Appendix F:
Hydrology Supporting Information

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F.1 - Preliminary Drainage Study

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PRELIMINARY DRAINAGE STUDY

ASHLEY TECHNOLOGY PARK
APN: 0276-144-48, -49 & -52
City of Colton, County of San Bernardino, CA

August 21, 2018

Prepared for:

Howard Industrial Partners, LLC
1944 N Tustin Street #122
Orange, CA 92865
T.714-602-7345

Report Prepared By:

FMCIVIL ENGINEERS INC.

29995 Technology Drive, Suite 306
Murrieta, CA 92563

Engineer of Work/ Contact Person:

Francisco Martinez Jr., PE, QSD

JN 2018-002

This report has been prepared by or under the direction of the following registered civil engineer who attests to the technical information contained herein. The registered civil engineer has also judged the qualifications of any technical specialists providing engineering data upon which recommendations, conclusions, and decisions are based.

	08/21/2018	
Francisco Martinez RCE Registered Civil Engineer	Date	Seal

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I. PURPOSE AND SCOPE

The purpose of this study is to determine the necessary drainage and increased runoff mitigation improvements required for the Ashley Technology Park project.

The scope of the preliminary study includes the following:

1. Determination of points of flow concentration and watershed subareas for onsite and offsite areas.
2. Determination of the 100-year peak storm flows based upon the post-project onsite and existing condition offsite areas utilizing the Rational Method as outlined in the San Bernardino County Flood Control Hydrology Manual.
3. Determine the 100-year peak storm flows based upon the pre-project and post-project condition for the 24-hour storm duration utilizing the Unit Hydrograph Method as outlined in the San Bernardino County Flood Control Hydrology Manual.
4. Determine the required facilities to mitigate the 100-year peak storm flows for the 24-hour storm duration in the post-project condition to flows less than or equal to the existing condition flow rates.
5. Determine the required storm drain infrastructure to flood protect the project site for the 100-year storm event.
6. Determine the required outlet control structure to safely by-pass the 100-year peak storm event;
7. Preparation of a hydrology report, which consist of hydrological and analytical results and exhibits.

II. PROJECT SITE AND DRAINAGE AREA OVERVIEW

The Ashley Technology Park project is a proposed industrial warehouse project that will include truck court and parking, landscaped/open space areas, storm drain infrastructure and an underground storm and water quality mitigation facilities.

The property is approximately 10.5 acres located on Ashley Way in the City of Colton, County of San Bernardino. The property is bounded by Ashley Way to the North, Reche Canyon Channel to the south, an Industrial warehouse facility (King's Equipment Rental and parking lot) to the east (freeway 215); and to the West, professional office buildings with parking lot.

The project site is currently vacant. However, in review of google earth's historical imagery, the property was graded and disturbed from its natural condition between 2003 and 2005; the grading activity was part of the construction for the industrial warehouse facility (currently King's Equipment Rental).

According to FEMA FIRM Map number 06071C8691J, and map revised September 2, 2016 the site is located within designated "Floodway Areas in ZONE X", and adjacent to Reche Canyon which lays along the southern boundary and designated as Zone "A".

Most of the property drains near the west boundary from north-east to south-west, flows travel to a low spot but no outlet; however, a small area along the south and south east side drains towards a 36-inch riser pipe with 30-inch outlet pipe that is connected directly to the Reche Canyon Channel. Under the proposed conditions, storm flows will be collected by storm inlets and subdrain pipes and directed to an onsite underground infiltration chambers for water quality and storm mitigation, out-letting to existing channel via storm pipe and connection to existing 30-inch pipe.

Off-site nuisance flows from King's Equipment Rental parking lot currently enter and drain into the property at the north-east corner, these flows in the ultimate developed condition will be intercepted via swale and/or small diameter pipe and directed to outlet at Ashley Way. Also, Storm flows from a portion the off-site parking lot drain to an existing curb inlet located at the south boundary and Reche Canyon Channel. There is an underlying drainage easement along the southerly boundary, that allows the offsite curb inlet to connect via underground pipe to the onsite existing riser and storm drain that outlets to the channel.

III. HYDROLOGY

The San Bernardino County Hydrology Manual (Reference 1), was used to develop the hydrological parameters for the hydrology analyses. The rational method and unit hydrograph method were used for the analyses and the computations were performed using the computer program developed by Civil CADD/Civil Design.

The rainfall depths for used in the hydrology calculations for the rational method and the unit hydrograph method are as follows:

Storm Event & Duration	Rainfall (inches)
2-Year, 6-Hour	1.14
2-Year, 24-Hour	2.03
10-Year, 1-Hour	0.732
100-Year, 1-Hour	1.14
100-Year, 6-Hour	2.65
100-Year, 24-Hour	4.76

The rainfall depths were obtained from NOAA Atlas 14, which has been included as Exhibit G.

The existing soil classification for the area consists of Hydrologic Soil Group "A", as shown in Exhibit F; it is a Soils Map obtained from the National Resource Conservation Service Websoil Survey. For 100-year storm events, Antecedent Moisture Condition (AMC) III was utilized.

The hydrology utilized the following land use covers:

Land Use Cover	Runoff Index	Pervious Ratio
Natural Covers – Barren (Graded Land)	78	1
Urban Cover – Good Cover	32	1
Commercial	98	0.1

The existing site was previously graded and analyzed as Natural Covers based on "Barren" graded land. Proposed onsite Landscaped Areas were analyzed as Urban Covers for Residential or Commercial Landscaping (lawns, shrubs, etc) utilizing "Good Cover" condition, and the proposed paved areas were analyzed as Commercial.

The Rational Method analysis for the onsite existing condition considered two separate onsite watershed areas and designated as Area "A" and Area "B". For the proposed condition, the areas were designated with same letter designations to represent the areas. Offsite flows will not be co-mingled and are not considered in this preliminary report.

To determine the required increased onsite runoff mitigation for the project, the Unit Hydrograph calculation was performed for watershed Area "A". Area "B" will drain towards Ashley Way and no mitigation proposed, this area will reduce runoff due to pervious cover. Note that 100% pervious cover was used for the existing condition.

The unit hydrographs were performed using a lag time that was calculated by the following formula:

Lag (hrs) = TC_{RM} (hrs) × 80%, where TC_{RM} is the corresponding rational method time of concentration.

The existing and proposed condition rational method hydrology calculations are included in Appendix A and B respectively and hydrology maps under figures 2 and 3. The existing and proposed condition unit hydrograph hydrology calculations are included in Appendix C and D, respectively.

IV. HYDRAULICS

The project will utilize a subsurface storm drain, drainage inlets, swales, gutters to collect and convey peak flows and underground infiltration chambers to mitigate for water quality and increased runoff.

An outlet control structure (weir with orifices) will be utilized to control and mitigate storm flows and sized to safely by-pass the peak 100-year frequency storm, 24-hour duration for the ultimate developed condition.

For preliminary purposes, a WSPG hydraulic capacity analysis was performed for the basin outlet pipes using the peak flow for developed condition. As a result of the analysis, a single 30-inch storm drain pipe is proposed to convey the routed/mitigated flows and discharge to the existing 30-inch pipe outlet for Reche Canyon Channel, based on soffit control.

During final design phase a complete WSPG analysis will be performed for main storm drain system. The WSPG calculation has been included in Appendix E.

V. WATER QUALITY AND STORM MITIGATION

The project site will utilize an infiltration basin to mitigate flows for increased runoff. This system will also serve as the water quality treatment facility for the project site. The water quality calculations and discussion have been provided in the Water Quality Management Plan. The required water quality volume for the project site is **33,686 ft^3**, and the calculation for the Design Capture Volume (DCV) has been included in Appendix F.

To store the required water quality volume, infiltrate the volume and mitigate for increased runoff, the infiltration basin is preliminary sized for **65,000 ft^3**. See summary table next page.

Infiltration testing was performed near the proposed underground chamber location, and referenced as area "A", an excerpt of the Soils Infiltration test report has been included in Appendix G. The area tested provides a rate of approximately 0.5 in/hr, which is the lowest value obtained from the test location, and after applying a safety factor in accordance with the technical guidance manual, the design infiltration rate is calculated to be **0.53 in/hr**, this rate was utilized in the design of the basin and subsurface system. A worksheet has been included in Appendix G.

To determine a flow rate through the soil that could be utilized in the basin routing calculations, the infiltration rate was multiplied by the bottom surface area of the infiltration basin and the subsurface system. The bottom surface area of the infiltration basin at elevation 943.0 is 15,033 ft^2. Converting the infiltration rate to ft/s, and multiplying by the surface area, the equivalent flow rate for infiltration is **0.18 ft^3/s**. This flow rate shall be utilized in the underground infiltration chamber routing analyses.

Since the water quality volume (DCV) must infiltrate through the underground basin/chamber bottom, the outlet control structure will have outflows at or above the required design capture volumes depth. The outflows will be restricted with inverts placed at or above the elevation of 945.35. The underground basin's emergency by-pass is a weir wall in the outlet control structure and a 30-inch outlet pipe that will safely by-pass the 100-year frequency storm event.

For preliminary purposes, the required mitigation was determined utilizing the volume under the curve generated by the Unit Hydrograph for the 100-year, 24-hour duration storm under proposed/developed conditions. Since the developed condition peak flow rate needs to be at or below the peak flow rate for the existing condition, then the existing condition flow rate was used on the rising and recess limbs of the proposed UH to determine the volume under the curve between the two locations (rising/recess limbs). The volume under the curve is the difference in volume between these two points on the curve. Below is a summary of the analysis.

Proposed Condition 100-year frequency, 24-hour duration storm:

Time	*Flow Rate (ft^3/s)	Volume (ac-ft)	**Net Volume (ac-ft / ft^3)
16+05	12.29	2.0799	0.5281 / **23,004.0**
16+25	10.75	2.6080	

*The existing condition Q_{100} = 15.55 cfs. **The net volume is the difference between the volumes of the rising and recess limb for each flow rate for the proposed condition 100-year, 24-hr UH.

In summary, the volume required for Water Quality is 33,686 ft^3 and for storm mitigation is 23,004 ft^3, the combined total being 56,690 ft^3, and the underground chamber can provide 65,000 ft^3. Therefore, the preliminary analysis shows that the underground chamber/basin provides storage capacity to mitigate for water quality and storm water flows as needed for the project under developed conditions. A basin routing analysis shall be provided as part of Final Drainage Report and final engineering documents.

VI. FINDINGS

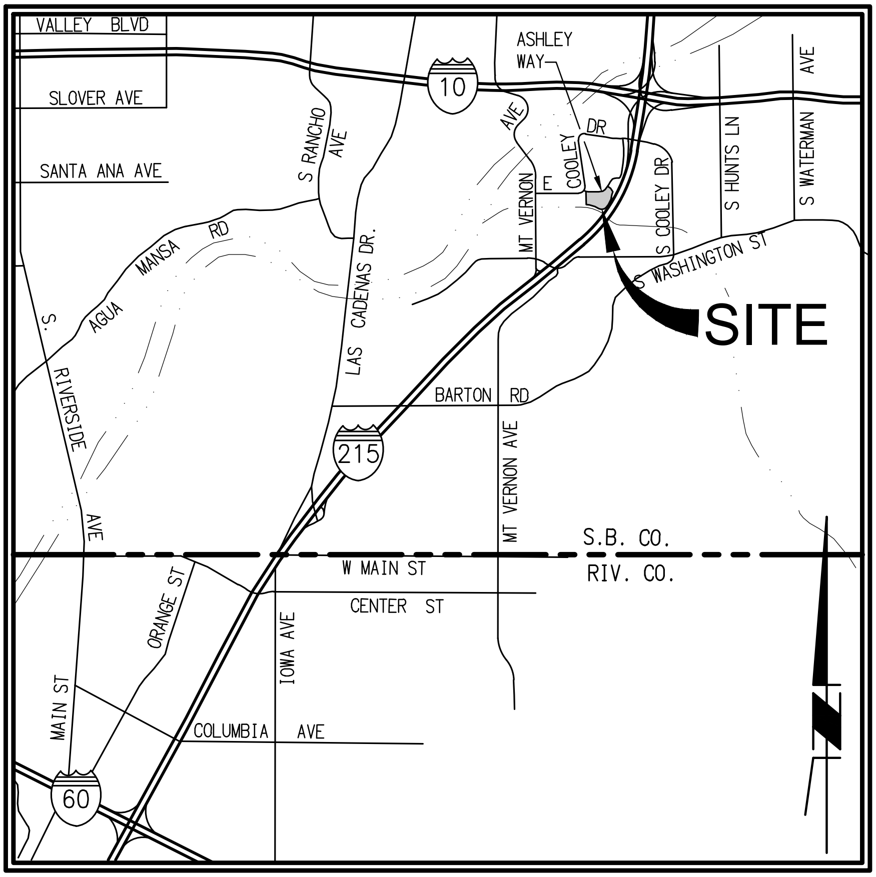
The preliminary hydrology analyses evaluated the proposed development to determine the necessary drainage improvements required to mitigate flows for increased runoff. It has been concluded that:

1. The proposed onsite drainage facilities are preliminary sized to convey the 100-year flows and provide flood protection to the project site.
2. The proposed infiltration basin is sized to a minimum to mitigate for increased runoff.

VII. REFERENCES

1. San Bernardino Flood Control Hydrology Manual, August 1986.
2. Brater, Ernest F., and Horace Williams King. 1976. *Handbook of Hydraulics for the Solution of Hydraulic Engineering Problems.* 6th ed. McGraw-Hill, Inc.
3. San Bernardino Rational Method and Unit Hydrograph modules, CivilDesign Engineering Software Version 9.0.

FIGURES



VICINITY MAP

T01S, R04W, SEC. 28
NOT TO SCALE

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951.331.9873 - FMCIVIL.COM

ASHLEY WAY

FIGURE 1
VICINITY MAP

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ASHLEY WAY SITE

FIGURE 2 - EXISTING CONDITIONS

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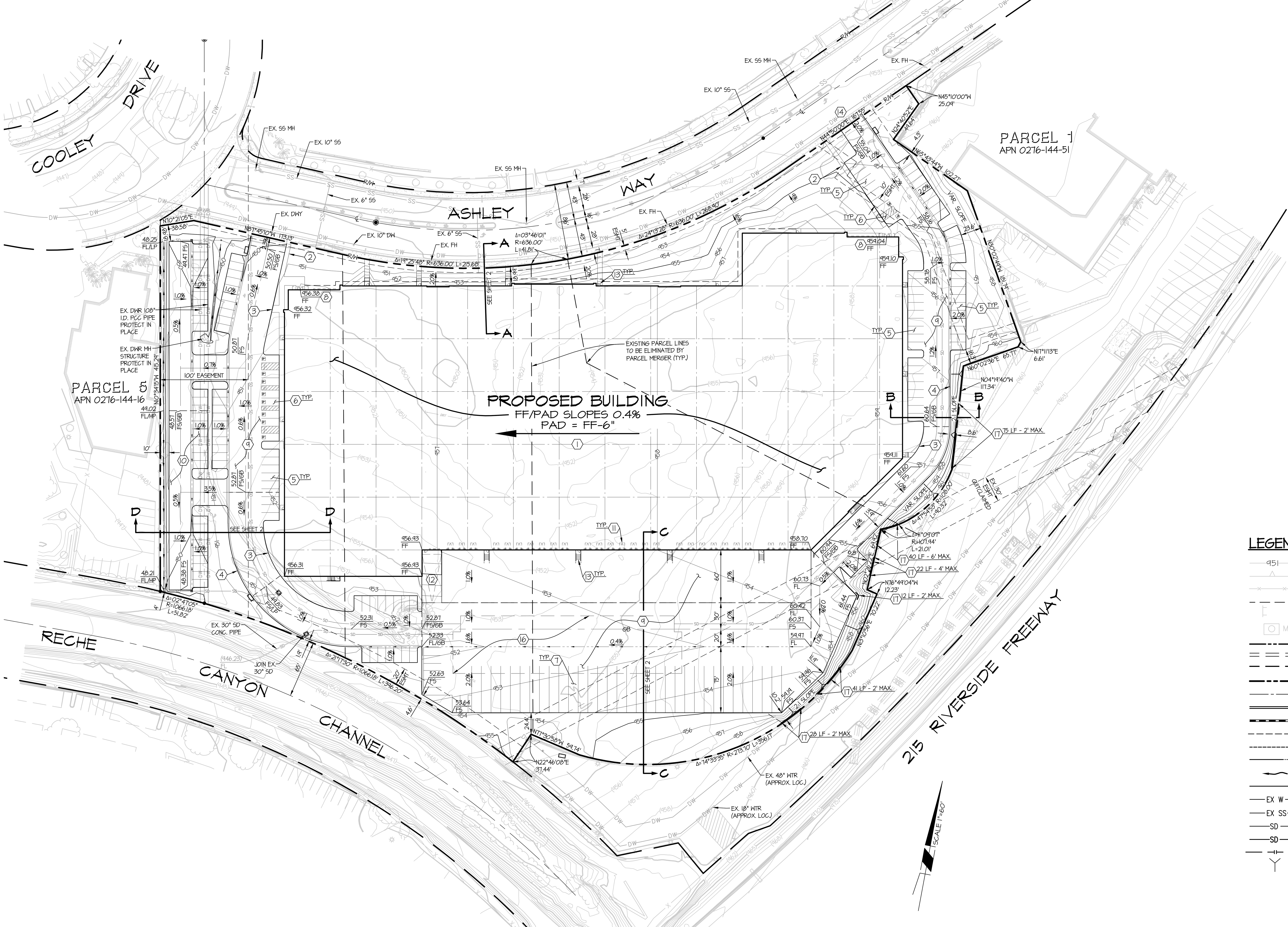
ASHLEY WAY SITE

FIGURE 3 – PROPOSED CONDITIONS

CONCEPTUAL GRADING PLAN

IN THE CITY OF COLTON, COUNTY OF SAN BERNARDINO, CALIFORNIA



APPLICANT/OWNER

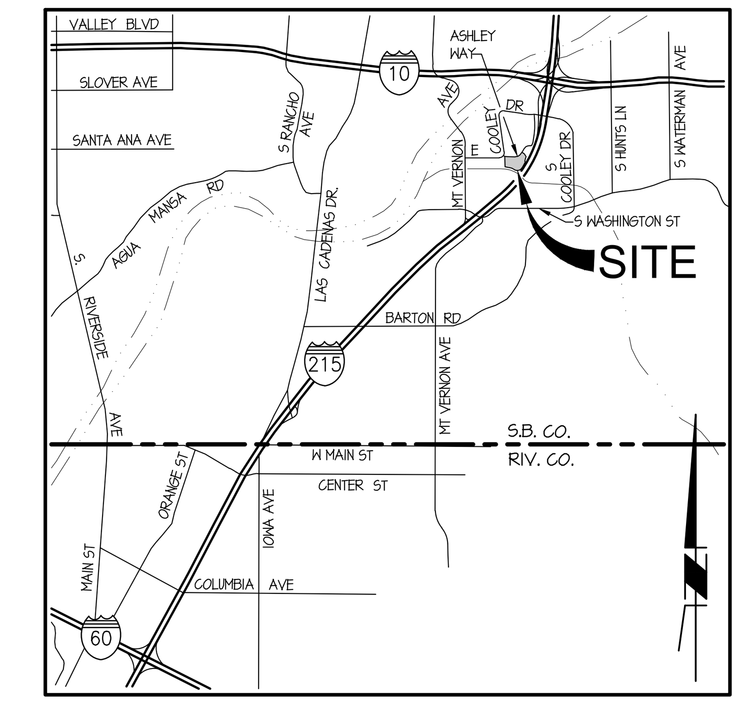
HOWARD INDUSTRIAL PARTNERS
1944 NORTH TUSTIN STREET, SUITE 122
ORANGE, CA 92865
CONTACT:TIM HOWARD
(TEL)714-769-9155

ENGINEER

FMCIVIL ENGINEERS INC.
29995 TECHNOLOGY DRIVE, SUITE 306
MURRIETA, CA 92563
CONTACT: FRANCISCO MARTINEZ
(TEL)951-331-9873

ARCHITECT

RGA
15231 ALTON PARKWAY, SUITE 100
IRVINE, CA 92618
CONTACT: JACOB HUBER
(TEL)949-341-0920



VICINITY MAP
T01S, R04W, SEC. 28
NOT TO SCALE

EARTHWORK ESTIMATE:

