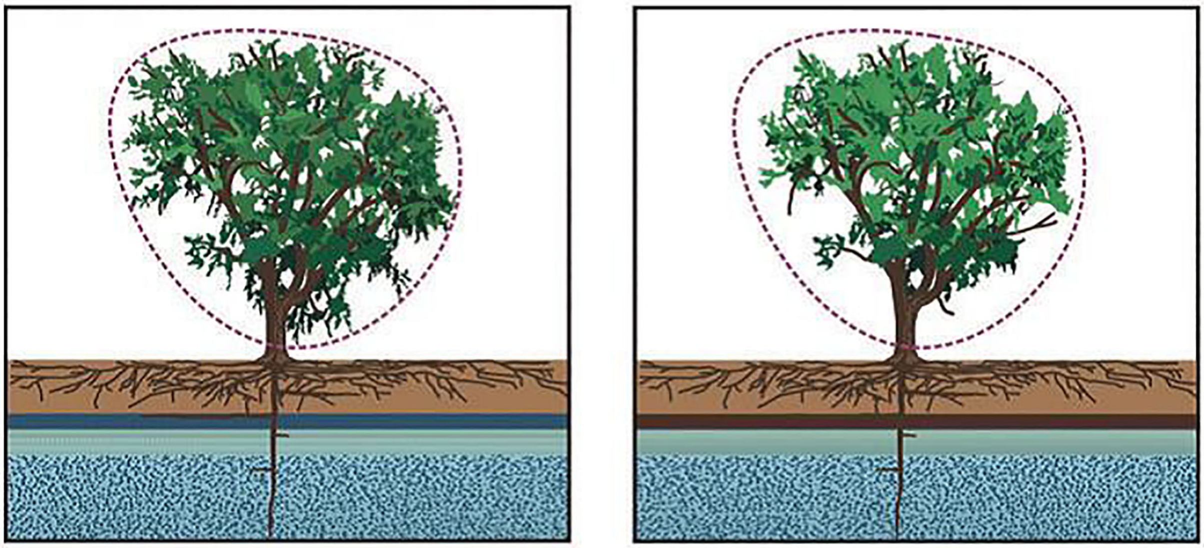
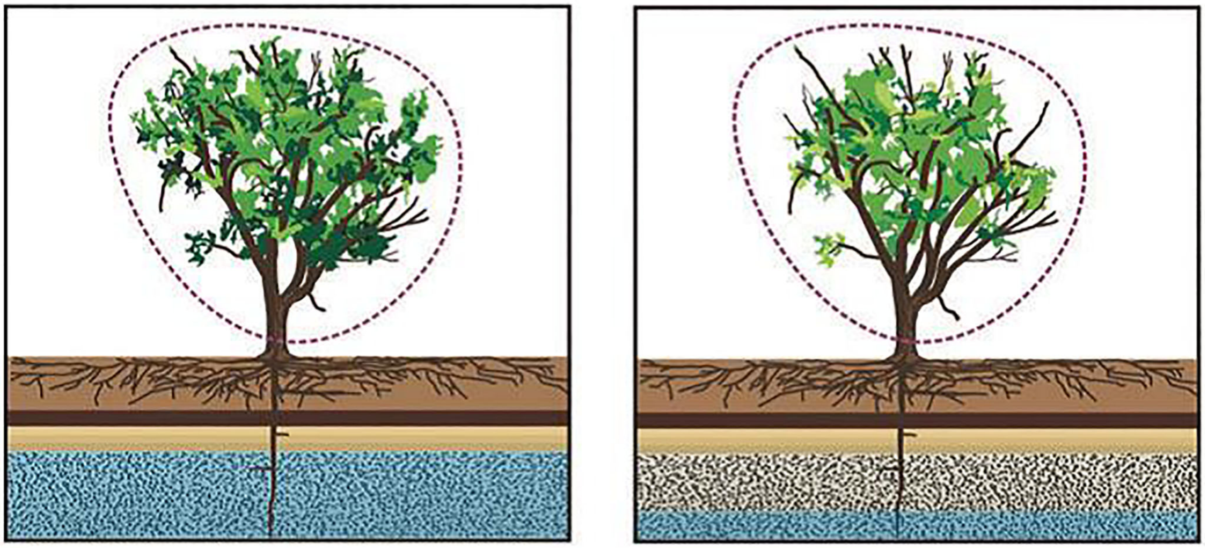