RAW CUT:	16,100	CY	
RAW FILL:	33,750	CY	
NET:	17,650	CY	IMPORT

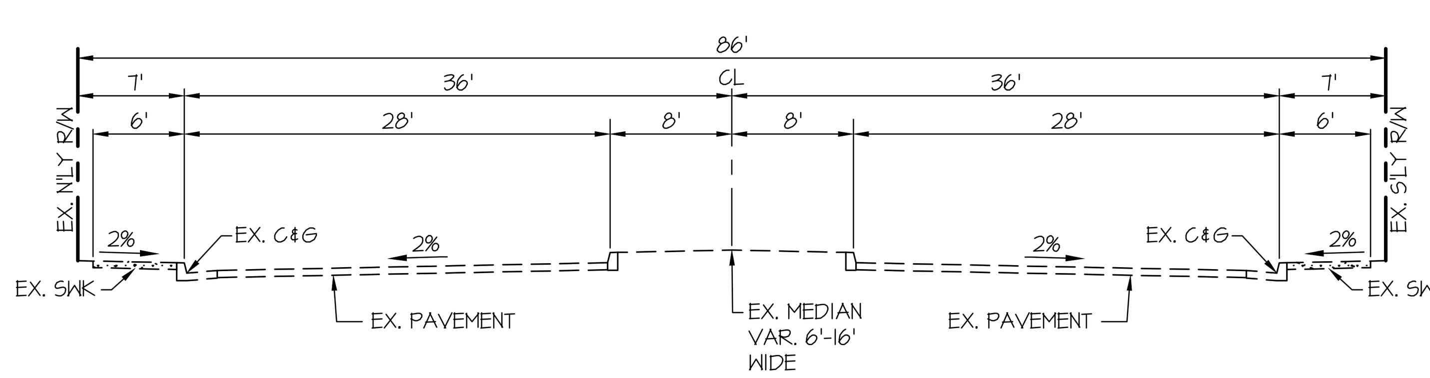
HAUL TRIPS:
ASSUMED (13 CY PER TRIP) = 1,367

LEGEND

- INDEX CONTOUR
- RETAINING WALL
- FENCE
- EDGE OF PAVEMENT
- SIGN
- MANHOLE
- RIGHT OF WAY
- EASEMENT
- PARCEL LINE
- PARCEL MAP BOUNDARY
- STREET CENTER LINE
- SCREEN WALL
- RETAINING WALL
- EXISTING LOT LINE
- RIDGE LINE
- RIBBON GUTTER
- FLOW ARROW
- PROPOSED EDGE OF PAVEMENT
- EXISTING WATER LINE
- EXISTING SEWER LINE
- EXISTING STORM DRAIN PIPE
- PROPOSED STORM DRAIN PIPE
- CUT/FILL LINE
- SLOPE SYMBOL

SITE PLAN KEYNOTES

1. PAINTED CONCRETE TILT-UP WAREHOUSE / OFFICE / MANUFACTURING FACILITY. BUILDING TO BE DESIGNED PER ARCHITECT'S PLANS
2. ON SITE ACCESSIBLE SIDEWALK AND CURB RAMPS.
3. CONCRETE CURB
4. CONCRETE CURB & GUTTER
5. STANDARD PARKING STALL - STRIPE PER STANDARDS SHOWN ON ARCHITECT'S PLANS
6. HANDICAP PARKING STALL - STRIPE PER STANDARDS SHOWN ON ARCHITECT'S PLANS
7. TRAILER PARKING STALL - STRIPE PER STANDARDS SHOWN ON ARCHITECT'S PLANS
8. ACCESSIBLE BUILDING ENTRY WITH ADJACENT BICYCLE RACKS PER ARCHITECT'S PLANS
9. PORTLAND CONC. CEMENT (PCC) PAVED TRUCK YARD ARCHITECT'S PLANS
10. ASPHALT CONCRETE (AC) PAVED PARKING PER ARCHITECT'S PLANS
11. DOCK HIGH TRUCK DOOR PER ARCHITECT'S PLANS
12. GRADE LEVEL RAMP DOOR PER ARCHITECT'S PLANS
13. EXTERIOR MAN DOOR AND STAIRS W/GUARD POST PER ARCHITECT'S PLANS
14. COMMERCIAL DRIVEWAY APPROACH PER CITY STD. DWG. NO. 111
15. WATER QUALITY BASIN
16. UNDERGROUND STORM WATER CHAMBER SYSTEM
17. RETAINING WALL PER ARCHITECT'S PLANS



TYPICAL SECTION ASHLEY WAY
HOR. SCALE: 1"=10'

REGISTERED PROFESSIONAL ENGINEER
FRANCISCO MARTINEZ JR.
C-84640
CIVIL
STATE OF CALIFORNIA

PREPARED BY:
FMCIVIL ENGINEERS INC.
29995 TECHNOLOGY DRIVE, SUITE 306 | MURRIETA | CA 92563
951.331.9873 - FMCIVIL.COM

FRANCISCO MARTINEZ JR. #84640 3/31/20
R.C.E. / EXP. DATE

BENCHMARK

THE CALIFORNIA SPATIAL REFERENCE CENTER C.O.R.S. "CRFP", ELEVATION = 2365.54 FEET (NAVD 88).

BASIS OF BEARING

THE BASIS OF BEARING FOR THIS SURVEY IS THE CALIFORNIA COORDINATES SYSTEM (CCS 83), ZONE 5, 1983 DATUM, DEFINED BY SECTIONS 8801 TO 8819 OF THE CALIFORNIA PUBLIC RESOURCES CODE.

CITY OF COLTON

ASHLEY WAY
CONCEPTUAL GRADING PLAN

SCALE:	AS SHOWN
DATE:	JULY 2018
DESIGNED:	AJ
CHECKED:	FM
PLN CK REF:	

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29995 TECHNOLOGY DRIVE, SUITE 306
MURRIETA | CA 92563
951.331.9873 - FMCIVIL.COM

SHEET 1 OF 2 SHEETS

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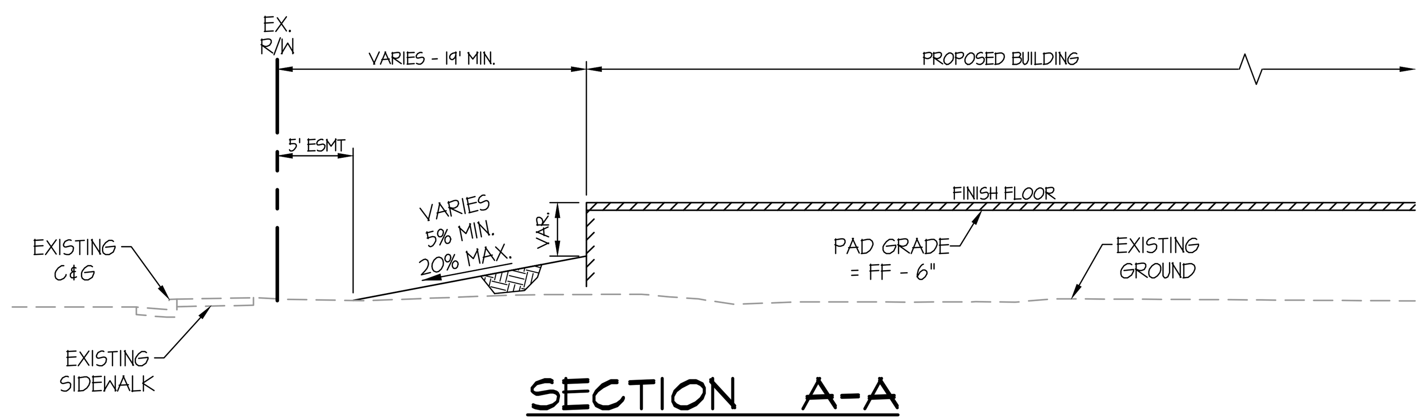
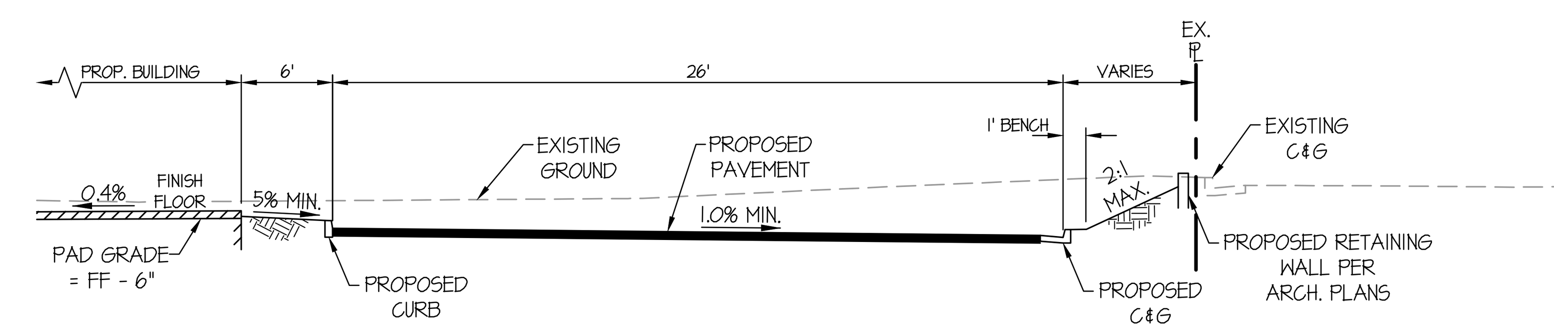
CONCEPTUAL GRADING PLAN

IN THE CITY OF COLTON, COUNTY OF SAN BERNARDINO, CALIFORNIA



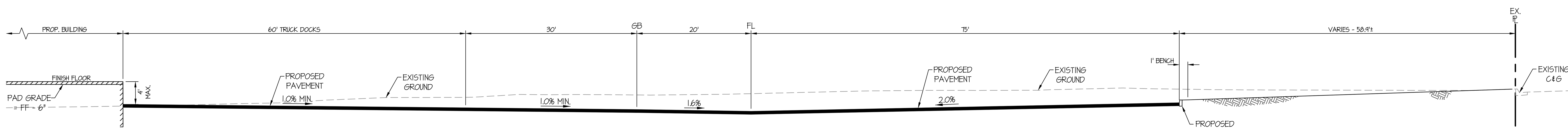
SECTION A-A

HOR. SCALE: 1"=10'



SECTION B-B

HOR. SCALE: 1"=10'



SECTION C-C

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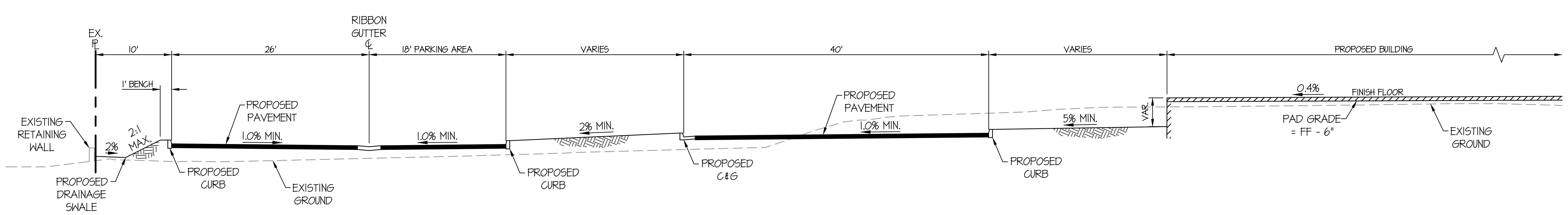

SECTION D-D

HOR. SCALE: 1"=10'

REGISTERED PROFESSIONAL ENGINEER
FRANCISCO MARTINEZ JR.
C-84640
CIVIL
STATE OF CALIFORNIA

PREPARED BY:

FMCIVIL ENGINEERS INC.

29995 TECHNOLOGY DRIVE, SUITE 306 | MURRIETA | CA 92563
951.331.9873 - FMCIVIL.COM

FRANCISCO MARTINEZ JR. — #84640 3/31/20 — R.C.E. / EXP. DATE

BENCHMARK

THE CALIFORNIA SPATIAL REFERENCE CENTER C.O.R.S. "CRFP",
ELEVATION = 2365.54 FEET (NAVD 88).

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CITY OF COLTON

ASHLEY WAY
CONCEPTUAL GRADING
SECTIONS

SCALE:	AS SHOWN
DATE:	JULY 2018
DESIGNED:	AJ
CHECKED:	FM
PLN CK REF:	

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SHEET 2 OF 2 SHEETS

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APPENDIX A

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            San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2014 Version 9.0
      Rational Hydrology Study       Date: 08/19/18
------------------------------------------------------------------------
HIP ASHLEY TECHNOLOGY PARK
EXISTING CONDITIONS WATERSHED A
100-YR STORM EVENT ANALYSIS

------------------------------------------------------------------------


Program License Serial Number 6405

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
   10 Year storm 1 hour rainfall  =      0.732(In.)
  100 Year storm 1 hour rainfall  =      1.140(In.)
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.140 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 3



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       11.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Initial subarea data:
Initial area flow distance =   400.000(Ft.)
Top (of initial area) elevation =   960.000(Ft.)
Bottom (of initial area) elevation =   953.600(Ft.)
Difference in elevation =     6.400(Ft.)
Slope =    0.01600  s(%)=       1.60
TC = k(0.615)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   15.448 min.
Rainfall intensity =      2.573(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.851
Subarea runoff =      1.971(CFS)
Total initial stream area =        0.900(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.140(In/Hr)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   953.600(Ft.)
Downstream point elevation =   947.500(Ft.)
Channel length thru subarea  =   883.000(Ft.)
Channel base width      =    0.500(Ft.)
Slope or 'Z' of left channel bank =  50.000
Slope or 'Z' of right channel bank =  50.000
Estimated mean flow rate at midpoint of channel =      9.264(CFS)
```

Manning's 'N'   = 0.030
Maximum depth of channel =   1.000(Ft.)
Flow(q) thru subarea =   9.264(CFS)
Depth of flow =   0.367(Ft.), Average velocity =   1.341(Ft/s)
Channel flow top width =   37.179(Ft.)
Flow Velocity =   1.34(Ft/s)
Travel time =   10.98 min.
Time of concentration =   26.43 min.
Critical depth =   0.287(Ft.)
Adding area flow to channel
Soil classification AP and SCS values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2) = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000   Max loss rate(Fm)=   0.140(In/Hr)
Rainfall intensity =   1.865(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.832
Subarea runoff =   14.512(CFS) for   9.720(Ac.)
Total runoff =   16.483(CFS)
Effective area this stream =   10.62(Ac.)
Total Study Area (Main Stream No. 1) =   10.62(Ac.)
Area averaged Fm value =   0.140(In/Hr)
Depth of flow =   0.456(Ft.), Average velocity =   1.548(Ft/s)
Critical depth =   0.363(Ft.)
End of computations, Total Study Area =   10.62 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 78.0

```
            San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2014 Version 9.0
      Rational Hydrology Study       Date: 08/19/18
------------------------------------------------------------------------
HIP ASHLEY TECHNOLOGY PARK
EXISTING CONDITIONS WATERSHED B
100-YR STORM EVENT ANALYSIS

------------------------------------------------------------------------


Program License Serial Number 6405

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
   10 Year storm 1 hour rainfall  =      0.732(In.)
  100 Year storm 1 hour rainfall  =      1.140(In.)
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.140 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 3



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      30.000 to Point/Station      31.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 78.00
Adjusted SCS curve number for AMC 3 = 92.80
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.140(In/Hr)
Initial subarea data:
Initial area flow distance =   877.000(Ft.)
Top (of initial area) elevation =   954.300(Ft.)
Bottom (of initial area) elevation =   949.300(Ft.)
Difference in elevation =     5.000(Ft.)
Slope =    0.00570  s(%)=      0.57
TC = k(0.615)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   25.995 min.
Rainfall intensity =      1.883(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.833
Subarea runoff =      0.643(CFS)
Total initial stream area =        0.410(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.140(In/Hr)
End of computations, Total Study Area =            0.41 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  78.0
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APPENDIX B

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            San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2014 Version 9.0
      Rational Hydrology Study        Date: 08/19/18
------------------------------------------------------------------------
HIP ASHLEY TECHNOLOGY PARK
PROPOSED CONDITIONS WATERSHED A
100-YR STORM EVENT ANALYSIS

------------------------------------------------------------------------


Program License Serial Number 6405

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
   10 Year storm 1 hour rainfall  =      0.732(In.)
  100 Year storm 1 hour rainfall  =      1.140(In.)
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.140 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       11.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Initial subarea data:
Initial area flow distance =   400.000(Ft.)
Top (of initial area) elevation =   958.800(Ft.)
Bottom (of initial area) elevation =   953.300(Ft.)
Difference in elevation =     5.500(Ft.)
Slope =    0.01375  s(%)=       1.38
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.871 min.
Rainfall intensity =      3.856(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.882
Subarea runoff =      2.550(CFS)
Total initial stream area =        0.750(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   949.800(Ft.)
Downstream point/station elevation =   949.000(Ft.)
Pipe length  =   117.20(Ft.)   Manning's N = 0.015
No. of pipes = 1  Required pipe flow  =     2.550(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     2.550(CFS)
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```
Normal flow depth in pipe =    7.22(In.)
Flow top width inside pipe =   17.65(In.)
Critical Depth =    7.26(In.)
Pipe flow velocity =      3.85(Ft/s)
Travel time through pipe =    0.51 min.
Time of concentration (TC) =     8.38 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.750(Ac.)
Runoff from this stream =      2.550(CFS)
Time of concentration =    8.38 min.
Rainfall intensity =     3.714(In/Hr)
Area averaged loss rate (Fm) =    0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       14.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Initial subarea data:
Initial area flow distance =   435.000(Ft.)
Top (of initial area) elevation =  1000.600(Ft.)
Bottom (of initial area) elevation =   999.100(Ft.)
Difference in elevation =     1.500(Ft.)
Slope =    0.00345  s(%)=       0.34
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.734 min.
Rainfall intensity =      3.201(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.878
Subarea runoff =      4.469(CFS)
Total initial stream area =        1.590(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   949.800(Ft.)
Downstream point/station elevation =   949.000(Ft.)
Pipe length  =    40.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.469(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     4.469(CFS)
Normal flow depth in pipe =    8.79(In.)
Flow top width inside pipe =   10.62(In.)
Critical Depth =   10.61(In.)
Pipe flow velocity =      7.25(Ft/s)
Travel time through pipe =    0.09 min.
Time of concentration (TC) =    10.83 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
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Process from Point/Station 14.000 to Point/Station 12.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 1.590(Ac.)
Runoff from this stream = 4.469(CFS)
Time of concentration = 10.83 min.
Rainfall intensity = 3.185(In/Hr)
Area averaged loss rate (Fm) = 0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream No.	Flow rate (CFS)	Area (Ac.)	TC (min)	Fm (In/Hr)	Rainfall Intensity (In/Hr)
1	2.55	0.750	8.38	0.079	3.714
2	4.47	1.590	10.83	0.079	3.185

Qmax(1) =
1.000 * 1.000 * 2.550) +
1.170 * 0.774 * 4.469) + = 6.598
Qmax(2) =
0.854 * 1.000 * 2.550) +
1.000 * 1.000 * 4.469) + = 6.648

Total of 2 streams to confluence:
Flow rates before confluence point:
2.550 4.469
Maximum flow rates at confluence using above data:
6.598 6.648
Area of streams before confluence:
0.750 1.590
Effective area values after confluence:
1.981 2.340
Results of confluence:
Total flow rate = 6.648(CFS)
Time of concentration = 10.826 min.
Effective stream area after confluence = 2.340(Ac.)
Study area average Pervious fraction(Ap) = 0.100
Study area average soil loss rate(Fm) = 0.079(In/Hr)
Study area total (this main stream) = 2.34(Ac.)

++
Process from Point/Station 12.000 to Point/Station 15.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 949.000(Ft.)
Downstream point/station elevation = 944.900(Ft.)
Pipe length = 639.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 6.648(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 6.648(CFS)
Normal flow depth in pipe = 12.07(In.)
Flow top width inside pipe = 16.92(In.)
Critical Depth = 11.97(In.)
Pipe flow velocity = 5.28(Ft/s)
Travel time through pipe = 2.02 min.
Time of concentration (TC) = 12.84 min.

++
Process from Point/Station 12.000 to Point/Station 15.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 2.340(Ac.)

```
Runoff from this stream =      6.648(CFS)
Time of concentration =   12.84 min.
Rainfall intensity =     2.875(In/Hr)
Area averaged loss rate (Fm) =    0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      16.000 to Point/Station      17.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Initial subarea data:
Initial area flow distance =   205.000(Ft.)
Top (of initial area) elevation =   951.700(Ft.)
Bottom (of initial area) elevation =   949.600(Ft.)
Difference in elevation =     2.100(Ft.)
Slope =    0.01024  s(%)=      1.02
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.390 min.
Rainfall intensity =      4.370(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.884
Subarea runoff =      0.927(CFS)
Total initial stream area =        0.240(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      17.000 to Point/Station      18.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   947.600(Ft.)
Downstream point/station elevation =   946.300(Ft.)
Pipe length  =    63.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.927(CFS)
Given pipe size =     10.00(In.)
Calculated individual pipe flow  =     0.927(CFS)
Normal flow depth in pipe =    3.72(In.)
Flow top width inside pipe =    9.67(In.)
Critical Depth =    5.12(In.)
Pipe flow velocity =      5.02(Ft/s)
Travel time through pipe =    0.21 min.
Time of concentration (TC) =     6.60 min.


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Process from Point/Station      17.000 to Point/Station      18.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      0.240(Ac.)
Runoff from this stream =      0.927(CFS)
Time of concentration =    6.60 min.
Rainfall intensity =     4.287(In/Hr)
Area averaged loss rate (Fm) =    0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station 19.000 to Point/Station 18.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Initial subarea data:
Initial area flow distance = 311.000(Ft.)
Top (of initial area) elevation = 952.500(Ft.)
Bottom (of initial area) elevation = 949.800(Ft.)
Difference in elevation = 2.700(Ft.)
Slope = 0.00868 s(%)= 0.87
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 7.803 min.
Rainfall intensity = 3.877(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.882
Subarea runoff = 1.812(CFS)
Total initial stream area = 0.530(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.079(In/Hr)

++
Process from Point/Station 19.000 to Point/Station 18.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 2 in normal stream number 2
Stream flow area = 0.530(Ac.)
Runoff from this stream = 1.812(CFS)
Time of concentration = 7.80 min.
Rainfall intensity = 3.877(In/Hr)
Area averaged loss rate (Fm) = 0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream No.	Flow rate (CFS)	Area (Ac.)	TC (min)	Fm (In/Hr)	Rainfall Intensity (In/Hr)
1	0.93	0.240	6.60	0.079	4.287
2	1.81	0.530	7.80	0.079	3.877

Qmax(1) =
1.000 * 1.000 * 0.927) +
1.108 * 0.846 * 1.812) + = 2.625
Qmax(2) =
0.903 * 1.000 * 0.927) +
1.000 * 1.000 * 1.812) + = 2.648

Total of 2 streams to confluence:
Flow rates before confluence point:
0.927 1.812
Maximum flow rates at confluence using above data:
2.625 2.648
Area of streams before confluence:
0.240 0.530
Effective area values after confluence:
0.688 0.770
Results of confluence:
Total flow rate = 2.648(CFS)
Time of concentration = 7.803 min.
Effective stream area after confluence = 0.770(Ac.)
Study area average Pervious fraction(Ap) = 0.100
Study area average soil loss rate(Fm) = 0.079(In/Hr)

```
Study area total (this main stream) =       0.77(Ac.)


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Process from Point/Station       18.000 to Point/Station       20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   946.300(Ft.)
Downstream point/station elevation =   946.060(Ft.)
Pipe length  =    48.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.648(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     2.648(CFS)
Normal flow depth in pipe =    7.43(In.)
Flow top width inside pipe =   17.72(In.)
Critical Depth =    7.40(In.)
Pipe flow velocity =      3.85(Ft/s)
Travel time through pipe =    0.21 min.
Time of concentration (TC) =     8.01 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       20.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      0.770(Ac.)
Runoff from this stream =      2.648(CFS)
Time of concentration =    8.01 min.
Rainfall intensity =     3.816(In/Hr)
Area averaged loss rate (Fm) =    0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       21.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Initial subarea data:
Initial area flow distance =   336.000(Ft.)
Top (of initial area) elevation =  1000.600(Ft.)
Bottom (of initial area) elevation =   996.300(Ft.)
Difference in elevation =     4.300(Ft.)
Slope =    0.01280  s(%)=      1.28
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.447 min.
Rainfall intensity =      3.987(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.882
Subarea runoff =      3.764(CFS)
Total initial stream area =       1.070(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.000 to Point/Station       20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   947.000(Ft.)
Downstream point/station elevation =   946.060(Ft.)
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```
Pipe length  =    46.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.764(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     3.764(CFS)
Normal flow depth in pipe =    7.68(In.)
Flow top width inside pipe =   11.52(In.)
Critical Depth =    9.91(In.)
Pipe flow velocity =      7.10(Ft/s)
Travel time through pipe =    0.11 min.
Time of concentration (TC) =     7.56 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.000 to Point/Station       20.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      1.070(Ac.)
Runoff from this stream =      3.764(CFS)
Time of concentration =    7.56 min.
Rainfall intensity =     3.952(In/Hr)
Area averaged loss rate (Fm) =    0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1      2.65     0.770      8.01    0.079      3.816
2      3.76     1.070      7.56    0.079      3.952
Qmax(1) =
         1.000 *    1.000 *     2.648) +
         0.965 *    1.000 *     3.764) + =       6.279
Qmax(2) =
         1.037 *    0.943 *     2.648) +
         1.000 *    1.000 *     3.764) + =       6.352

Total of 2 streams to confluence:
Flow rates before confluence point:
       2.648       3.764
Maximum flow rates at confluence using above data:
        6.279        6.352
Area of streams before confluence:
        0.770        1.070
Effective area values after confluence:
        1.840        1.796
Results of confluence:
Total flow rate =      6.352(CFS)
Time of concentration =     7.555 min.
Effective stream area after confluence =      1.796(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.079(In/Hr)
Study area total (this main stream) =       1.84(Ac.)


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Process from Point/Station       20.000 to Point/Station       22.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   946.060(Ft.)
Downstream point/station elevation =   944.300(Ft.)
Pipe length  =   556.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.352(CFS)
Given pipe size =     18.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.574(Ft.)  at the headworks or inlet of the pipe(s)
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```
 Pipe friction loss =      2.033(Ft.)
 Minor friction loss =      0.301(Ft.)    K-factor =   1.50
Pipe flow velocity =      3.59(Ft/s)
Travel time through pipe =    2.58 min.
Time of concentration (TC) =    10.13 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station      22.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      1.796(Ac.)
Runoff from this stream =      6.352(CFS)
Time of concentration =   10.13 min.
Rainfall intensity =     3.314(In/Hr)
Area averaged loss rate (Fm) =    0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station      23.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.079(In/Hr)
Initial subarea data:
Initial area flow distance =   219.000(Ft.)
Top (of initial area) elevation =   951.700(Ft.)
Bottom (of initial area) elevation =   949.600(Ft.)
Difference in elevation =     2.100(Ft.)
Slope =    0.00959  s(%)=       0.96
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.648 min.
Rainfall intensity =      4.268(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.883
Subarea runoff =      1.470(CFS)
Total initial stream area =        0.390(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.079(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       23.000 to Point/Station      24.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   946.500(Ft.)
Downstream point/station elevation =   945.000(Ft.)
Pipe length  =    65.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.470(CFS)
Given pipe size =     10.00(In.)
Calculated individual pipe flow  =     1.470(CFS)
Normal flow depth in pipe =    4.65(In.)
Flow top width inside pipe =    9.98(In.)
Critical Depth =    6.52(In.)
Pipe flow velocity =      5.91(Ft/s)
Travel time through pipe =    0.18 min.
Time of concentration (TC) =     6.83 min.
```

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Process from Point/Station 23.000 to Point/Station 24.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 2 in normal stream number 1
Stream flow area = 0.390(Ac.)
Runoff from this stream = 1.470(CFS)
Time of concentration = 6.83 min.
Rainfall intensity = 4.198(In/Hr)
Area averaged loss rate (Fm) = 0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000

++
Process from Point/Station 10.000 to Point/Station 24.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
Initial subarea data:
Initial area flow distance = 965.000(Ft.)
Top (of initial area) elevation = 958.600(Ft.)
Bottom (of initial area) elevation = 950.750(Ft.)
Difference in elevation = 7.850(Ft.)
Slope = 0.00813 s(%)= 0.81
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 12.434 min.
Rainfall intensity = 2.931(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.876
Subarea runoff = 14.377(CFS)
Total initial stream area = 5.600(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.079(In/Hr)

++
Process from Point/Station 10.000 to Point/Station 24.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 2 in normal stream number 2
Stream flow area = 5.600(Ac.)
Runoff from this stream = 14.377(CFS)
Time of concentration = 12.43 min.
Rainfall intensity = 2.931(In/Hr)
Area averaged loss rate (Fm) = 0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream No.	Flow rate (CFS)	Area (Ac.)	TC (min)	Fm (In/Hr)	Rainfall Intensity (In/Hr)
1	1.47	0.390	6.83	0.079	4.198
2	14.38	5.600	12.43	0.079	2.931

Qmax(1) =
1.000 * 1.000 * 1.470) +
1.444 * 0.549 * 14.377) + = 12.878
Qmax(2) =
0.692 * 1.000 * 1.470) +
1.000 * 1.000 * 14.377) + = 15.395

Total of 2 streams to confluence:

```
Flow rates before confluence point:
       1.470      14.377
Maximum flow rates at confluence using above data:
       12.878       15.395
Area of streams before confluence:
        0.390        5.600
Effective area values after confluence:
        3.467        5.990
Results of confluence:
Total flow rate =     15.395(CFS)
Time of concentration =    12.434 min.
Effective stream area after confluence =      5.990(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.079(In/Hr)
Study area total (this main stream) =       5.99(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       24.000 to Point/Station       22.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   945.000(Ft.)
Downstream point/station elevation =   944.300(Ft.)
Pipe length  =    32.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    15.395(CFS)
Given pipe size =     24.00(In.)
Calculated individual pipe flow  =    15.395(CFS)
Normal flow depth in pipe =   11.44(In.)
Flow top width inside pipe =   23.97(In.)
Critical Depth =   16.97(In.)
Pipe flow velocity =     10.43(Ft/s)
Travel time through pipe =    0.05 min.
Time of concentration (TC) =    12.49 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       24.000 to Point/Station       22.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      5.990(Ac.)
Runoff from this stream =     15.395(CFS)
Time of concentration =   12.49 min.
Rainfall intensity =     2.924(In/Hr)
Area averaged loss rate (Fm) =    0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1      6.35     1.796     10.13    0.079      3.314
2     15.39     5.990     12.49    0.079      2.924
Qmax(1) =
         1.000 *    1.000 *     6.352) +
         1.137 *    0.812 *    15.395) + =      20.560
Qmax(2) =
         0.879 *    1.000 *     6.352) +
         1.000 *    1.000 *    15.395) + =      20.981

Total of 2 main streams to confluence:
Flow rates before confluence point:
       7.352      16.395
Maximum flow rates at confluence using above data:
       20.560       20.981
Area of streams before confluence:
```

```
        1.796        5.990
Effective area values after confluence:
        6.658        7.786


Results of confluence:
Total flow rate =     20.981(CFS)
Time of concentration =    12.485 min.
Effective stream area after confluence  =      7.786(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.079(In/Hr)
Study area total =       7.79(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       22.000 to Point/Station       25.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   944.300(Ft.)
Downstream point/station elevation =   943.200(Ft.)
Pipe length  =   204.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    20.981(CFS)
Given pipe size =     24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     1.693(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      1.754(Ft.)
 Minor friction loss =      1.039(Ft.)    K-factor =   1.50
Pipe flow velocity =      6.68(Ft/s)
Travel time through pipe =    0.51 min.
Time of concentration (TC) =    12.99 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       22.000 to Point/Station       25.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      7.786(Ac.)
Runoff from this stream =     20.981(CFS)
Time of concentration =   12.99 min.
Rainfall intensity =     2.855(In/Hr)
Area averaged loss rate (Fm) =    0.0785(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1      6.35     1.796     10.13    0.079      3.314
2     20.98     7.786     12.99    0.079      2.855
Qmax(1) =
         1.000 *    1.000 *     6.352) +
         1.165 *    0.780 *    20.981) + =      25.421
Qmax(2) =
         0.858 *    1.000 *     6.352) +
         1.000 *    1.000 *    20.981) + =      26.432

Total of 2 main streams to confluence:
Flow rates before confluence point:
       7.352      21.981
Maximum flow rates at confluence using above data:
       25.421       26.432
Area of streams before confluence:
        1.796        7.786
Effective area values after confluence:
```

```
        7.868        9.582


Results of confluence:
Total flow rate =     26.432(CFS)
Time of concentration =    12.994 min.
Effective stream area after confluence  =      9.582(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.079(In/Hr)
Study area total =       9.58(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       26.000 to Point/Station       27.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   947.900(Ft.)
Downstream point/station elevation =   947.100(Ft.)
Pipe length  =   146.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    26.432(CFS)
Given pipe size =     30.00(In.)
Calculated individual pipe flow  =    26.432(CFS)
Normal flow depth in pipe =   21.66(In.)
Flow top width inside pipe =   26.88(In.)
Critical Depth =   21.02(In.)
Pipe flow velocity =      6.97(Ft/s)
Travel time through pipe =    0.35 min.
Time of concentration (TC) =    13.34 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       27.000 to Point/Station       28.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   947.100(Ft.)
Downstream point/station elevation =   946.230(Ft.)
Pipe length  =    59.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    26.432(CFS)
Given pipe size =     30.00(In.)
Calculated individual pipe flow  =    26.432(CFS)
Normal flow depth in pipe =   15.54(In.)
Flow top width inside pipe =   29.98(In.)
Critical Depth =   21.02(In.)
Pipe flow velocity =     10.30(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =    13.44 min.
End of computations, Total Study Area =           10.17 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number =  32.0
```

```
            San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2014 Version 9.0
      Rational Hydrology Study        Date: 08/19/18
------------------------------------------------------------------------
HIP ASHLEY TECHNOLOGY PARK
PROPOSED CONDITIONS WATERSHED B
100-YR STORM EVENT ANALYSIS

------------------------------------------------------------------------


Program License Serial Number 6405

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
   10 Year storm 1 hour rainfall  =      0.732(In.)
  100 Year storm 1 hour rainfall  =      1.140(In.)
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.140 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 3