95% Potential canopy

75% Potential canopy



55% Potential canopy

35% Potential canopy

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FIGURE 10a

Estimated Canopy
San Gabriel River AMP
Los Angeles County, California

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Proportion of healthy canopy cover present: 100%

Proportion of healthy canopy cover present: >70%

Proportion of healthy canopy cover present: 65%

Proportion of healthy canopy cover present: 55%

Proportion of healthy canopy cover present: 45%

Proportion of healthy canopy cover present: 30%

Proportion of healthy canopy cover present: 20%

Proportion of healthy canopy cover present: 10%

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FIGURE 10b

Estimated Canopy
San Gabriel River AMP
Los Angeles County, California

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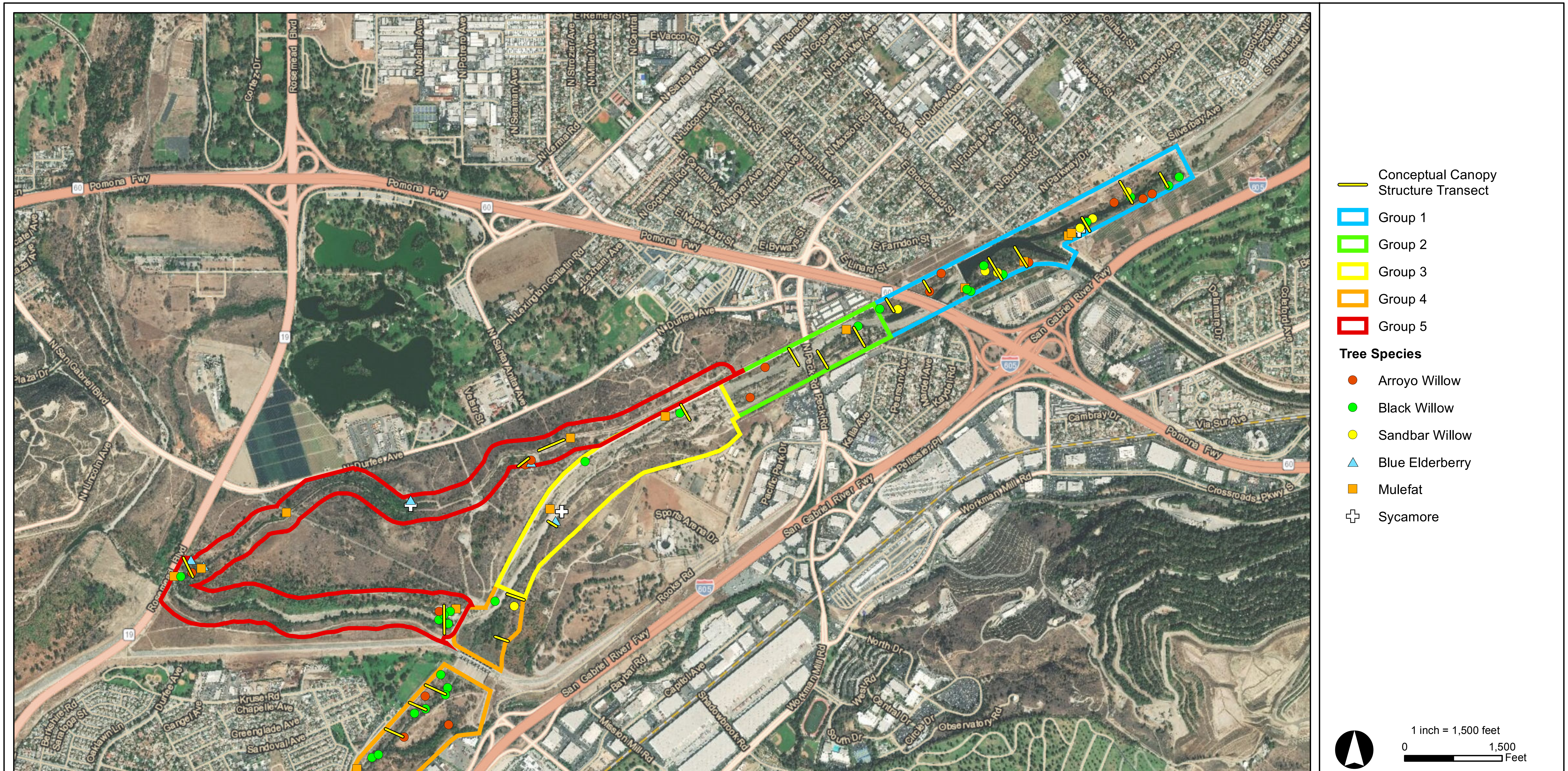

FIGURE 11

Canopy Structure Transect
Conceptual Locations
San Gabriel River AMP
Los Angeles County, California

wood.