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       30.000 to Point/Station       31.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Soil classification AP and SCS  values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.785(In/Hr)
Initial subarea data:
Initial area flow distance =   877.000(Ft.)
Top (of initial area) elevation =   954.300(Ft.)
Bottom (of initial area) elevation =   949.300(Ft.)
Difference in elevation =     5.000(Ft.)
Slope =    0.00570  s(%)=       0.57
TC = k(0.950)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   40.154 min.
Rainfall intensity =      1.451(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.413
Subarea runoff =      0.521(CFS)
Total initial stream area =        0.870(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.785(In/Hr)
End of computations, Total Study Area =            0.87 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  32.0
```

APPENDIX C

U n i t   H y d r o g r a p h   A n a l y s i s

Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2014, Version 9.0

Study date 08/20/18

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San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 6405

HIP ASHLEY TECHNOLOGY PARK
EXISTING CONDITIONS WATERSHED A
100-YEAR STORM EVENT, 24 HOUR RAINFALL

Storm Event Year = 100

Antecedent Moisture Condition = 3

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 10		
10.62	1	0.73
Rainfall data for year 2		
10.62	6	1.14
Rainfall data for year 2		
10.62	24	2.03
Rainfall data for year 100		
10.62	1	1.14
Rainfall data for year 100		
10.62	6	2.65
Rainfall data for year 100		
10.62	24	4.76

++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	SCS curve NO.(AMC 3)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
78.0	92.8	10.62	1.000	0.140	1.000	0.140

Area-averaged adjusted loss rate Fm (In/Hr) = 0.140

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC3)	S	Pervious Yield Fr
10.62	1.000	78.0	92.8	0.78	0.828

Area-averaged catchment yield fraction, Y = 0.828
Area-averaged low loss fraction, Yb = 0.172
User entry of time of concentration = 0.441 (hours)
++
Watershed area = 10.62(Ac.)
Catchment Lag time = 0.352 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 23.6474
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.140(In/Hr)
Average low loss rate fraction (Yb) = 0.172 (decimal)
VALLEY UNDEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.422(In)
Computed peak 30-minute rainfall = 0.864(In)
Specified peak 1-hour rainfall = 1.140(In)
Computed peak 3-hour rainfall = 1.912(In)
Specified peak 6-hour rainfall = 2.650(In)
Specified peak 24-hour rainfall = 4.760(In)

Rainfall depth area reduction factors:
Using a total area of 10.62(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000 Adjusted rainfall = 0.422(In)
30-minute factor = 1.000 Adjusted rainfall = 0.864(In)
1-hour factor = 1.000 Adjusted rainfall = 1.139(In)
3-hour factor = 1.000 Adjusted rainfall = 1.912(In)
6-hour factor = 1.000 Adjusted rainfall = 2.650(In)
24-hour factor = 1.000 Adjusted rainfall = 4.760(In)

U n i t H y d r o g r a p h
+++

(K = 128.44 (CFS))

Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
1	2.155	2.768
2	9.094	8.912
3	21.352	15.743
4	37.598	20.867
5	53.232	20.079
6	63.529	13.224
7	70.178	8.540
8	74.607	5.688
9	78.051	4.423
10	80.902	3.662
11	83.304	3.084
12	85.405	2.699
13	87.169	2.265
14	88.654	1.908
15	90.066	1.813
16	91.228	1.492
17	92.267	1.335
18	93.143	1.125
19	93.899	0.972
20	94.634	0.943
21	95.343	0.911
22	95.983	0.822
23	96.505	0.671

24	97.000	0.635
25	97.428	0.551
26	97.836	0.523
27	98.173	0.434
28	98.492	0.409
29	98.740	0.318
30	98.976	0.304
31	99.212	0.304
32	99.449	0.304
33	99.685	0.304
34	100.000	0.152

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.4217	0.4217
2	0.5565	0.1347
3	0.6544	0.0980
4	0.7342	0.0798
5	0.8028	0.0686
6	0.8635	0.0607
7	0.9184	0.0549
8	0.9688	0.0504
9	1.0156	0.0467
10	1.0593	0.0437
11	1.1005	0.0412
12	1.1394	0.0390
13	1.1832	0.0438
14	1.2253	0.0420
15	1.2658	0.0405
16	1.3048	0.0391
17	1.3427	0.0378
18	1.3793	0.0367
19	1.4149	0.0356
20	1.4495	0.0346
21	1.4832	0.0337
22	1.5161	0.0329
23	1.5482	0.0321
24	1.5795	0.0314
25	1.6102	0.0307
26	1.6402	0.0300
27	1.6697	0.0294
28	1.6985	0.0289
29	1.7268	0.0283
30	1.7546	0.0278
31	1.7820	0.0273
32	1.8088	0.0269
33	1.8352	0.0264
34	1.8612	0.0260
35	1.8868	0.0256
36	1.9120	0.0252
37	1.9369	0.0248
38	1.9613	0.0245
39	1.9855	0.0241
40	2.0093	0.0238
41	2.0328	0.0235
42	2.0560	0.0232
43	2.0789	0.0229
44	2.1015	0.0226
45	2.1239	0.0224
46	2.1460	0.0221
47	2.1678	0.0218
48	2.1894	0.0216
49	2.2107	0.0214
50	2.2319	0.0211
51	2.2528	0.0209
52	2.2735	0.0207
53	2.2940	0.0205
54	2.3142	0.0203

55	2.3343	0.0201
56	2.3542	0.0199
57	2.3739	0.0197
58	2.3934	0.0195
59	2.4128	0.0193
60	2.4319	0.0192
61	2.4509	0.0190
62	2.4698	0.0188
63	2.4884	0.0187
64	2.5070	0.0185
65	2.5253	0.0184
66	2.5435	0.0182
67	2.5616	0.0181
68	2.5795	0.0179
69	2.5973	0.0178
70	2.6150	0.0177
71	2.6325	0.0175
72	2.6499	0.0174
73	2.6654	0.0155
74	2.6808	0.0154
75	2.6960	0.0152
76	2.7111	0.0151
77	2.7262	0.0150
78	2.7411	0.0149
79	2.7559	0.0148
80	2.7705	0.0147
81	2.7851	0.0146
82	2.7996	0.0145
83	2.8140	0.0144
84	2.8282	0.0143
85	2.8424	0.0142
86	2.8565	0.0141
87	2.8705	0.0140
88	2.8844	0.0139
89	2.8982	0.0138
90	2.9119	0.0137
91	2.9255	0.0136
92	2.9391	0.0135
93	2.9525	0.0135
94	2.9659	0.0134
95	2.9792	0.0133
96	2.9924	0.0132
97	3.0055	0.0131
98	3.0186	0.0131
99	3.0315	0.0130
100	3.0444	0.0129
101	3.0573	0.0128
102	3.0700	0.0128
103	3.0827	0.0127
104	3.0953	0.0126
105	3.1079	0.0125
106	3.1203	0.0125
107	3.1327	0.0124
108	3.1451	0.0123
109	3.1573	0.0123
110	3.1695	0.0122
111	3.1817	0.0121
112	3.1938	0.0121
113	3.2058	0.0120
114	3.2177	0.0120
115	3.2296	0.0119
116	3.2415	0.0118
117	3.2532	0.0118
118	3.2650	0.0117
119	3.2766	0.0117
120	3.2882	0.0116
121	3.2998	0.0115
122	3.3113	0.0115

123	3.3227	0.0114
124	3.3341	0.0114
125	3.3454	0.0113
126	3.3567	0.0113
127	3.3679	0.0112
128	3.3791	0.0112
129	3.3903	0.0111
130	3.4013	0.0111
131	3.4124	0.0110
132	3.4233	0.0110
133	3.4343	0.0109
134	3.4452	0.0109
135	3.4560	0.0108
136	3.4668	0.0108
137	3.4775	0.0107
138	3.4882	0.0107
139	3.4989	0.0107
140	3.5095	0.0106
141	3.5201	0.0106
142	3.5306	0.0105
143	3.5411	0.0105
144	3.5515	0.0104
145	3.5619	0.0104
146	3.5723	0.0104
147	3.5826	0.0103
148	3.5929	0.0103
149	3.6031	0.0102
150	3.6133	0.0102
151	3.6235	0.0102
152	3.6336	0.0101
153	3.6437	0.0101
154	3.6537	0.0100
155	3.6637	0.0100
156	3.6737	0.0100
157	3.6836	0.0099
158	3.6935	0.0099
159	3.7034	0.0099
160	3.7132	0.0098
161	3.7230	0.0098
162	3.7327	0.0098
163	3.7425	0.0097
164	3.7521	0.0097
165	3.7618	0.0096
166	3.7714	0.0096
167	3.7810	0.0096
168	3.7905	0.0095
169	3.8001	0.0095
170	3.8095	0.0095
171	3.8190	0.0095
172	3.8284	0.0094
173	3.8378	0.0094
174	3.8472	0.0094
175	3.8565	0.0093
176	3.8658	0.0093
177	3.8750	0.0093
178	3.8843	0.0092
179	3.8935	0.0092
180	3.9027	0.0092
181	3.9118	0.0091
182	3.9209	0.0091
183	3.9300	0.0091
184	3.9391	0.0091
185	3.9481	0.0090
186	3.9571	0.0090
187	3.9661	0.0090
188	3.9750	0.0089
189	3.9839	0.0089
190	3.9928	0.0089

191	4.0017	0.0089
192	4.0105	0.0088
193	4.0194	0.0088
194	4.0281	0.0088
195	4.0369	0.0088
196	4.0456	0.0087
197	4.0543	0.0087
198	4.0630	0.0087
199	4.0717	0.0087
200	4.0803	0.0086
201	4.0889	0.0086
202	4.0975	0.0086
203	4.1061	0.0086
204	4.1146	0.0085
205	4.1231	0.0085
206	4.1316	0.0085
207	4.1400	0.0085
208	4.1485	0.0084
209	4.1569	0.0084
210	4.1653	0.0084
211	4.1737	0.0084
212	4.1820	0.0083
213	4.1903	0.0083
214	4.1986	0.0083
215	4.2069	0.0083
216	4.2152	0.0083
217	4.2234	0.0082
218	4.2316	0.0082
219	4.2398	0.0082
220	4.2480	0.0082
221	4.2561	0.0081
222	4.2642	0.0081
223	4.2723	0.0081
224	4.2804	0.0081
225	4.2885	0.0081
226	4.2965	0.0080
227	4.3046	0.0080
228	4.3126	0.0080
229	4.3205	0.0080
230	4.3285	0.0080
231	4.3364	0.0079
232	4.3444	0.0079
233	4.3523	0.0079
234	4.3602	0.0079
235	4.3680	0.0079
236	4.3759	0.0078
237	4.3837	0.0078
238	4.3915	0.0078
239	4.3993	0.0078
240	4.4070	0.0078
241	4.4148	0.0077
242	4.4225	0.0077
243	4.4302	0.0077
244	4.4379	0.0077
245	4.4456	0.0077
246	4.4533	0.0077
247	4.4609	0.0076
248	4.4685	0.0076
249	4.4761	0.0076
250	4.4837	0.0076
251	4.4913	0.0076
252	4.4988	0.0076
253	4.5064	0.0075
254	4.5139	0.0075
255	4.5214	0.0075
256	4.5289	0.0075
257	4.5363	0.0075
258	4.5438	0.0074

259	4.5512	0.0074
260	4.5586	0.0074
261	4.5660	0.0074
262	4.5734	0.0074
263	4.5808	0.0074
264	4.5881	0.0074
265	4.5955	0.0073
266	4.6028	0.0073
267	4.6101	0.0073
268	4.6174	0.0073
269	4.6246	0.0073
270	4.6319	0.0073
271	4.6391	0.0072
272	4.6464	0.0072
273	4.6536	0.0072
274	4.6608	0.0072
275	4.6679	0.0072
276	4.6751	0.0072
277	4.6823	0.0071
278	4.6894	0.0071
279	4.6965	0.0071
280	4.7036	0.0071
281	4.7107	0.0071
282	4.7178	0.0071
283	4.7248	0.0071
284	4.7319	0.0070
285	4.7389	0.0070
286	4.7459	0.0070
287	4.7529	0.0070
288	4.7599	0.0070

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0070	0.0012	0.0058
2	0.0070	0.0012	0.0058
3	0.0070	0.0012	0.0058
4	0.0070	0.0012	0.0058
5	0.0071	0.0012	0.0059
6	0.0071	0.0012	0.0059
7	0.0071	0.0012	0.0059
8	0.0071	0.0012	0.0059
9	0.0072	0.0012	0.0059
10	0.0072	0.0012	0.0059
11	0.0072	0.0012	0.0060
12	0.0072	0.0012	0.0060
13	0.0073	0.0012	0.0060
14	0.0073	0.0013	0.0060
15	0.0073	0.0013	0.0060
16	0.0073	0.0013	0.0061
17	0.0074	0.0013	0.0061
18	0.0074	0.0013	0.0061
19	0.0074	0.0013	0.0061
20	0.0074	0.0013	0.0061
21	0.0074	0.0013	0.0062
22	0.0075	0.0013	0.0062
23	0.0075	0.0013	0.0062
24	0.0075	0.0013	0.0062
25	0.0076	0.0013	0.0063
26	0.0076	0.0013	0.0063
27	0.0076	0.0013	0.0063
28	0.0076	0.0013	0.0063
29	0.0077	0.0013	0.0063
30	0.0077	0.0013	0.0064
31	0.0077	0.0013	0.0064
32	0.0077	0.0013	0.0064
33	0.0078	0.0013	0.0064

34	0.0078	0.0013	0.0064
35	0.0078	0.0013	0.0065
36	0.0078	0.0013	0.0065
37	0.0079	0.0014	0.0065
38	0.0079	0.0014	0.0065
39	0.0079	0.0014	0.0066
40	0.0080	0.0014	0.0066
41	0.0080	0.0014	0.0066
42	0.0080	0.0014	0.0066
43	0.0081	0.0014	0.0067
44	0.0081	0.0014	0.0067
45	0.0081	0.0014	0.0067
46	0.0081	0.0014	0.0067
47	0.0082	0.0014	0.0068
48	0.0082	0.0014	0.0068
49	0.0083	0.0014	0.0068
50	0.0083	0.0014	0.0069
51	0.0083	0.0014	0.0069
52	0.0083	0.0014	0.0069
53	0.0084	0.0014	0.0069
54	0.0084	0.0014	0.0070
55	0.0085	0.0015	0.0070
56	0.0085	0.0015	0.0070
57	0.0085	0.0015	0.0071
58	0.0086	0.0015	0.0071
59	0.0086	0.0015	0.0071
60	0.0086	0.0015	0.0071
61	0.0087	0.0015	0.0072
62	0.0087	0.0015	0.0072
63	0.0088	0.0015	0.0073
64	0.0088	0.0015	0.0073
65	0.0088	0.0015	0.0073
66	0.0089	0.0015	0.0073
67	0.0089	0.0015	0.0074
68	0.0089	0.0015	0.0074
69	0.0090	0.0015	0.0075
70	0.0090	0.0016	0.0075
71	0.0091	0.0016	0.0075
72	0.0091	0.0016	0.0075
73	0.0092	0.0016	0.0076
74	0.0092	0.0016	0.0076
75	0.0093	0.0016	0.0077
76	0.0093	0.0016	0.0077
77	0.0094	0.0016	0.0077
78	0.0094	0.0016	0.0078
79	0.0095	0.0016	0.0078
80	0.0095	0.0016	0.0079
81	0.0095	0.0016	0.0079
82	0.0096	0.0016	0.0079
83	0.0096	0.0017	0.0080
84	0.0097	0.0017	0.0080
85	0.0098	0.0017	0.0081
86	0.0098	0.0017	0.0081
87	0.0099	0.0017	0.0082
88	0.0099	0.0017	0.0082
89	0.0100	0.0017	0.0083
90	0.0100	0.0017	0.0083
91	0.0101	0.0017	0.0083
92	0.0101	0.0017	0.0084
93	0.0102	0.0018	0.0084
94	0.0102	0.0018	0.0085
95	0.0103	0.0018	0.0085
96	0.0104	0.0018	0.0086
97	0.0104	0.0018	0.0086
98	0.0105	0.0018	0.0087
99	0.0106	0.0018	0.0088
100	0.0106	0.0018	0.0088
101	0.0107	0.0018	0.0089

102	0.0107	0.0018	0.0089
103	0.0108	0.0019	0.0090
104	0.0109	0.0019	0.0090
105	0.0110	0.0019	0.0091
106	0.0110	0.0019	0.0091
107	0.0111	0.0019	0.0092
108	0.0112	0.0019	0.0093
109	0.0113	0.0019	0.0093
110	0.0113	0.0020	0.0094
111	0.0114	0.0020	0.0095
112	0.0115	0.0020	0.0095
113	0.0116	0.0020	0.0096
114	0.0117	0.0020	0.0097
115	0.0118	0.0020	0.0098
116	0.0118	0.0020	0.0098
117	0.0120	0.0021	0.0099
118	0.0120	0.0021	0.0099
119	0.0121	0.0021	0.0101
120	0.0122	0.0021	0.0101
121	0.0123	0.0021	0.0102
122	0.0124	0.0021	0.0103
123	0.0125	0.0022	0.0104
124	0.0126	0.0022	0.0104
125	0.0128	0.0022	0.0106
126	0.0128	0.0022	0.0106
127	0.0130	0.0022	0.0107
128	0.0131	0.0022	0.0108
129	0.0132	0.0023	0.0109
130	0.0133	0.0023	0.0110
131	0.0135	0.0023	0.0111
132	0.0135	0.0023	0.0112
133	0.0137	0.0024	0.0114
134	0.0138	0.0024	0.0114
135	0.0140	0.0024	0.0116
136	0.0141	0.0024	0.0117
137	0.0143	0.0025	0.0118
138	0.0144	0.0025	0.0119
139	0.0146	0.0025	0.0121
140	0.0147	0.0025	0.0122
141	0.0149	0.0026	0.0123
142	0.0150	0.0026	0.0124
143	0.0152	0.0026	0.0126
144	0.0154	0.0026	0.0127
145	0.0174	0.0030	0.0144
146	0.0175	0.0030	0.0145
147	0.0178	0.0031	0.0147
148	0.0179	0.0031	0.0148
149	0.0182	0.0031	0.0151
150	0.0184	0.0032	0.0152
151	0.0187	0.0032	0.0155
152	0.0188	0.0032	0.0156
153	0.0192	0.0033	0.0159
154	0.0193	0.0033	0.0160
155	0.0197	0.0034	0.0163
156	0.0199	0.0034	0.0165
157	0.0203	0.0035	0.0168
158	0.0205	0.0035	0.0170
159	0.0209	0.0036	0.0173
160	0.0211	0.0036	0.0175
161	0.0216	0.0037	0.0179
162	0.0218	0.0038	0.0181
163	0.0224	0.0038	0.0185
164	0.0226	0.0039	0.0187
165	0.0232	0.0040	0.0192
166	0.0235	0.0040	0.0195
167	0.0241	0.0042	0.0200
168	0.0245	0.0042	0.0203
169	0.0252	0.0043	0.0209

170	0.0256	0.0044	0.0212
171	0.0264	0.0045	0.0219
172	0.0269	0.0046	0.0222
173	0.0278	0.0048	0.0230
174	0.0283	0.0049	0.0234
175	0.0294	0.0051	0.0244
176	0.0300	0.0052	0.0249
177	0.0314	0.0054	0.0260
178	0.0321	0.0055	0.0266
179	0.0337	0.0058	0.0279
180	0.0346	0.0060	0.0287
181	0.0367	0.0063	0.0303
182	0.0378	0.0065	0.0313
183	0.0405	0.0070	0.0335
184	0.0420	0.0072	0.0348
185	0.0390	0.0067	0.0323
186	0.0412	0.0071	0.0341
187	0.0467	0.0080	0.0387
188	0.0504	0.0087	0.0417
189	0.0607	0.0105	0.0503
190	0.0686	0.0117	0.0569
191	0.0980	0.0117	0.0863
192	0.1347	0.0117	0.1231
193	0.4217	0.0117	0.4100
194	0.0798	0.0117	0.0681
195	0.0549	0.0095	0.0455
196	0.0437	0.0075	0.0362
197	0.0438	0.0075	0.0363
198	0.0391	0.0067	0.0324
199	0.0356	0.0061	0.0295
200	0.0329	0.0057	0.0272
201	0.0307	0.0053	0.0254
202	0.0289	0.0050	0.0239
203	0.0273	0.0047	0.0226
204	0.0260	0.0045	0.0215
205	0.0248	0.0043	0.0206
206	0.0238	0.0041	0.0197
207	0.0229	0.0039	0.0190
208	0.0221	0.0038	0.0183
209	0.0214	0.0037	0.0177
210	0.0207	0.0036	0.0171
211	0.0201	0.0035	0.0166
212	0.0195	0.0034	0.0162
213	0.0190	0.0033	0.0157
214	0.0185	0.0032	0.0153
215	0.0181	0.0031	0.0150
216	0.0177	0.0030	0.0146
217	0.0155	0.0027	0.0128
218	0.0151	0.0026	0.0125
219	0.0148	0.0025	0.0122
220	0.0145	0.0025	0.0120
221	0.0142	0.0024	0.0117
222	0.0139	0.0024	0.0115
223	0.0136	0.0023	0.0113
224	0.0134	0.0023	0.0111
225	0.0131	0.0023	0.0109
226	0.0129	0.0022	0.0107
227	0.0127	0.0022	0.0105
228	0.0125	0.0021	0.0103
229	0.0123	0.0021	0.0102
230	0.0121	0.0021	0.0100
231	0.0119	0.0020	0.0098
232	0.0117	0.0020	0.0097
233	0.0115	0.0020	0.0096
234	0.0114	0.0020	0.0094
235	0.0112	0.0019	0.0093
236	0.0111	0.0019	0.0092
237	0.0109	0.0019	0.0091

238	0.0108	0.0019	0.0089
239	0.0107	0.0018	0.0088
240	0.0105	0.0018	0.0087
241	0.0104	0.0018	0.0086
242	0.0103	0.0018	0.0085
243	0.0102	0.0017	0.0084
244	0.0100	0.0017	0.0083
245	0.0099	0.0017	0.0082
246	0.0098	0.0017	0.0081
247	0.0097	0.0017	0.0080
248	0.0096	0.0017	0.0080
249	0.0095	0.0016	0.0079
250	0.0094	0.0016	0.0078
251	0.0093	0.0016	0.0077
252	0.0092	0.0016	0.0076
253	0.0091	0.0016	0.0076
254	0.0091	0.0016	0.0075
255	0.0090	0.0015	0.0074
256	0.0089	0.0015	0.0074
257	0.0088	0.0015	0.0073
258	0.0087	0.0015	0.0072
259	0.0087	0.0015	0.0072
260	0.0086	0.0015	0.0071
261	0.0085	0.0015	0.0070
262	0.0084	0.0015	0.0070
263	0.0084	0.0014	0.0069
264	0.0083	0.0014	0.0069
265	0.0082	0.0014	0.0068
266	0.0082	0.0014	0.0068
267	0.0081	0.0014	0.0067
268	0.0080	0.0014	0.0067
269	0.0080	0.0014	0.0066
270	0.0079	0.0014	0.0066
271	0.0079	0.0014	0.0065
272	0.0078	0.0013	0.0065
273	0.0077	0.0013	0.0064
274	0.0077	0.0013	0.0064
275	0.0076	0.0013	0.0063
276	0.0076	0.0013	0.0063
277	0.0075	0.0013	0.0062
278	0.0075	0.0013	0.0062
279	0.0074	0.0013	0.0062
280	0.0074	0.0013	0.0061
281	0.0073	0.0013	0.0061
282	0.0073	0.0013	0.0060
283	0.0072	0.0012	0.0060
284	0.0072	0.0012	0.0060
285	0.0071	0.0012	0.0059
286	0.0071	0.0012	0.0059
287	0.0071	0.0012	0.0058
288	0.0070	0.0012	0.0058

```
-------------------------------------------------------------------
-------------------------------------------------------------------
Total soil rain loss =      0.74(In)
Total effective rainfall =      4.02(In)
Peak flow rate in flood hydrograph =     15.55(CFS)
--------------------------------------------------------------------
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                    24 - H O U R   S T O R M
               R u n o f f     H y d r o g r a p h
-------------------------------------------------------------------
            Hydrograph in   5   Minute intervals ((CFS))