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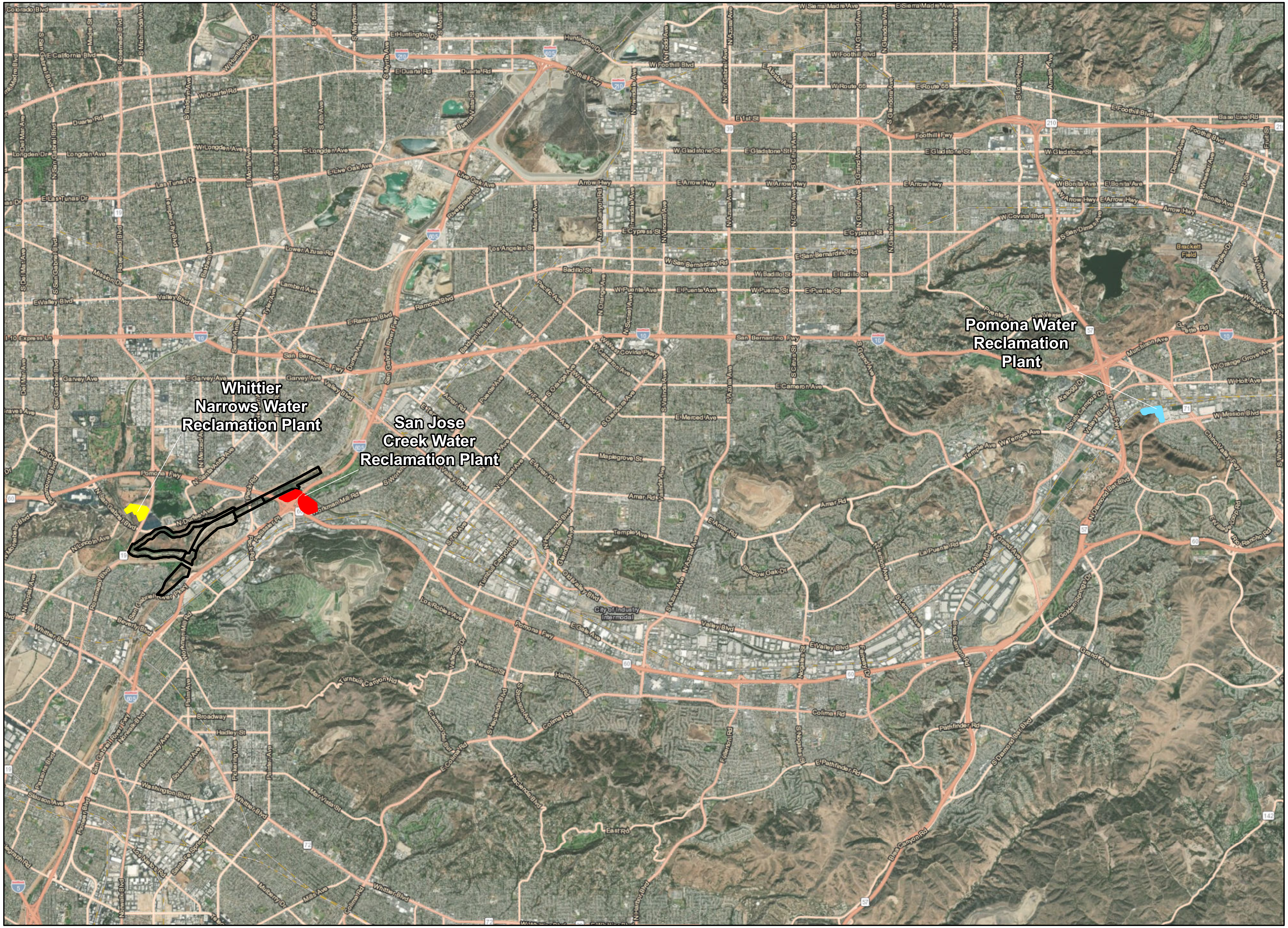