-------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0      10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5      0.0001      0.02  Q         |         |         |         |
  0+10      0.0006      0.07  Q         |         |         |         |
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 0+15        0.0017       0.16  Q         |          |          |          |
 0+20        0.0036       0.28  Q         |          |          |          |
 0+25        0.0063       0.40  Q         |          |          |          |
 0+30        0.0096       0.47  Q         |          |          |          |
 0+35        0.0132       0.53  VQ        |          |          |          |
 0+40        0.0171       0.56  VQ        |          |          |          |
 0+45        0.0211       0.59  VQ        |          |          |          |
 0+50        0.0253       0.61  VQ        |          |          |          |
 0+55        0.0297       0.63  VQ        |          |          |          |
 1+ 0        0.0341       0.65  VQ        |          |          |          |
 1+ 5        0.0387       0.66  VQ        |          |          |          |
 1+10        0.0434       0.68  VQ        |          |          |          |
 1+15        0.0481       0.69  VQ        |          |          |          |
 1+20        0.0529       0.70  VQ        |          |          |          |
 1+25        0.0578       0.71  VQ        |          |          |          |
 1+30        0.0627       0.72  VQ        |          |          |          |
 1+35        0.0677       0.73  VQ        |          |          |          |
 1+40        0.0728       0.73  VQ        |          |          |          |
 1+45        0.0779       0.74  VQ        |          |          |          |
 1+50        0.0831       0.75  VQ        |          |          |          |
 1+55        0.0883       0.76  VQ        |          |          |          |
 2+ 0        0.0935       0.76  |Q        |          |          |          |
 2+ 5        0.0988       0.77  |Q        |          |          |          |
 2+10        0.1041       0.77  |Q        |          |          |          |
 2+15        0.1095       0.78  |Q        |          |          |          |
 2+20        0.1149       0.78  |Q        |          |          |          |
 2+25        0.1203       0.79  |Q        |          |          |          |
 2+30        0.1257       0.79  |Q        |          |          |          |
 2+35        0.1312       0.80  |Q        |          |          |          |
 2+40        0.1367       0.80  |Q        |          |          |          |
 2+45        0.1423       0.81  |Q        |          |          |          |
 2+50        0.1478       0.81  |Q        |          |          |          |
 2+55        0.1534       0.81  |Q        |          |          |          |
 3+ 0        0.1590       0.81  |Q        |          |          |          |
 3+ 5        0.1647       0.82  |Q        |          |          |          |
 3+10        0.1703       0.82  |Q        |          |          |          |
 3+15        0.1760       0.82  |Q        |          |          |          |
 3+20        0.1817       0.83  |QV       |          |          |          |
 3+25        0.1874       0.83  |QV       |          |          |          |
 3+30        0.1931       0.83  |QV       |          |          |          |
 3+35        0.1989       0.84  |QV       |          |          |          |
 3+40        0.2047       0.84  |QV       |          |          |          |
 3+45        0.2105       0.84  |QV       |          |          |          |
 3+50        0.2163       0.84  |QV       |          |          |          |
 3+55        0.2221       0.85  |QV       |          |          |          |
 4+ 0        0.2280       0.85  |QV       |          |          |          |
 4+ 5        0.2339       0.85  |QV       |          |          |          |
 4+10        0.2398       0.86  |QV       |          |          |          |
 4+15        0.2457       0.86  |QV       |          |          |          |
 4+20        0.2517       0.86  |QV       |          |          |          |
 4+25        0.2576       0.87  |QV       |          |          |          |
 4+30        0.2636       0.87  |QV       |          |          |          |
 4+35        0.2697       0.88  |Q V      |          |          |          |
 4+40        0.2757       0.88  |Q V      |          |          |          |
 4+45        0.2818       0.88  |Q V      |          |          |          |
 4+50        0.2879       0.89  |Q V      |          |          |          |
 4+55        0.2940       0.89  |Q V      |          |          |          |
 5+ 0        0.3002       0.89  |Q V      |          |          |          |
 5+ 5        0.3064       0.90  |Q V      |          |          |          |
 5+10        0.3126       0.90  |Q V      |          |          |          |
 5+15        0.3188       0.90  |Q V      |          |          |          |
 5+20        0.3250       0.91  |Q V      |          |          |          |
 5+25        0.3313       0.91  |Q V      |          |          |          |
 5+30        0.3376       0.92  |Q V      |          |          |          |
 5+35        0.3440       0.92  |Q V      |          |          |          |
 5+40        0.3503       0.92  |Q V      |          |          |          |
 5+45        0.3567       0.93  |Q  V     |          |          |          |
 5+50        0.3632       0.93  |Q  V     |          |          |          |
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  5+55       0.3696       0.94  |Q  V     |         |         |         |
  6+ 0       0.3761       0.94  |Q  V     |         |         |         |
  6+ 5       0.3826       0.95  |Q  V     |         |         |         |
  6+10       0.3891       0.95  |Q  V     |         |         |         |
  6+15       0.3957       0.95  |Q  V     |         |         |         |
  6+20       0.4023       0.96  |Q  V     |         |         |         |
  6+25       0.4089       0.96  |Q  V     |         |         |         |
  6+30       0.4156       0.97  |Q  V     |         |         |         |
  6+35       0.4223       0.97  |Q  V     |         |         |         |
  6+40       0.4290       0.98  |Q  V     |         |         |         |
  6+45       0.4358       0.98  |Q  V     |         |         |         |
  6+50       0.4426       0.99  |Q  V     |         |         |         |
  6+55       0.4494       0.99  |Q   V    |         |         |         |
  7+ 0       0.4563       1.00  |Q   V    |         |         |         |
  7+ 5       0.4632       1.00  | Q  V    |         |         |         |
  7+10       0.4701       1.01  | Q  V    |         |         |         |
  7+15       0.4771       1.01  | Q  V    |         |         |         |
  7+20       0.4841       1.02  | Q  V    |         |         |         |
  7+25       0.4911       1.02  | Q  V    |         |         |         |
  7+30       0.4982       1.03  | Q  V    |         |         |         |
  7+35       0.5053       1.03  | Q  V    |         |         |         |
  7+40       0.5125       1.04  | Q  V    |         |         |         |
  7+45       0.5197       1.04  | Q  V    |         |         |         |
  7+50       0.5269       1.05  | Q  V    |         |         |         |
  7+55       0.5342       1.06  | Q   V   |         |         |         |
  8+ 0       0.5415       1.06  | Q   V   |         |         |         |
  8+ 5       0.5489       1.07  | Q   V   |         |         |         |
  8+10       0.5563       1.07  | Q   V   |         |         |         |
  8+15       0.5637       1.08  | Q   V   |         |         |         |
  8+20       0.5712       1.09  | Q   V   |         |         |         |
  8+25       0.5787       1.09  | Q   V   |         |         |         |
  8+30       0.5863       1.10  | Q   V   |         |         |         |
  8+35       0.5939       1.11  | Q   V   |         |         |         |
  8+40       0.6016       1.11  | Q   V   |         |         |         |
  8+45       0.6093       1.12  | Q   V   |         |         |         |
  8+50       0.6171       1.13  | Q   V   |         |         |         |
  8+55       0.6249       1.13  | Q    V  |         |         |         |
  9+ 0       0.6328       1.14  | Q    V  |         |         |         |
  9+ 5       0.6407       1.15  | Q    V  |         |         |         |
  9+10       0.6486       1.16  | Q    V  |         |         |         |
  9+15       0.6566       1.16  | Q    V  |         |         |         |
  9+20       0.6647       1.17  | Q    V  |         |         |         |
  9+25       0.6728       1.18  | Q    V  |         |         |         |
  9+30       0.6810       1.19  | Q    V  |         |         |         |
  9+35       0.6892       1.20  | Q    V  |         |         |         |
  9+40       0.6975       1.20  | Q    V  |         |         |         |
  9+45       0.7059       1.21  | Q    V  |         |         |         |
  9+50       0.7143       1.22  | Q     V |         |         |         |
  9+55       0.7228       1.23  | Q     V |         |         |         |
 10+ 0       0.7313       1.24  | Q     V |         |         |         |
 10+ 5       0.7399       1.25  | Q     V |         |         |         |
 10+10       0.7486       1.26  | Q     V |         |         |         |
 10+15       0.7573       1.27  | Q     V |         |         |         |
 10+20       0.7661       1.28  | Q     V |         |         |         |
 10+25       0.7749       1.29  | Q     V |         |         |         |
 10+30       0.7839       1.30  | Q     V |         |         |         |
 10+35       0.7929       1.31  | Q     V |         |         |         |
 10+40       0.8020       1.32  | Q      V|         |         |         |
 10+45       0.8111       1.33  | Q      V|         |         |         |
 10+50       0.8204       1.34  | Q      V|         |         |         |
 10+55       0.8297       1.35  | Q      V|         |         |         |
 11+ 0       0.8391       1.36  | Q      V|         |         |         |
 11+ 5       0.8485       1.38  | Q      V|         |         |         |
 11+10       0.8581       1.39  | Q      V|         |         |         |
 11+15       0.8677       1.40  | Q      V|         |         |         |
 11+20       0.8775       1.41  | Q      V|         |         |         |
 11+25       0.8873       1.43  | Q      V|         |         |         |
 11+30       0.8972       1.44  | Q       V         |         |         |
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11+35       0.9072      1.45  | Q       V         |         |         |
11+40       0.9173      1.47  | Q       V         |         |         |
11+45       0.9276      1.48  | Q       V         |         |         |
11+50       0.9379      1.50  | Q       V         |         |         |
11+55       0.9483      1.51  |  Q      V         |         |         |
12+ 0       0.9588      1.53  |  Q      V         |         |         |
12+ 5       0.9695      1.55  |  Q      V         |         |         |
12+10       0.9804      1.58  |  Q      |V        |         |         |
12+15       0.9916      1.62  |  Q      |V        |         |         |
12+20       1.0031      1.67  |  Q      |V        |         |         |
12+25       1.0149      1.72  |  Q      |V        |         |         |
12+30       1.0270      1.76  |  Q      |V        |         |         |
12+35       1.0393      1.79  |  Q      |V        |         |         |
12+40       1.0519      1.82  |  Q      |V        |         |         |
12+45       1.0646      1.85  |  Q      |V        |         |         |
12+50       1.0775      1.88  |  Q      | V       |         |         |
12+55       1.0906      1.90  |  Q      | V       |         |         |
13+ 0       1.1039      1.93  |  Q      | V       |         |         |
13+ 5       1.1174      1.96  |  Q      | V       |         |         |
13+10       1.1311      1.99  |  Q      | V       |         |         |
13+15       1.1450      2.02  |   Q     | V       |         |         |
13+20       1.1591      2.05  |   Q     |  V      |         |         |
13+25       1.1734      2.08  |   Q     |  V      |         |         |
13+30       1.1880      2.11  |   Q     |  V      |         |         |
13+35       1.2027      2.14  |   Q     |  V      |         |         |
13+40       1.2177      2.18  |   Q     |  V      |         |         |
13+45       1.2330      2.22  |   Q     |  V      |         |         |
13+50       1.2485      2.25  |   Q     |   V     |         |         |
13+55       1.2643      2.29  |   Q     |   V     |         |         |
14+ 0       1.2804      2.33  |   Q     |   V     |         |         |
14+ 5       1.2967      2.38  |   Q     |   V     |         |         |
14+10       1.3134      2.42  |   Q     |   V     |         |         |
14+15       1.3304      2.47  |   Q     |   V     |         |         |
14+20       1.3478      2.52  |    Q    |    V    |         |         |
14+25       1.3655      2.58  |    Q    |    V    |         |         |
14+30       1.3837      2.63  |    Q    |    V    |         |         |
14+35       1.4022      2.69  |    Q    |    V    |         |         |
14+40       1.4213      2.76  |    Q    |     V   |         |         |
14+45       1.4407      2.83  |    Q    |     V   |         |         |
14+50       1.4608      2.91  |    Q    |     V   |         |         |
14+55       1.4813      2.99  |    Q    |     V   |         |         |
15+ 0       1.5025      3.08  |     Q   |     V   |         |         |
15+ 5       1.5244      3.18  |     Q   |      V  |         |         |
15+10       1.5470      3.28  |     Q   |      V  |         |         |
15+15       1.5705      3.40  |     Q   |      V  |         |         |
15+20       1.5948      3.54  |      Q  |      V  |         |         |
15+25       1.6201      3.67  |      Q  |       V |         |         |
15+30       1.6463      3.80  |      Q  |       V |         |         |
15+35       1.6732      3.91  |      Q  |       V |         |         |
15+40       1.7010      4.03  |       Q |        V|         |         |
15+45       1.7300      4.21  |       Q |        V|         |         |
15+50       1.7610      4.50  |        Q|        V|         |         |
15+55       1.7952      4.97  |        Q|         V         |         |
16+ 0       1.8350      5.78  |         |Q        V         |         |
16+ 5       1.8886      7.78  |         |    Q    |V        |         |
16+10       1.9637     10.91  |         |         |QV       |         |
16+15       2.0594     13.89  |         |         |  V   Q  |         |
16+20       2.1665     15.55  |         |         |   V     |Q        |
16+25       2.2670     14.59  |         |         |    V   Q|         |
16+30       2.3460     11.47  |         |         | Q   V   |         |
16+35       2.4089      9.13  |         |       Q |      V  |         |
16+40       2.4612      7.60  |         |    Q    |      V  |         |
16+45       2.5077      6.75  |         |  Q      |       V |         |
16+50       2.5499      6.13  |         | Q       |       V |         |
16+55       2.5886      5.62  |         |Q        |        V|         |
17+ 0       2.6245      5.21  |         Q         |        V|         |
17+ 5       2.6576      4.81  |        Q|         |        V|         |
17+10       2.6884      4.47  |       Q |         |         V         |
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17+15       2.7176      4.24  |       Q |         |         V         |
17+20       2.7448      3.95  |      Q  |         |         V         |
17+25       2.7706      3.73  |      Q  |         |         |V        |
17+30       2.7948      3.52  |      Q  |         |         |V        |
17+35       2.8178      3.34  |     Q   |         |         |V        |
17+40       2.8400      3.22  |     Q   |         |         | V       |
17+45       2.8613      3.09  |     Q   |         |         | V       |
17+50       2.8816      2.96  |    Q    |         |         | V       |
17+55       2.9010      2.81  |    Q    |         |         | V       |
18+ 0       2.9196      2.70  |    Q    |         |         | V       |
18+ 5       2.9374      2.59  |    Q    |         |         |  V      |
18+10       2.9545      2.49  |   Q     |         |         |  V      |
18+15       2.9708      2.36  |   Q     |         |         |  V      |
18+20       2.9863      2.25  |   Q     |         |         |  V      |
18+25       3.0009      2.13  |   Q     |         |         |  V      |
18+30       3.0150      2.04  |   Q     |         |         |  V      |
18+35       3.0286      1.97  |  Q      |         |         |   V     |
18+40       3.0417      1.91  |  Q      |         |         |   V     |
18+45       3.0544      1.84  |  Q      |         |         |   V     |
18+50       3.0663      1.72  |  Q      |         |         |   V     |
18+55       3.0774      1.62  |  Q      |         |         |   V     |
19+ 0       3.0882      1.57  |  Q      |         |         |   V     |
19+ 5       3.0988      1.53  |  Q      |         |         |   V     |
19+10       3.1091      1.49  | Q       |         |         |    V    |
19+15       3.1191      1.46  | Q       |         |         |    V    |
19+20       3.1289      1.43  | Q       |         |         |    V    |
19+25       3.1386      1.40  | Q       |         |         |    V    |
19+30       3.1480      1.37  | Q       |         |         |    V    |
19+35       3.1573      1.35  | Q       |         |         |    V    |
19+40       3.1664      1.32  | Q       |         |         |    V    |
19+45       3.1753      1.30  | Q       |         |         |    V    |
19+50       3.1841      1.28  | Q       |         |         |    V    |
19+55       3.1928      1.26  | Q       |         |         |    V    |
20+ 0       3.2013      1.24  | Q       |         |         |     V   |
20+ 5       3.2097      1.22  | Q       |         |         |     V   |
20+10       3.2179      1.20  | Q       |         |         |     V   |
20+15       3.2261      1.18  | Q       |         |         |     V   |
20+20       3.2341      1.17  | Q       |         |         |     V   |
20+25       3.2420      1.15  | Q       |         |         |     V   |
20+30       3.2498      1.13  | Q       |         |         |     V   |
20+35       3.2575      1.12  | Q       |         |         |     V   |
20+40       3.2651      1.11  | Q       |         |         |     V   |
20+45       3.2727      1.09  | Q       |         |         |     V   |
20+50       3.2801      1.08  | Q       |         |         |     V   |
20+55       3.2874      1.07  | Q       |         |         |      V  |
21+ 0       3.2947      1.05  | Q       |         |         |      V  |
21+ 5       3.3019      1.04  | Q       |         |         |      V  |
21+10       3.3090      1.03  | Q       |         |         |      V  |
21+15       3.3160      1.02  | Q       |         |         |      V  |
21+20       3.3229      1.01  | Q       |         |         |      V  |
21+25       3.3298      1.00  |Q        |         |         |      V  |
21+30       3.3366      0.99  |Q        |         |         |      V  |
21+35       3.3434      0.98  |Q        |         |         |      V  |
21+40       3.3500      0.97  |Q        |         |         |      V  |
21+45       3.3566      0.96  |Q        |         |         |      V  |
21+50       3.3632      0.95  |Q        |         |         |      V  |
21+55       3.3697      0.94  |Q        |         |         |      V  |
22+ 0       3.3761      0.93  |Q        |         |         |       V |
22+ 5       3.3825      0.93  |Q        |         |         |       V |
22+10       3.3888      0.92  |Q        |         |         |       V |
22+15       3.3951      0.91  |Q        |         |         |       V |
22+20       3.4013      0.90  |Q        |         |         |       V |
22+25       3.4074      0.89  |Q        |         |         |       V |
22+30       3.4135      0.89  |Q        |         |         |       V |
22+35       3.4196      0.88  |Q        |         |         |       V |
22+40       3.4256      0.87  |Q        |         |         |       V |
22+45       3.4316      0.87  |Q        |         |         |       V |
22+50       3.4375      0.86  |Q        |         |         |       V |
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   22+55        3.4433      0.85  |Q         |         |         |       V |
   23+ 0        3.4492      0.85  |Q         |         |         |       V |
   23+ 5        3.4549      0.84  |Q         |         |         |       V |
   23+10        3.4607      0.83  |Q         |         |         |       V |
   23+15        3.4664      0.83  |Q         |         |         |        V|
   23+20        3.4720      0.82  |Q         |         |         |        V|
   23+25        3.4776      0.81  |Q         |         |         |        V|
   23+30        3.4832      0.81  |Q         |         |         |        V|
   23+35        3.4887      0.80  |Q         |         |         |        V|
   23+40        3.4942      0.80  |Q         |         |         |        V|
   23+45        3.4997      0.79  |Q         |         |         |        V|
   23+50        3.5051      0.79  |Q         |         |         |        V|
   23+55        3.5105      0.78  |Q         |         |         |        V|
   24+ 0        3.5158      0.78  |Q         |         |         |        V|
   24+ 5        3.5210      0.76  |Q         |         |         |        V|
   24+10        3.5259      0.70  |Q         |         |         |        V|
   24+15        3.5300      0.60  |Q         |         |         |        V|
   24+20        3.5333      0.48  Q          |         |         |        V|
   24+25        3.5358      0.36  Q          |         |         |        V|
   24+30        3.5377      0.28  Q          |         |         |        V|
   24+35        3.5393      0.23  Q          |         |         |        V|
   24+40        3.5407      0.20  Q          |         |         |        V|
   24+45        3.5419      0.17  Q          |         |         |        V|
   24+50        3.5429      0.15  Q          |         |         |        V|
   24+55        3.5438      0.13  Q          |         |         |        V|
   25+ 0        3.5445      0.11  Q          |         |         |        V|
   25+ 5        3.5452      0.10  Q          |         |         |        V|
   25+10        3.5458      0.09  Q          |         |         |        V|
   25+15        3.5463      0.08  Q          |         |         |        V|
   25+20        3.5468      0.07  Q          |         |         |        V|
   25+25        3.5472      0.06  Q          |         |         |        V|
   25+30        3.5475      0.05  Q          |         |         |        V|
   25+35        3.5478      0.05  Q          |         |         |        V|
   25+40        3.5481      0.04  Q          |         |         |        V|
   25+45        3.5484      0.03  Q          |         |         |        V|
   25+50        3.5486      0.03  Q          |         |         |        V|
   25+55        3.5487      0.03  Q          |         |         |        V|
   26+ 0        3.5489      0.02  Q          |         |         |        V|
   26+ 5        3.5490      0.02  Q          |         |         |        V|
   26+10        3.5491      0.01  Q          |         |         |        V|
   26+15        3.5492      0.01  Q          |         |         |        V|
   26+20        3.5493      0.01  Q          |         |         |        V|
   26+25        3.5493      0.01  Q          |         |         |        V|
   26+30        3.5494      0.01  Q          |         |         |        V|
   26+35        3.5494      0.00  Q          |         |         |        V|
   26+40        3.5494      0.00  Q          |         |         |        V|
   26+45        3.5494      0.00  Q          |         |         |        V|
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APPENDIX D

U n i t   H y d r o g r a p h   A n a l y s i s

Study date 08/20/18

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San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 6405

HIP ASHLEY TECHNOLOGY PARK
PROPOSED CONDITIONS WATERSHED A
100-YEAR STORM EVENT, 24 HOUR RAINFALL

Storm Event Year = 100

Antecedent Moisture Condition = 3

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 10		
10.17	1	0.73
Rainfall data for year 2		
10.17	6	1.14
Rainfall data for year 2		
10.17	24	2.03
Rainfall data for year 100		
10.17	1	1.14
Rainfall data for year 100		
10.17	6	2.65
Rainfall data for year 100		
10.17	24	4.76

++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	SCS curve NO.(AMC 3)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
32.0	52.0	10.17	1.000	0.785	0.100	0.079

Area-averaged adjusted loss rate Fm (In/Hr) = 0.079

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC3)	S	Pervious Yield Fr
1.02	0.100	32.0	52.0	9.23	0.147
9.15	0.900	98.0	98.0	0.20	0.950

Area-averaged catchment yield fraction, Y = 0.870
Area-averaged low loss fraction, Yb = 0.130
User entry of time of concentration = 0.224 (hours)
++
Watershed area = 10.17(Ac.)
Catchment Lag time = 0.179 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 46.5030
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.079(In/Hr)
Average low loss rate fraction (Yb) = 0.130 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.422(In)
Computed peak 30-minute rainfall = 0.864(In)
Specified peak 1-hour rainfall = 1.140(In)
Computed peak 3-hour rainfall = 1.912(In)
Specified peak 6-hour rainfall = 2.650(In)
Specified peak 24-hour rainfall = 4.760(In)

Rainfall depth area reduction factors:
Using a total area of 10.17(Ac.) (Ref: fig. E-4)

Factor	Adjusted rainfall
5-minute factor = 1.000	Adjusted rainfall = 0.422(In)
30-minute factor = 1.000	Adjusted rainfall = 0.864(In)
1-hour factor = 1.000	Adjusted rainfall = 1.139(In)
3-hour factor = 1.000	Adjusted rainfall = 1.912(In)
6-hour factor = 1.000	Adjusted rainfall = 2.650(In)
24-hour factor = 1.000	Adjusted rainfall = 4.760(In)

U n i t H y d r o g r a p h
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(K = 122.99 (CFS))

Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
1	3.989	4.906
2	25.999	27.072
3	62.891	45.374
4	86.568	29.121
5	95.610	11.121
6	98.384	3.412
7	99.241	1.054
8	100.000	0.934

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.4217	0.4217
2	0.5565	0.1347
3	0.6544	0.0980
4	0.7343	0.0798
5	0.8028	0.0686
6	0.8635	0.0607
7	0.9185	0.0549
8	0.9689	0.0504
9	1.0156	0.0467
10	1.0593	0.0437
11	1.1005	0.0412

12	1.1395	0.0390
13	1.1832	0.0438
14	1.2253	0.0420
15	1.2658	0.0405
16	1.3049	0.0391
17	1.3427	0.0378
18	1.3793	0.0367
19	1.4149	0.0356
20	1.4495	0.0346
21	1.4832	0.0337
22	1.5161	0.0329
23	1.5482	0.0321
24	1.5795	0.0314
25	1.6102	0.0307
26	1.6403	0.0300
27	1.6697	0.0294
28	1.6985	0.0289
29	1.7269	0.0283
30	1.7547	0.0278
31	1.7820	0.0273
32	1.8088	0.0269
33	1.8352	0.0264
34	1.8612	0.0260
35	1.8868	0.0256
36	1.9121	0.0252
37	1.9369	0.0248
38	1.9613	0.0245
39	1.9855	0.0241
40	2.0093	0.0238
41	2.0328	0.0235
42	2.0560	0.0232
43	2.0789	0.0229
44	2.1015	0.0226
45	2.1239	0.0224
46	2.1460	0.0221
47	2.1678	0.0218
48	2.1894	0.0216
49	2.2108	0.0214
50	2.2319	0.0211
51	2.2528	0.0209
52	2.2735	0.0207
53	2.2940	0.0205
54	2.3142	0.0203
55	2.3343	0.0201
56	2.3542	0.0199
57	2.3739	0.0197
58	2.3934	0.0195
59	2.4128	0.0193
60	2.4319	0.0192
61	2.4509	0.0190
62	2.4698	0.0188
63	2.4884	0.0187
64	2.5070	0.0185
65	2.5253	0.0184
66	2.5435	0.0182
67	2.5616	0.0181
68	2.5796	0.0179
69	2.5973	0.0178
70	2.6150	0.0177
71	2.6325	0.0175
72	2.6499	0.0174
73	2.6654	0.0155
74	2.6808	0.0154
75	2.6960	0.0152
76	2.7111	0.0151
77	2.7262	0.0150
78	2.7411	0.0149
79	2.7559	0.0148

80	2.7705	0.0147
81	2.7851	0.0146
82	2.7996	0.0145
83	2.8140	0.0144
84	2.8282	0.0143
85	2.8424	0.0142
86	2.8565	0.0141
87	2.8705	0.0140
88	2.8844	0.0139
89	2.8982	0.0138
90	2.9119	0.0137
91	2.9255	0.0136
92	2.9391	0.0135
93	2.9525	0.0135
94	2.9659	0.0134
95	2.9792	0.0133
96	2.9924	0.0132
97	3.0055	0.0131
98	3.0186	0.0131
99	3.0315	0.0130
100	3.0445	0.0129
101	3.0573	0.0128
102	3.0700	0.0128
103	3.0827	0.0127
104	3.0953	0.0126
105	3.1079	0.0125
106	3.1203	0.0125
107	3.1327	0.0124
108	3.1451	0.0123
109	3.1573	0.0123
110	3.1695	0.0122
111	3.1817	0.0121
112	3.1938	0.0121
113	3.2058	0.0120
114	3.2177	0.0120
115	3.2296	0.0119
116	3.2415	0.0118
117	3.2532	0.0118
118	3.2650	0.0117
119	3.2766	0.0117
120	3.2882	0.0116
121	3.2998	0.0115
122	3.3113	0.0115
123	3.3227	0.0114
124	3.3341	0.0114
125	3.3454	0.0113
126	3.3567	0.0113
127	3.3680	0.0112
128	3.3791	0.0112
129	3.3903	0.0111
130	3.4013	0.0111
131	3.4124	0.0110
132	3.4233	0.0110
133	3.4343	0.0109
134	3.4452	0.0109
135	3.4560	0.0108
136	3.4668	0.0108
137	3.4775	0.0107
138	3.4882	0.0107
139	3.4989	0.0107
140	3.5095	0.0106
141	3.5201	0.0106
142	3.5306	0.0105
143	3.5411	0.0105
144	3.5515	0.0104
145	3.5619	0.0104
146	3.5723	0.0104
147	3.5826	0.0103

148	3.5929	0.0103
149	3.6031	0.0102
150	3.6133	0.0102
151	3.6235	0.0102
152	3.6336	0.0101
153	3.6437	0.0101
154	3.6537	0.0100
155	3.6637	0.0100
156	3.6737	0.0100
157	3.6836	0.0099
158	3.6935	0.0099
159	3.7034	0.0099
160	3.7132	0.0098
161	3.7230	0.0098
162	3.7327	0.0098
163	3.7425	0.0097
164	3.7521	0.0097
165	3.7618	0.0096
166	3.7714	0.0096
167	3.7810	0.0096
168	3.7905	0.0095
169	3.8001	0.0095
170	3.8095	0.0095
171	3.8190	0.0095
172	3.8284	0.0094
173	3.8378	0.0094
174	3.8472	0.0094
175	3.8565	0.0093
176	3.8658	0.0093
177	3.8750	0.0093
178	3.8843	0.0092
179	3.8935	0.0092
180	3.9027	0.0092
181	3.9118	0.0091
182	3.9209	0.0091
183	3.9300	0.0091
184	3.9391	0.0091
185	3.9481	0.0090
186	3.9571	0.0090
187	3.9661	0.0090
188	3.9750	0.0089
189	3.9839	0.0089
190	3.9928	0.0089
191	4.0017	0.0089
192	4.0105	0.0088
193	4.0194	0.0088
194	4.0281	0.0088
195	4.0369	0.0088
196	4.0456	0.0087
197	4.0543	0.0087
198	4.0630	0.0087
199	4.0717	0.0087
200	4.0803	0.0086
201	4.0889	0.0086
202	4.0975	0.0086
203	4.1061	0.0086
204	4.1146	0.0085
205	4.1231	0.0085
206	4.1316	0.0085
207	4.1401	0.0085
208	4.1485	0.0084
209	4.1569	0.0084
210	4.1653	0.0084
211	4.1737	0.0084
212	4.1820	0.0083
213	4.1903	0.0083
214	4.1986	0.0083
215	4.2069	0.0083

216	4.2152	0.0083
217	4.2234	0.0082
218	4.2316	0.0082
219	4.2398	0.0082
220	4.2480	0.0082
221	4.2561	0.0081
222	4.2642	0.0081
223	4.2724	0.0081
224	4.2804	0.0081
225	4.2885	0.0081
226	4.2965	0.0080
227	4.3046	0.0080
228	4.3126	0.0080
229	4.3205	0.0080
230	4.3285	0.0080
231	4.3364	0.0079
232	4.3444	0.0079
233	4.3523	0.0079
234	4.3602	0.0079
235	4.3680	0.0079
236	4.3759	0.0078
237	4.3837	0.0078
238	4.3915	0.0078
239	4.3993	0.0078
240	4.4070	0.0078
241	4.4148	0.0077
242	4.4225	0.0077
243	4.4302	0.0077
244	4.4379	0.0077
245	4.4456	0.0077
246	4.4533	0.0077
247	4.4609	0.0076
248	4.4685	0.0076
249	4.4761	0.0076
250	4.4837	0.0076
251	4.4913	0.0076
252	4.4988	0.0076
253	4.5064	0.0075
254	4.5139	0.0075
255	4.5214	0.0075
256	4.5289	0.0075
257	4.5363	0.0075
258	4.5438	0.0074
259	4.5512	0.0074
260	4.5586	0.0074
261	4.5660	0.0074
262	4.5734	0.0074
263	4.5808	0.0074
264	4.5881	0.0074
265	4.5955	0.0073
266	4.6028	0.0073
267	4.6101	0.0073
268	4.6174	0.0073
269	4.6246	0.0073
270	4.6319	0.0073
271	4.6391	0.0072
272	4.6464	0.0072
273	4.6536	0.0072
274	4.6608	0.0072
275	4.6680	0.0072
276	4.6751	0.0072
277	4.6823	0.0071
278	4.6894	0.0071
279	4.6965	0.0071
280	4.7036	0.0071
281	4.7107	0.0071
282	4.7178	0.0071
283	4.7248	0.0071

284	4.7319	0.0070	
285	4.7389	0.0070	
286	4.7459	0.0070	
287	4.7529	0.0070	
288	4.7599	0.0070	

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0070	0.0009	0.0061
2	0.0070	0.0009	0.0061
3	0.0070	0.0009	0.0061
4	0.0070	0.0009	0.0061
5	0.0071	0.0009	0.0062
6	0.0071	0.0009	0.0062
7	0.0071	0.0009	0.0062
8	0.0071	0.0009	0.0062
9	0.0072	0.0009	0.0062
10	0.0072	0.0009	0.0062
11	0.0072	0.0009	0.0063
12	0.0072	0.0009	0.0063
13	0.0073	0.0009	0.0063
14	0.0073	0.0009	0.0063
15	0.0073	0.0009	0.0064
16	0.0073	0.0010	0.0064
17	0.0074	0.0010	0.0064
18	0.0074	0.0010	0.0064
19	0.0074	0.0010	0.0064
20	0.0074	0.0010	0.0065
21	0.0074	0.0010	0.0065
22	0.0075	0.0010	0.0065
23	0.0075	0.0010	0.0065
24	0.0075	0.0010	0.0065
25	0.0076	0.0010	0.0066
26	0.0076	0.0010	0.0066
27	0.0076	0.0010	0.0066
28	0.0076	0.0010	0.0066
29	0.0077	0.0010	0.0067
30	0.0077	0.0010	0.0067
31	0.0077	0.0010	0.0067
32	0.0077	0.0010	0.0067
33	0.0078	0.0010	0.0068
34	0.0078	0.0010	0.0068
35	0.0078	0.0010	0.0068
36	0.0078	0.0010	0.0068
37	0.0079	0.0010	0.0069
38	0.0079	0.0010	0.0069
39	0.0079	0.0010	0.0069
40	0.0080	0.0010	0.0069
41	0.0080	0.0010	0.0070
42	0.0080	0.0010	0.0070
43	0.0081	0.0010	0.0070
44	0.0081	0.0011	0.0070
45	0.0081	0.0011	0.0071
46	0.0081	0.0011	0.0071
47	0.0082	0.0011	0.0071
48	0.0082	0.0011	0.0071
49	0.0083	0.0011	0.0072
50	0.0083	0.0011	0.0072
51	0.0083	0.0011	0.0072
52	0.0083	0.0011	0.0073
53	0.0084	0.0011	0.0073
54	0.0084	0.0011	0.0073
55	0.0085	0.0011	0.0074
56	0.0085	0.0011	0.0074
57	0.0085	0.0011	0.0074
58	0.0086	0.0011	0.0074

59	0.0086	0.0011	0.0075
60	0.0086	0.0011	0.0075
61	0.0087	0.0011	0.0076
62	0.0087	0.0011	0.0076
63	0.0088	0.0011	0.0076
64	0.0088	0.0011	0.0076
65	0.0088	0.0011	0.0077
66	0.0089	0.0012	0.0077
67	0.0089	0.0012	0.0078
68	0.0089	0.0012	0.0078
69	0.0090	0.0012	0.0078
70	0.0090	0.0012	0.0079
71	0.0091	0.0012	0.0079
72	0.0091	0.0012	0.0079
73	0.0092	0.0012	0.0080
74	0.0092	0.0012	0.0080
75	0.0093	0.0012	0.0081
76	0.0093	0.0012	0.0081
77	0.0094	0.0012	0.0081
78	0.0094	0.0012	0.0082
79	0.0095	0.0012	0.0082
80	0.0095	0.0012	0.0083
81	0.0095	0.0012	0.0083
82	0.0096	0.0012	0.0083
83	0.0096	0.0013	0.0084
84	0.0097	0.0013	0.0084
85	0.0098	0.0013	0.0085
86	0.0098	0.0013	0.0085
87	0.0099	0.0013	0.0086
88	0.0099	0.0013	0.0086
89	0.0100	0.0013	0.0087
90	0.0100	0.0013	0.0087
91	0.0101	0.0013	0.0088
92	0.0101	0.0013	0.0088
93	0.0102	0.0013	0.0089
94	0.0102	0.0013	0.0089
95	0.0103	0.0013	0.0090
96	0.0104	0.0013	0.0090
97	0.0104	0.0014	0.0091
98	0.0105	0.0014	0.0091
99	0.0106	0.0014	0.0092
100	0.0106	0.0014	0.0092
101	0.0107	0.0014	0.0093
102	0.0107	0.0014	0.0093
103	0.0108	0.0014	0.0094
104	0.0109	0.0014	0.0095
105	0.0110	0.0014	0.0096
106	0.0110	0.0014	0.0096
107	0.0111	0.0014	0.0097
108	0.0112	0.0015	0.0097
109	0.0113	0.0015	0.0098
110	0.0113	0.0015	0.0099
111	0.0114	0.0015	0.0100
112	0.0115	0.0015	0.0100
113	0.0116	0.0015	0.0101
114	0.0117	0.0015	0.0101
115	0.0118	0.0015	0.0102
116	0.0118	0.0015	0.0103
117	0.0120	0.0016	0.0104
118	0.0120	0.0016	0.0105
119	0.0121	0.0016	0.0106
120	0.0122	0.0016	0.0106
121	0.0123	0.0016	0.0107
122	0.0124	0.0016	0.0108
123	0.0125	0.0016	0.0109
124	0.0126	0.0016	0.0110
125	0.0128	0.0017	0.0111
126	0.0128	0.0017	0.0112

127	0.0130	0.0017	0.0113
128	0.0131	0.0017	0.0114
129	0.0132	0.0017	0.0115
130	0.0133	0.0017	0.0116
131	0.0135	0.0017	0.0117
132	0.0135	0.0018	0.0118
133	0.0137	0.0018	0.0119
134	0.0138	0.0018	0.0120
135	0.0140	0.0018	0.0122
136	0.0141	0.0018	0.0123
137	0.0143	0.0019	0.0124
138	0.0144	0.0019	0.0125
139	0.0146	0.0019	0.0127
140	0.0147	0.0019	0.0128
141	0.0149	0.0019	0.0130
142	0.0150	0.0020	0.0131
143	0.0152	0.0020	0.0133
144	0.0154	0.0020	0.0134
145	0.0174	0.0023	0.0151
146	0.0175	0.0023	0.0152
147	0.0178	0.0023	0.0155
148	0.0179	0.0023	0.0156
149	0.0182	0.0024	0.0158
150	0.0184	0.0024	0.0160
151	0.0187	0.0024	0.0162
152	0.0188	0.0024	0.0164
153	0.0192	0.0025	0.0167
154	0.0193	0.0025	0.0168
155	0.0197	0.0026	0.0171
156	0.0199	0.0026	0.0173
157	0.0203	0.0026	0.0176
158	0.0205	0.0027	0.0178
159	0.0209	0.0027	0.0182
160	0.0211	0.0027	0.0184
161	0.0216	0.0028	0.0188
162	0.0218	0.0028	0.0190
163	0.0224	0.0029	0.0194
164	0.0226	0.0029	0.0197
165	0.0232	0.0030	0.0202
166	0.0235	0.0031	0.0204
167	0.0241	0.0031	0.0210
168	0.0245	0.0032	0.0213
169	0.0252	0.0033	0.0219
170	0.0256	0.0033	0.0223
171	0.0264	0.0034	0.0230
172	0.0269	0.0035	0.0234
173	0.0278	0.0036	0.0242
174	0.0283	0.0037	0.0246
175	0.0294	0.0038	0.0256
176	0.0300	0.0039	0.0261
177	0.0314	0.0041	0.0273
178	0.0321	0.0042	0.0279
179	0.0337	0.0044	0.0293
180	0.0346	0.0045	0.0301
181	0.0367	0.0048	0.0319
182	0.0378	0.0049	0.0329
183	0.0405	0.0053	0.0352
184	0.0420	0.0055	0.0366
185	0.0390	0.0051	0.0339
186	0.0412	0.0054	0.0358
187	0.0467	0.0061	0.0407
188	0.0504	0.0065	0.0438
189	0.0607	0.0065	0.0542
190	0.0686	0.0065	0.0620
191	0.0980	0.0065	0.0914
192	0.1347	0.0065	0.1282
193	0.4217	0.0065	0.4152
194	0.0798	0.0065	0.0733

195	0.0549	0.0065	0.0484
196	0.0437	0.0057	0.0380
197	0.0438	0.0057	0.0381
198	0.0391	0.0051	0.0340
199	0.0356	0.0046	0.0310
200	0.0329	0.0043	0.0286
201	0.0307	0.0040	0.0267
202	0.0289	0.0038	0.0251
203	0.0273	0.0036	0.0238
204	0.0260	0.0034	0.0226
205	0.0248	0.0032	0.0216
206	0.0238	0.0031	0.0207
207	0.0229	0.0030	0.0199
208	0.0221	0.0029	0.0192
209	0.0214	0.0028	0.0186
210	0.0207	0.0027	0.0180
211	0.0201	0.0026	0.0175
212	0.0195	0.0025	0.0170
213	0.0190	0.0025	0.0165
214	0.0185	0.0024	0.0161
215	0.0181	0.0023	0.0157
216	0.0177	0.0023	0.0154
217	0.0155	0.0020	0.0135
218	0.0151	0.0020	0.0132
219	0.0148	0.0019	0.0129
220	0.0145	0.0019	0.0126
221	0.0142	0.0018	0.0123
222	0.0139	0.0018	0.0121
223	0.0136	0.0018	0.0119
224	0.0134	0.0017	0.0116
225	0.0131	0.0017	0.0114
226	0.0129	0.0017	0.0112
227	0.0127	0.0016	0.0110
228	0.0125	0.0016	0.0108
229	0.0123	0.0016	0.0107
230	0.0121	0.0016	0.0105
231	0.0119	0.0015	0.0103
232	0.0117	0.0015	0.0102
233	0.0115	0.0015	0.0100
234	0.0114	0.0015	0.0099
235	0.0112	0.0015	0.0098
236	0.0111	0.0014	0.0096
237	0.0109	0.0014	0.0095
238	0.0108	0.0014	0.0094
239	0.0107	0.0014	0.0093
240	0.0105	0.0014	0.0092
241	0.0104	0.0014	0.0090
242	0.0103	0.0013	0.0089
243	0.0102	0.0013	0.0088
244	0.0100	0.0013	0.0087
245	0.0099	0.0013	0.0086
246	0.0098	0.0013	0.0085
247	0.0097	0.0013	0.0085
248	0.0096	0.0013	0.0084
249	0.0095	0.0012	0.0083
250	0.0094	0.0012	0.0082
251	0.0093	0.0012	0.0081
252	0.0092	0.0012	0.0080
253	0.0091	0.0012	0.0080
254	0.0091	0.0012	0.0079
255	0.0090	0.0012	0.0078
256	0.0089	0.0012	0.0077
257	0.0088	0.0011	0.0077
258	0.0087	0.0011	0.0076
259	0.0087	0.0011	0.0075
260	0.0086	0.0011	0.0075
261	0.0085	0.0011	0.0074
262	0.0084	0.0011	0.0073

263	0.0084	0.0011	0.0073
264	0.0083	0.0011	0.0072
265	0.0082	0.0011	0.0072
266	0.0082	0.0011	0.0071
267	0.0081	0.0011	0.0071
268	0.0080	0.0010	0.0070
269	0.0080	0.0010	0.0069
270	0.0079	0.0010	0.0069
271	0.0079	0.0010	0.0068
272	0.0078	0.0010	0.0068
273	0.0077	0.0010	0.0067
274	0.0077	0.0010	0.0067
275	0.0076	0.0010	0.0066
276	0.0076	0.0010	0.0066
277	0.0075	0.0010	0.0066
278	0.0075	0.0010	0.0065
279	0.0074	0.0010	0.0065
280	0.0074	0.0010	0.0064
281	0.0073	0.0010	0.0064
282	0.0073	0.0009	0.0063
283	0.0072	0.0009	0.0063
284	0.0072	0.0009	0.0063
285	0.0071	0.0009	0.0062
286	0.0071	0.0009	0.0062
287	0.0071	0.0009	0.0061
288	0.0070	0.0009	0.0061

Total soil rain loss = 0.55(In)
Total effective rainfall = 4.21(In)
Peak flow rate in flood hydrograph = 26.12(CFS)