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FIGURE 12

LACSD_Facilities
San Gabriel River AMP
Los Angeles County, California

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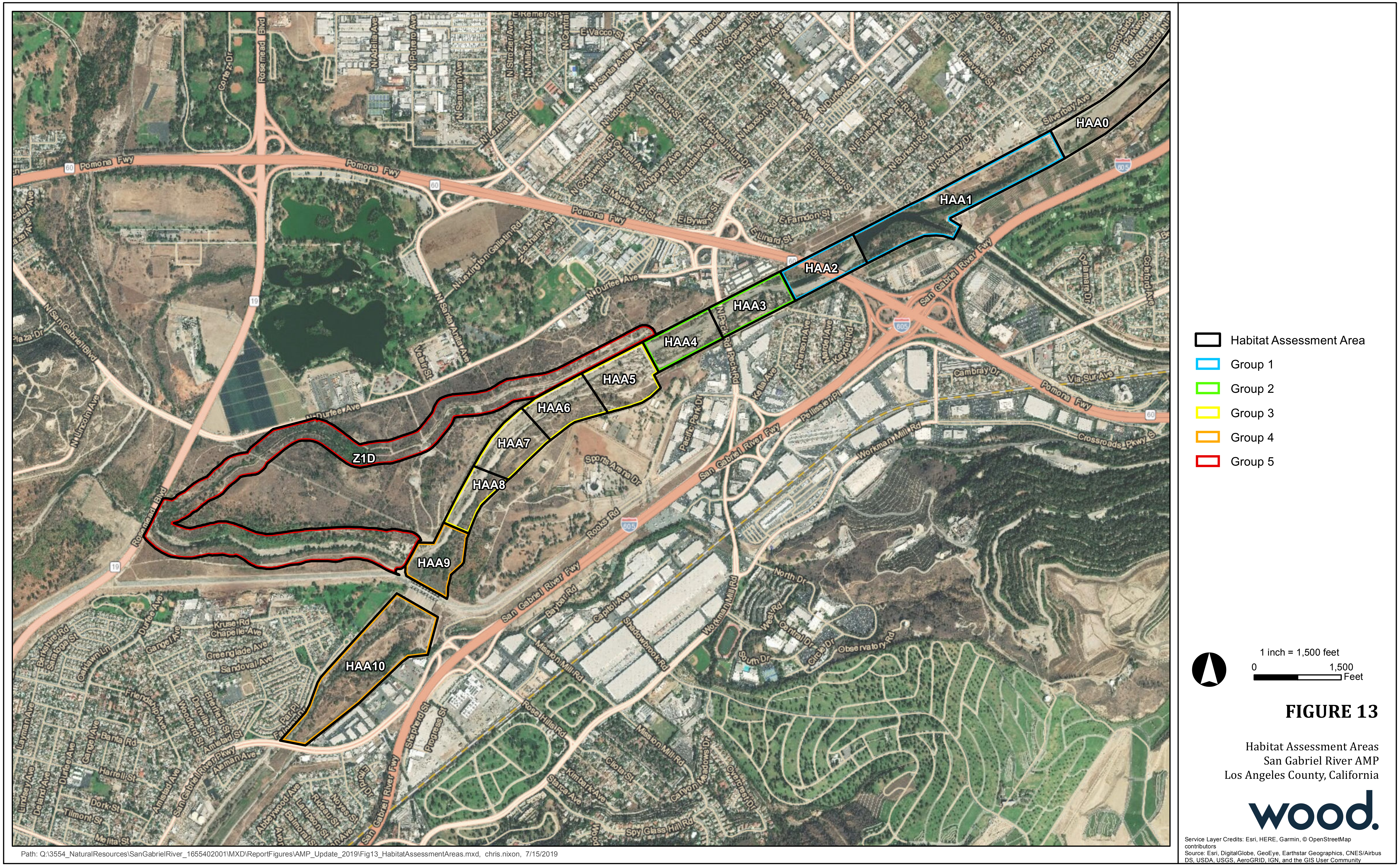

FIGURE 13

Habitat Assessment Areas
San Gabriel River AMP
Los Angeles County, California

wood.

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APPENDIX A

User Manual for Stem Water Potential Pressure Chamber

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