24 - H O U R   S T O R M
R u n o f f   H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

```
Time(h+m) Volume Ac.Ft   Q(CFS)  0        7.5      15.0      22.5      30.0
--------------------------------------------------------------------------
  0+ 5      0.0002      0.03  Q          |         |         |         |
  0+10      0.0015      0.19  Q          |         |         |         |
  0+15      0.0048      0.47  Q          |         |         |         |
  0+20      0.0093      0.65  Q          |         |         |         |
  0+25      0.0142      0.72  Q          |         |         |         |
  0+30      0.0193      0.74  Q          |         |         |         |
  0+35      0.0245      0.75  VQ         |         |         |         |
  0+40      0.0297      0.76  VQ         |         |         |         |
  0+45      0.0349      0.76  VQ         |         |         |         |
  0+50      0.0402      0.76  VQ         |         |         |         |
  0+55      0.0455      0.77  VQ         |         |         |         |
  1+ 0      0.0508      0.77  VQ         |         |         |         |
  1+ 5      0.0561      0.77  VQ         |         |         |         |
  1+10      0.0614      0.77  VQ         |         |         |         |
  1+15      0.0667      0.78  VQ         |         |         |         |
  1+20      0.0721      0.78  VQ         |         |         |         |
  1+25      0.0775      0.78  VQ         |         |         |         |
  1+30      0.0829      0.78  VQ         |         |         |         |
  1+35      0.0883      0.79  VQ         |         |         |         |
  1+40      0.0937      0.79  |Q         |         |         |         |
  1+45      0.0991      0.79  |Q         |         |         |         |
  1+50      0.1046      0.79  |Q         |         |         |         |
  1+55      0.1101      0.80  |Q         |         |         |         |
  2+ 0      0.1156      0.80  |Q         |         |         |         |
  2+ 5      0.1211      0.80  |Q         |         |         |         |
  2+10      0.1266      0.80  |Q         |         |         |         |
  2+15      0.1322      0.81  |Q         |         |         |         |
```

```
2+20        0.1378      0.81  |Q         |         |         |         |
2+25        0.1434      0.81  |Q         |         |         |         |
2+30        0.1490      0.82  |Q         |         |         |         |
2+35        0.1546      0.82  |Q         |         |         |         |
2+40        0.1603      0.82  |Q         |         |         |         |
2+45        0.1659      0.82  |Q         |         |         |         |
2+50        0.1716      0.83  |Q         |         |         |         |
2+55        0.1774      0.83  |Q         |         |         |         |
3+ 0        0.1831      0.83  |QV        |         |         |         |
3+ 5        0.1888      0.84  |QV        |         |         |         |
3+10        0.1946      0.84  |QV        |         |         |         |
3+15        0.2004      0.84  |QV        |         |         |         |
3+20        0.2062      0.85  |QV        |         |         |         |
3+25        0.2121      0.85  |QV        |         |         |         |
3+30        0.2180      0.85  |QV        |         |         |         |
3+35        0.2238      0.85  |QV        |         |         |         |
3+40        0.2297      0.86  |QV        |         |         |         |
3+45        0.2357      0.86  |QV        |         |         |         |
3+50        0.2416      0.86  |QV        |         |         |         |
3+55        0.2476      0.87  |QV        |         |         |         |
4+ 0        0.2536      0.87  |QV        |         |         |         |
4+ 5        0.2596      0.87  |QV        |         |         |         |
4+10        0.2657      0.88  |QV        |         |         |         |
4+15        0.2718      0.88  |Q V       |         |         |         |
4+20        0.2779      0.89  |Q V       |         |         |         |
4+25        0.2840      0.89  |Q V       |         |         |         |
4+30        0.2901      0.89  |Q V       |         |         |         |
4+35        0.2963      0.90  |Q V       |         |         |         |
4+40        0.3025      0.90  |Q V       |         |         |         |
4+45        0.3087      0.90  |Q V       |         |         |         |
4+50        0.3150      0.91  |Q V       |         |         |         |
4+55        0.3213      0.91  |Q V       |         |         |         |
5+ 0        0.3276      0.92  |Q V       |         |         |         |
5+ 5        0.3339      0.92  |Q V       |         |         |         |
5+10        0.3403      0.92  |Q V       |         |         |         |
5+15        0.3466      0.93  |Q V       |         |         |         |
5+20        0.3531      0.93  |Q V       |         |         |         |
5+25        0.3595      0.94  |Q  V      |         |         |         |
5+30        0.3660      0.94  |Q  V      |         |         |         |
5+35        0.3725      0.94  |Q  V      |         |         |         |
5+40        0.3790      0.95  |Q  V      |         |         |         |
5+45        0.3856      0.95  |Q  V      |         |         |         |
5+50        0.3921      0.96  |Q  V      |         |         |         |
5+55        0.3988      0.96  |Q  V      |         |         |         |
6+ 0        0.4054      0.97  |Q  V      |         |         |         |
6+ 5        0.4121      0.97  |Q  V      |         |         |         |
6+10        0.4188      0.98  |Q  V      |         |         |         |
6+15        0.4256      0.98  |Q  V      |         |         |         |
6+20        0.4323      0.98  |Q  V      |         |         |         |
6+25        0.4392      0.99  |Q  V      |         |         |         |
6+30        0.4460      0.99  |Q  V      |         |         |         |
6+35        0.4529      1.00  |Q   V     |         |         |         |
6+40        0.4598      1.00  |Q   V     |         |         |         |
6+45        0.4668      1.01  |Q   V     |         |         |         |
6+50        0.4737      1.01  |Q   V     |         |         |         |
6+55        0.4808      1.02  |Q   V     |         |         |         |
7+ 0        0.4878      1.02  |Q   V     |         |         |         |
7+ 5        0.4949      1.03  |Q   V     |         |         |         |
7+10        0.5020      1.04  |Q   V     |         |         |         |
7+15        0.5092      1.04  |Q   V     |         |         |         |
7+20        0.5164      1.05  |Q   V     |         |         |         |
7+25        0.5237      1.05  |Q   V     |         |         |         |
7+30        0.5310      1.06  |Q   V     |         |         |         |
7+35        0.5383      1.06  |Q    V    |         |         |         |
7+40        0.5457      1.07  |Q    V    |         |         |         |
7+45        0.5531      1.08  |Q    V    |         |         |         |
7+50        0.5605      1.08  |Q    V    |         |         |         |
7+55        0.5680      1.09  |Q    V    |         |         |         |
```

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 8+ 0       0.5756      1.09  |Q    V   |         |         |         |
 8+ 5       0.5831      1.10  |Q    V   |         |         |         |
 8+10       0.5908      1.11  |Q    V   |         |         |         |
 8+15       0.5984      1.11  |Q    V   |         |         |         |
 8+20       0.6062      1.12  |Q    V   |         |         |         |
 8+25       0.6139      1.13  |Q    V   |         |         |         |
 8+30       0.6218      1.13  |Q    V   |         |         |         |
 8+35       0.6296      1.14  |Q     V  |         |         |         |
 8+40       0.6375      1.15  |Q     V  |         |         |         |
 8+45       0.6455      1.16  |Q     V  |         |         |         |
 8+50       0.6535      1.16  |Q     V  |         |         |         |
 8+55       0.6616      1.17  |Q     V  |         |         |         |
 9+ 0       0.6697      1.18  |Q     V  |         |         |         |
 9+ 5       0.6779      1.19  |Q     V  |         |         |         |
 9+10       0.6861      1.20  |Q     V  |         |         |         |
 9+15       0.6944      1.20  |Q     V  |         |         |         |
 9+20       0.7028      1.21  |Q     V  |         |         |         |
 9+25       0.7112      1.22  |Q     V  |         |         |         |
 9+30       0.7196      1.23  |Q      V |         |         |         |
 9+35       0.7282      1.24  |Q      V |         |         |         |
 9+40       0.7367      1.25  |Q      V |         |         |         |
 9+45       0.7454      1.26  |Q      V |         |         |         |
 9+50       0.7541      1.27  |Q      V |         |         |         |
 9+55       0.7629      1.28  |Q      V |         |         |         |
10+ 0       0.7717      1.28  |Q      V |         |         |         |
10+ 5       0.7807      1.29  |Q      V |         |         |         |
10+10       0.7896      1.31  |Q      V |         |         |         |
10+15       0.7987      1.32  |Q      V |         |         |         |
10+20       0.8078      1.33  |Q       V|         |         |         |
10+25       0.8170      1.34  |Q       V|         |         |         |
10+30       0.8263      1.35  |Q       V|         |         |         |
10+35       0.8357      1.36  |Q       V|         |         |         |
10+40       0.8451      1.37  |Q       V|         |         |         |
10+45       0.8547      1.38  |Q       V|         |         |         |
10+50       0.8643      1.40  |Q       V|         |         |         |
10+55       0.8740      1.41  |Q       V|         |         |         |
11+ 0       0.8838      1.42  |Q       V|         |         |         |
11+ 5       0.8936      1.43  |Q        V         |         |         |
11+10       0.9036      1.45  |Q        V         |         |         |
11+15       0.9137      1.46  |Q        V         |         |         |
11+20       0.9238      1.48  |Q        V         |         |         |
11+25       0.9341      1.49  |Q        V         |         |         |
11+30       0.9445      1.51  | Q       V         |         |         |
11+35       0.9549      1.52  | Q       V         |         |         |
11+40       0.9655      1.54  | Q       V         |         |         |
11+45       0.9762      1.55  | Q       V         |         |         |
11+50       0.9870      1.57  | Q       |V        |         |         |
11+55       0.9980      1.59  | Q       |V        |         |         |
12+ 0       1.0090      1.61  | Q       |V        |         |         |
12+ 5       1.0203      1.63  | Q       |V        |         |         |
12+10       1.0319      1.69  | Q       |V        |         |         |
12+15       1.0442      1.78  | Q       |V        |         |         |
12+20       1.0569      1.85  | Q       |V        |         |         |
12+25       1.0699      1.89  | Q       |V        |         |         |
12+30       1.0831      1.91  | Q       | V       |         |         |
12+35       1.0964      1.94  | Q       | V       |         |         |
12+40       1.1099      1.96  | Q       | V       |         |         |
12+45       1.1236      1.99  | Q       | V       |         |         |
12+50       1.1375      2.01  | Q       | V       |         |         |
12+55       1.1516      2.04  | Q       | V       |         |         |
13+ 0       1.1658      2.07  | Q       |  V      |         |         |
13+ 5       1.1802      2.10  | Q       |  V      |         |         |
13+10       1.1949      2.13  | Q       |  V      |         |         |
13+15       1.2097      2.16  | Q       |  V      |         |         |
13+20       1.2248      2.19  | Q       |  V      |         |         |
13+25       1.2401      2.22  | Q       |  V      |         |         |
13+30       1.2557      2.26  |  Q      |   V     |         |         |
13+35       1.2715      2.30  |  Q      |   V     |         |         |
```

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13+40       1.2875      2.33  |  Q      |   V     |         |         |
13+45       1.3039      2.38  |  Q      |   V     |         |         |
13+50       1.3205      2.42  |  Q      |   V     |         |         |
13+55       1.3375      2.46  |  Q      |   V     |         |         |
14+ 0       1.3548      2.51  |  Q      |    V    |         |         |
14+ 5       1.3724      2.56  |  Q      |    V    |         |         |
14+10       1.3905      2.62  |  Q      |    V    |         |         |
14+15       1.4089      2.67  |  Q      |    V    |         |         |
14+20       1.4277      2.73  |  Q      |    V    |         |         |
14+25       1.4470      2.80  |  Q      |     V   |         |         |
14+30       1.4668      2.87  |  Q      |     V   |         |         |
14+35       1.4870      2.95  |  Q      |     V   |         |         |
14+40       1.5079      3.03  |   Q     |     V   |         |         |
14+45       1.5293      3.11  |   Q     |      V  |         |         |
14+50       1.5514      3.21  |   Q     |      V  |         |         |
14+55       1.5743      3.31  |   Q     |      V  |         |         |
15+ 0       1.5979      3.43  |   Q     |      V  |         |         |
15+ 5       1.6224      3.56  |   Q     |       V |         |         |
15+10       1.6479      3.70  |   Q     |       V |         |         |
15+15       1.6744      3.86  |    Q    |       V |         |         |
15+20       1.7023      4.04  |    Q    |        V|         |         |
15+25       1.7314      4.23  |    Q    |        V|         |         |
15+30       1.7611      4.31  |    Q    |        V|         |         |
15+35       1.7910      4.34  |    Q    |         V         |         |
15+40       1.8221      4.52  |     Q   |         V         |         |
15+45       1.8559      4.91  |     Q   |         V         |         |
15+50       1.8940      5.53  |      Q  |         |V        |         |
15+55       1.9388      6.51  |       Q |         |V        |         |
16+ 0       1.9953      8.19  |         Q         | V       |         |
16+ 5       2.0799     12.29  |         |     Q   |  V      |         |
16+10       2.2248     21.04  |         |         |   V   Q |         |
16+15       2.4047     26.12  |         |         |     V   |   Q     |
16+20       2.5339     18.76  |         |         |    Q  V |         |
16+25       2.6080     10.75  |         |   Q     |        V|         |
16+30       2.6547      6.78  |        Q|         |        V|         |
16+35       2.6909      5.25  |      Q  |         |         V         |
16+40       2.7231      4.68  |     Q   |         |         V         |
16+45       2.7505      3.97  |    Q    |         |         V         |
16+50       2.7756      3.64  |   Q     |         |         |V        |
16+55       2.7988      3.38  |   Q     |         |         |V        |
17+ 0       2.8206      3.17  |   Q     |         |         |V        |
17+ 5       2.8412      2.99  |  Q      |         |         |V        |
17+10       2.8607      2.83  |  Q      |         |         | V       |
17+15       2.8793      2.70  |  Q      |         |         | V       |
17+20       2.8971      2.59  |  Q      |         |         | V       |
17+25       2.9142      2.48  |  Q      |         |         | V       |
17+30       2.9307      2.39  |  Q      |         |         | V       |
17+35       2.9466      2.31  |  Q      |         |         |  V      |
17+40       2.9621      2.24  | Q       |         |         |  V      |
17+45       2.9770      2.17  | Q       |         |         |  V      |
17+50       2.9915      2.11  | Q       |         |         |  V      |
17+55       3.0056      2.05  | Q       |         |         |  V      |
18+ 0       3.0194      2.00  | Q       |         |         |  V      |
18+ 5       3.0328      1.94  | Q       |         |         |  V      |
18+10       3.0455      1.85  | Q       |         |         |   V     |
18+15       3.0575      1.74  | Q       |         |         |   V     |
18+20       3.0689      1.66  | Q       |         |         |   V     |
18+25       3.0800      1.60  | Q       |         |         |   V     |
18+30       3.0907      1.56  | Q       |         |         |   V     |
18+35       3.1013      1.53  | Q       |         |         |   V     |
18+40       3.1116      1.50  |Q        |         |         |   V     |
18+45       3.1217      1.47  |Q        |         |         |   V     |
18+50       3.1316      1.44  |Q        |         |         |    V    |
18+55       3.1413      1.41  |Q        |         |         |    V    |
19+ 0       3.1509      1.39  |Q        |         |         |    V    |
19+ 5       3.1603      1.36  |Q        |         |         |    V    |
19+10       3.1695      1.34  |Q        |         |         |    V    |
19+15       3.1786      1.32  |Q        |         |         |    V    |
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   19+20       3.1875      1.30  |Q        |         |         |    V    |
   19+25       3.1963      1.28  |Q        |         |         |    V    |
   19+30       3.2050      1.26  |Q        |         |         |    V    |
   19+35       3.2136      1.24  |Q        |         |         |     V   |
   19+40       3.2220      1.22  |Q        |         |         |     V   |
   19+45       3.2303      1.21  |Q        |         |         |     V   |
   19+50       3.2385      1.19  |Q        |         |         |     V   |
   19+55       3.2466      1.17  |Q        |         |         |     V   |
   20+ 0       3.2546      1.16  |Q        |         |         |     V   |
   20+ 5       3.2625      1.14  |Q        |         |         |     V   |
   20+10       3.2702      1.13  |Q        |         |         |     V   |
   20+15       3.2779      1.12  |Q        |         |         |     V   |
   20+20       3.2855      1.10  |Q        |         |         |     V   |
   20+25       3.2930      1.09  |Q        |         |         |     V   |
   20+30       3.3005      1.08  |Q        |         |         |     V   |
   20+35       3.3078      1.07  |Q        |         |         |      V  |
   20+40       3.3151      1.05  |Q        |         |         |      V  |
   20+45       3.3223      1.04  |Q        |         |         |      V  |
   20+50       3.3294      1.03  |Q        |         |         |      V  |
   20+55       3.3364      1.02  |Q        |         |         |      V  |
   21+ 0       3.3434      1.01  |Q        |         |         |      V  |
   21+ 5       3.3503      1.00  |Q        |         |         |      V  |
   21+10       3.3571      0.99  |Q        |         |         |      V  |
   21+15       3.3638      0.98  |Q        |         |         |      V  |
   21+20       3.3705      0.97  |Q        |         |         |      V  |
   21+25       3.3772      0.96  |Q        |         |         |      V  |
   21+30       3.3837      0.95  |Q        |         |         |      V  |
   21+35       3.3903      0.95  |Q        |         |         |      V  |
   21+40       3.3967      0.94  |Q        |         |         |       V |
   21+45       3.4031      0.93  |Q        |         |         |       V |
   21+50       3.4094      0.92  |Q        |         |         |       V |
   21+55       3.4157      0.91  |Q        |         |         |       V |
   22+ 0       3.4220      0.91  |Q        |         |         |       V |
   22+ 5       3.4281      0.90  |Q        |         |         |       V |
   22+10       3.4343      0.89  |Q        |         |         |       V |
   22+15       3.4404      0.88  |Q        |         |         |       V |
   22+20       3.4464      0.88  |Q        |         |         |       V |
   22+25       3.4524      0.87  |Q        |         |         |       V |
   22+30       3.4583      0.86  |Q        |         |         |       V |
   22+35       3.4642      0.86  |Q        |         |         |       V |
   22+40       3.4701      0.85  |Q        |         |         |       V |
   22+45       3.4759      0.84  |Q        |         |         |       V |
   22+50       3.4816      0.84  |Q        |         |         |        V|
   22+55       3.4874      0.83  |Q        |         |         |        V|
   23+ 0       3.4930      0.82  |Q        |         |         |        V|
   23+ 5       3.4987      0.82  |Q        |         |         |        V|
   23+10       3.5043      0.81  |Q        |         |         |        V|
   23+15       3.5098      0.81  |Q        |         |         |        V|
   23+20       3.5154      0.80  |Q        |         |         |        V|
   23+25       3.5209      0.80  |Q        |         |         |        V|
   23+30       3.5263      0.79  |Q        |         |         |        V|
   23+35       3.5317      0.79  |Q        |         |         |        V|
   23+40       3.5371      0.78  |Q        |         |         |        V|
   23+45       3.5424      0.78  |Q        |         |         |        V|
   23+50       3.5478      0.77  |Q        |         |         |        V|
   23+55       3.5530      0.77  |Q        |         |         |        V|
   24+ 0       3.5583      0.76  |Q        |         |         |        V|
   24+ 5       3.5633      0.73  Q         |         |         |        V|
   24+10       3.5671      0.56  Q         |         |         |        V|
   24+15       3.5691      0.28  Q         |         |         |        V|
   24+20       3.5698      0.10  Q         |         |         |        V|
   24+25       3.5700      0.03  Q         |         |         |        V|
   24+30       3.5701      0.01  Q         |         |         |        V|
   24+35       3.5701      0.01  Q         |         |         |         V
-----------------------------------------------------------------------
```

APPENDIX E

```
                    HIP ASHLEY TECHNOLOGY PARK
                      PRELIM ANALYSIS - OUTLET PIPE
                        30-INCH STORM DRAIN
**************************************************************************************************************************** ********
         | Invert  |  Depth |  Water   |     Q    |  Vel    Vel   |  Energy | Super  |Critical|Flow Top|Height/|Base Wt|      |No Wth
 Station |  Elev   |  (FT)  |  Elev    |   (CFS)  | (FPS)   Head  | Grd.El.| Elev   | Depth  | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
        -|-       -|-      -|-        -|-        -|-      -|-     -|-       -|-      -|-      -|-      -|-     -|-     -|-    -|
 L/Elem  |Ch Slope |        |          |          |       SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR  |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
         |         |        |         |         |       |       |         |       |        |        |       |       |      |
 1000.000  946.230    2.520  948.750     26.40     5.38     .45   949.20     .00    1.75      .00    2.500    .000    .00   1   .0
        -|-       -|-      -|-        -|-        -|-      -|-     -|-       -|-      -|-      -|-      -|-     -|-     -|-    |-
   2.306    .0128                                         .0041      .01     2.52     .00     1.35    .013     .00     .00  PIPE
         |         |        |         |         |       |       |         |       |        |        |       |       |      |
 1002.306  946.260    2.500  948.760     26.40     5.38     .45   949.21     .00    1.75      .00    2.500    .000    .00   1   .0
        -|-       -|-      -|-        -|-        -|-      -|-     -|-       -|-      -|-      -|-      -|-     -|-     -|-    |-
  20.711    .0128                                         .0038      .08     2.50     .00     1.35    .013     .00     .00  PIPE
         |         |        |         |         |       |       |         |       |        |        |       |       |      |
 1023.017  946.525    2.268  948.793     26.40     5.64     .49   949.29     .00    1.75     1.45    2.500    .000    .00   1   .0
        -|-       -|-      -|-        -|-        -|-      -|-     -|-       -|-      -|-      -|-      -|-     -|-     -|-    |-
   9.349    .0128                                         .0038      .04     2.27     .55     1.35    .013     .00     .00  PIPE
         |         |        |         |         |       |       |         |       |        |        |       |       |      |
 1032.366  946.645    2.134  948.779     26.40     5.92     .54   949.32     .00    1.75     1.77    2.500    .000    .00   1   .0
        -|-       -|-      -|-        -|-        -|-      -|-     -|-       -|-      -|-      -|-      -|-     -|-     -|-    |-
HYDRAULIC JUMP
         |         |        |         |         |       |       |         |       |        |        |       |       |      |
 1032.366  946.645    1.430  948.075     26.40     9.09    1.28   949.36     .00    1.75     2.47    2.500    .000    .00   1   .0
        -|-       -|-      -|-        -|-        -|-      -|-     -|-       -|-      -|-      -|-      -|-     -|-     -|-    |-
   3.348    .0128                                         .0106      .04     1.43    1.48     1.35    .013     .00     .00  PIPE
         |         |        |         |         |       |       |         |       |        |        |       |       |      |
 1035.714  946.688    1.430  948.118     26.40     9.09    1.28   949.40     .00    1.75     2.47    2.500    .000    .00   1   .0
        -|-       -|-      -|-        -|-        -|-      -|-     -|-       -|-      -|-      -|-      -|-     -|-     -|-    |-
  21.216    .0128                                         .0100      .21     1.43    1.48     1.35    .013     .00     .00  PIPE
         |         |        |         |         |       |       |         |       |        |        |       |       |      |
 1056.930  946.960    1.488  948.448     26.40     8.67    1.17   949.62     .00    1.75     2.45    2.500    .000    .00   1   .0
        -|-       -|-      -|-        -|-        -|-      -|-     -|-       -|-      -|-      -|-      -|-     -|-     -|-    |-
JUNCT STR   .0299                                         .0089      .04     1.49    1.37             .014     .00     .00  PIPE
         |         |        |         |         |       |       |         |       |        |        |       |       |      |
 1061.610  947.100    1.751  948.851     26.40     7.19     .80   949.65     .00    1.75     2.29    2.500    .000    .00   1   .0
        -|-       -|-      -|-        -|-        -|-      -|-     -|-       -|-      -|-      -|-      -|-     -|-     -|-    |-
  16.075    .0054                                         .0057      .09     1.75    1.00     1.81    .013     .00     .00  PIPE
         |         |        |         |         |       |       |         |       |        |        |       |       |      |
 1077.685  947.187    1.808  948.995     26.40     6.94     .75   949.74     .00    1.75     2.24    2.500    .000    .00   1   .0
        -|-       -|-      -|-        -|-        -|-      -|-     -|-       -|-      -|-      -|-      -|-     -|-     -|-    |-
  33.585    .0054                                         .0054      .18     1.81     .94     1.81    .013     .00     .00  PIPE
```



```
                    HIP ASHLEY TECHNOLOGY PARK
                      PRELIM ANALYSIS - OUTLET PIPE
                        30-INCH STORM DRAIN
**************************************************************************************************************************** ********
         | Invert  |  Depth |  Water   |     Q    |  Vel    Vel   |  Energy | Super  |Critical|Flow Top|Height/|Base Wt|      |No Wth
```

Station	Elev	(FT)	Elev	(CFS)	(FPS)	Head	Grd.El.	Elev	Depth	Width	Dia.-FT	or I.D.	ZL	Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1111.270	947.370	1.808	949.178	26.40	6.94	.75	949.93	.00	1.75	2.24	2.500	.000	.00	1 .0
21.294	.0056					.0055	.12	1.81	.94	1.79	.013	.00	.00	PIPE
1132.564	947.489	1.790	949.278	26.40	7.02	.77	950.04	.00	1.75	2.26	2.500	.000	.00	1 .0
73.696	.0056					.0055	.41	1.79	.96	1.79	.013	.00	.00	PIPE
1206.260	947.900	1.790	949.690	26.40	7.02	.77	950.46	.00	1.75	2.26	2.500	.000	.00	1 .0

APPENDIX F

Project:

Chamber Model -	MC-4500	
Units -	**Imperial**	Click Here for Metric
Number of Chambers -	378	
Number of End Caps -	12	
Voids in the stone (porosity) -	40	%
Base of STONE Elevation -	0.00	ft
Amount of Stone Above Chambers -	12	in
Amount of Stone Below Chambers -	9	in
Area of system -	15033	sf Min. Area - 14208 sf min. area

StormTech® Detention • Retention • Water Quality
A division of ADS

☑ Include Perimeter Stone in Calculations

Height of System *(inches)*	Incremental Single Chamber *(cubic feet)*	Incremental Single End Cap *(cubic feet)*	Incremental Chambers *(cubic feet)*	Incremental End Cap *(cubic feet)*	Incremental Stone *(cubic feet)*	Incremental Ch, EC and Stone *(cubic feet)*	Cumulative System (cubic feet)	Elevation (feet)
81	0.00	0.00	0.00	0.00	501.10	501.10	65001.90	6.75
80	0.00	0.00	0.00	0.00	501.10	501.10	64500.80	6.67
79	0.00	0.00	0.00	0.00	501.10	501.10	63999.70	6.58
78	0.00	0.00	0.00	0.00	501.10	501.10	63498.60	6.50
77	0.00	0.00	0.00	0.00	501.10	501.10	62997.50	6.42
76	0.00	0.00	0.00	0.00	501.10	501.10	62496.40	6.33
75	0.00	0.00	0.00	0.00	501.10	501.10	61995.30	6.25
74	0.00	0.00	0.00	0.00	501.10	501.10	61494.20	6.17
73	0.00	0.00	0.00	0.00	501.10	501.10	60993.10	6.08
72	0.00	0.00	0.00	0.00	501.10	501.10	60492.00	6.00
71	0.00	0.00	0.00	0.00	501.10	501.10	59990.90	5.92
70	0.00	0.00	0.00	0.00	501.10	501.10	59489.80	5.83
69	0.04	0.00	15.48	0.00	494.91	510.39	58988.70	5.75
68	0.12	0.01	43.88	0.12	483.50	527.50	58478.31	5.67
67	0.16	0.03	62.27	0.32	476.07	538.65	57950.81	5.58
66	0.21	0.05	78.90	0.57	469.31	548.78	57412.16	5.50
65	0.27	0.07	101.43	0.81	460.20	562.45	56863.37	5.42
64	0.45	0.09	171.15	1.05	432.22	604.42	56300.93	5.33
63	0.67	0.11	251.47	1.36	399.97	652.79	55696.50	5.25
62	0.80	0.14	302.03	1.70	379.61	683.34	55043.71	5.17
61	0.91	0.17	343.27	2.01	362.99	708.27	54360.37	5.08
60	1.00	0.19	379.10	2.30	348.54	729.94	53652.10	5.00
59	1.09	0.22	411.01	2.58	335.66	749.26	52922.17	4.92
58	1.16	0.24	439.80	2.90	324.02	766.72	52172.91	4.83
57	1.23	0.27	466.46	3.24	313.22	782.92	51406.19	4.75
56	1.30	0.30	491.28	3.57	303.16	798.01	50623.27	4.67
55	1.36	0.32	514.47	3.88	293.76	812.11	49825.26	4.58
54	1.42	0.35	536.27	4.17	284.92	825.37	49013.15	4.50
53	1.47	0.37	556.92	4.45	276.55	837.92	48187.79	4.42
52	1.53	0.39	576.51	4.73	268.61	849.84	47349.86	4.33
51	1.57	0.42	595.16	5.01	261.03	861.20	46500.02	4.25
50	1.62	0.44	612.88	5.28	253.83	872.00	45638.82	4.17
49	1.67	0.46	629.83	5.55	246.95	882.33	44766.82	4.08
48	1.71	0.48	646.04	5.81	240.36	892.21	43884.49	4.00
47	1.75	0.50	661.53	6.06	234.06	901.66	42992.28	3.92
46	1.79	0.53	676.35	6.30	228.04	910.69	42090.62	3.83
45	1.83	0.55	690.68	6.54	222.21	919.43	41179.93	3.75
44	1.86	0.56	704.38	6.77	216.64	927.79	40260.50	3.67
43	1.90	0.58	717.57	7.00	211.27	935.84	39332.71	3.58
42	1.93	0.60	730.23	7.22	206.12	943.57	38396.87	3.50
41	1.96	0.62	742.42	7.44	201.16	951.02	37453.29	3.42
40	2.00	0.64	754.15	7.66	196.38	958.19	36502.28	3.33
39	2.03	0.66	765.45	7.87	191.77	965.09	35544.09	3.25
38	2.05	0.67	776.33	8.08	187.34	971.75	34579.00	3.17
37	2.08	0.69	786.81	8.28	183.06	978.15	33607.25	3.08
36	2.11	0.71	796.85	8.49	178.96	984.30	32629.10	3.00

35	2.13	0.72	806.59	8.69	174.99	990.27	31644.79	2.92
34	2.16	0.74	815.98	8.88	171.16	996.02	30654.52	2.83
33	2.18	0.76	825.00	9.07	167.47	1001.54	29658.51	2.75
32	2.21	0.77	833.69	9.26	163.92	1006.87	28656.96	2.67
31	2.23	0.79	842.05	9.44	160.50	1012.00	27650.09	2.58
30	2.25	0.80	850.07	9.62	157.22	1016.92	26638.10	2.50
29	2.27	0.82	857.81	9.85	154.04	1021.70	25621.18	2.42
28	2.29	0.84	865.24	10.09	150.97	1026.30	24599.48	2.33
27	2.31	0.85	872.37	10.15	148.09	1030.61	23573.19	2.25
26	2.33	0.86	879.21	10.30	145.30	1034.81	22542.58	2.17
25	2.34	0.87	885.77	10.46	142.61	1038.84	21507.77	2.08
24	2.36	0.89	892.05	10.62	140.03	1042.70	20468.93	2.00
23	2.38	0.90	898.05	10.78	137.57	1046.40	19426.23	1.92
22	2.39	0.91	903.79	10.92	135.21	1049.93	18379.84	1.83
21	2.41	0.92	909.26	11.07	132.97	1053.30	17329.91	1.75
20	2.42	0.93	914.48	11.21	130.82	1056.51	16276.61	1.67
19	2.43	0.95	919.44	11.35	128.78	1059.57	15220.09	1.58
18	2.44	0.96	924.15	11.48	126.85	1062.48	14160.52	1.50
17	2.46	0.97	928.61	11.61	125.01	1065.23	13098.04	1.42
16	2.47	0.98	932.82	11.73	123.28	1067.83	12032.81	1.33

APPENDIX G

United States Department of Agriculture

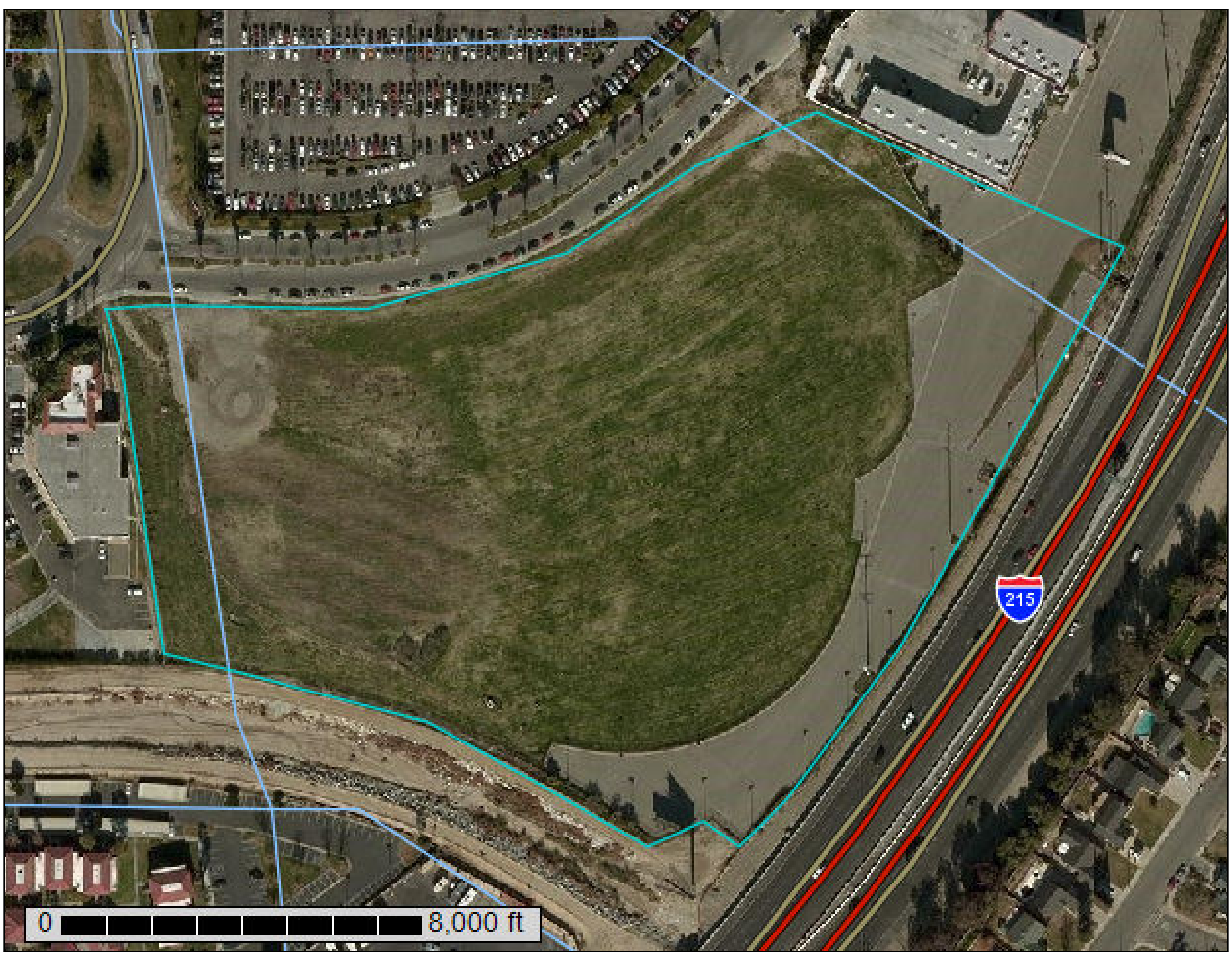
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for San Bernardino County Southwestern Part, California

FMCIVIL ENGINEERS INC.



May 29, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:2,170 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 30, 60, 120, 180

Feet: 0, 100, 200, 400, 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Bernardino County Southwestern Part, California
Survey Area Data: Version 9, Sep 11, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jan 5, 2015—Jan 18, 2015

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
HaD	Hanford coarse sandy loam, 9 to 15 percent slopes	1.8	13.6%
ScA	San Emigdio fine sandy loam, 0 to 2 percent slopes	1.4	10.8%
ScC	San Emigdio fine sandy loam, 2 to 9 percent slopes	10.1	75.7%
Totals for Area of Interest		**13.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

San Bernardino County Southwestern Part, California

HaD—Hanford coarse sandy loam, 9 to 15 percent slopes

Map Unit Setting

National map unit symbol: hck4
Elevation: 150 to 900 feet
Mean annual precipitation: 10 to 20 inches
Mean annual air temperature: 63 degrees F
Frost-free period: 250 to 280 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hanford and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hanford

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

H1 - 0 to 12 inches: sandy loam
H2 - 12 to 60 inches: sandy loam

Properties and qualities

Slope: 9 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Greenfield, sandy loam

Percent of map unit: 10 percent
Hydric soil rating: No

Ramona, sandy loam

Percent of map unit: 5 percent
Hydric soil rating: No

ScA—San Emigdio fine sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hckp
Elevation: 1,000 to 2,000 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 230 to 280 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

San emigdio and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of San Emigdio

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 60 inches: fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.3 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c

Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Metz, coarse sandy loam

Percent of map unit: 5 percent
Hydric soil rating: No

Hanford, cosl

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed

Percent of map unit: 5 percent
Hydric soil rating: No

ScC—San Emigdio fine sandy loam, 2 to 9 percent slopes

Map Unit Setting

National map unit symbol: hckq
Elevation: 1,000 to 2,000 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 230 to 280 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

San emigdio and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of San Emigdio

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 60 inches: fine sandy loam

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.3 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Hanford, coarse sandy loam

Percent of map unit: 10 percent
Hydric soil rating: No

San emigdio, sandy loam

Percent of map unit: 5 percent
Hydric soil rating: No

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NOAA Atlas 14, Volume 6, Version 2
Location name: Colton, California, USA*
Latitude: 34.054°, Longitude: -117.3017°
Elevation: 959.65 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.096 (0.080-0.117)	0.125 (0.104-0.152)	0.162 (0.135-0.197)	0.193 (0.159-0.237)	0.235 (0.187-0.298)	0.267 (0.208-0.347)	0.301 (0.228-0.400)	0.335 (0.247-0.460)	0.382 (0.270-0.547)	0.419 (0.286-0.621)
10-min	0.138 (0.115-0.168)	0.179 (0.149-0.217)	0.232 (0.193-0.283)	0.276 (0.227-0.339)	0.337 (0.268-0.428)	0.383 (0.298-0.498)	0.431 (0.327-0.574)	0.480 (0.354-0.659)	0.548 (0.387-0.784)	0.601 (0.409-0.891)
15-min	0.167 (0.139-0.203)	0.216 (0.180-0.263)	0.281 (0.233-0.342)	0.334 (0.275-0.410)	0.407 (0.324-0.517)	0.463 (0.360-0.602)	0.521 (0.395-0.694)	0.581 (0.428-0.797)	0.663 (0.468-0.948)	0.727 (0.495-1.08)
30-min	0.252 (0.210-0.305)	0.326 (0.271-0.395)	0.423 (0.351-0.515)	0.503 (0.414-0.618)	0.612 (0.487-0.778)	0.697 (0.542-0.906)	0.784 (0.595-1.04)	0.874 (0.644-1.20)	0.997 (0.704-1.43)	1.09 (0.745-1.62)
60-min	0.366 (0.305-0.444)	0.474 (0.394-0.575)	0.616 (0.511-0.750)	0.732 (0.602-0.899)	0.892 (0.709-1.13)	1.01 (0.790-1.32)	1.14 (0.866-1.52)	1.27 (0.938-1.75)	1.45 (1.02-2.08)	1.59 (1.09-2.36)
2-hr	0.524 (0.437-0.635)	0.672 (0.559-0.815)	0.866 (0.718-1.05)	1.02 (0.843-1.26)	1.24 (0.988-1.58)	1.41 (1.10-1.83)	1.58 (1.20-2.11)	1.76 (1.30-2.41)	2.00 (1.41-2.87)	2.19 (1.49-3.25)
3-hr	0.644 (0.537-0.781)	0.823 (0.685-0.999)	1.06 (0.878-1.29)	1.25 (1.03-1.54)	1.51 (1.20-1.92)	1.72 (1.34-2.23)	1.92 (1.46-2.56)	2.14 (1.58-2.93)	2.43 (1.72-3.48)	2.66 (1.81-3.94)
6-hr	0.897 (0.747-1.09)	1.14 (0.951-1.39)	1.47 (1.22-1.79)	1.73 (1.43-2.13)	2.09 (1.66-2.66)	2.37 (1.84-3.08)	2.65 (2.01-3.53)	2.94 (2.17-4.04)	3.34 (2.36-4.78)	3.65 (2.49-5.41)
12-hr	1.19 (0.989-1.44)	1.52 (1.26-1.84)	1.95 (1.62-2.37)	2.30 (1.89-2.82)	2.78 (2.21-3.53)	3.14 (2.44-4.08)	3.52 (2.67-4.68)	3.90 (2.87-5.34)	4.42 (3.12-6.32)	4.82 (3.28-7.14)
24-hr	1.58 (1.40-1.82)	2.03 (1.80-2.35)	2.62 (2.32-3.04)	3.11 (2.72-3.62)	3.76 (3.18-4.52)	4.25 (3.53-5.23)	4.76 (3.85-5.99)	5.27 (4.16-6.83)	5.97 (4.52-8.05)	6.51 (4.76-9.08)
2-day	1.91 (1.69-2.20)	2.50 (2.21-2.89)	3.28 (2.89-3.79)	3.91 (3.42-4.56)	4.76 (4.04-5.74)	5.43 (4.50-6.67)	6.10 (4.94-7.68)	6.79 (5.35-8.79)	7.73 (5.85-10.4)	8.46 (6.19-11.8)
3-day	2.04 (1.80-2.35)	2.71 (2.40-3.13)	3.60 (3.18-4.17)	4.33 (3.79-5.05)	5.34 (4.52-6.43)	6.12 (5.08-7.52)	6.92 (5.60-8.71)	7.75 (6.11-10.0)	8.88 (6.72-12.0)	9.77 (7.15-13.6)
4-day	2.17 (1.93-2.51)	2.92 (2.58-3.37)	3.92 (3.46-4.53)	4.74 (4.15-5.53)	5.87 (4.97-7.08)	6.76 (5.61-8.31)	7.67 (6.21-9.66)	8.62 (6.79-11.2)	9.92 (7.51-13.4)	11.0 (8.01-15.3)
7-day	2.50 (2.22-2.89)	3.40 (3.01-3.92)	4.60 (4.05-5.32)	5.59 (4.89-6.52)	6.96 (5.89-8.38)	8.03 (6.66-9.88)	9.14 (7.40-11.5)	10.3 (8.11-13.3)	11.9 (9.00-16.0)	13.2 (9.62-18.3)
10-day	2.72 (2.41-3.13)	3.72 (3.29-4.29)	5.05 (4.45-5.84)	6.16 (5.39-7.19)	7.70 (6.52-9.28)	8.91 (7.39-11.0)	10.2 (8.23-12.8)	11.5 (9.03-14.8)	13.3 (10.0-17.9)	14.7 (10.8-20.5)
20-day	3.31 (2.93-3.81)	4.57 (4.04-5.27)	6.26 (5.52-7.25)	7.68 (6.72-8.96)	9.66 (8.18-11.6)	11.2 (9.32-13.8)	12.9 (10.4-16.2)	14.6 (11.5-18.9)	17.0 (12.8-22.9)	18.8 (13.8-26.3)
30-day	3.92 (3.47-4.52)	5.42 (4.80-6.26)	7.46 (6.58-8.63)	9.17 (8.02-10.7)	11.6 (9.80-13.9)	13.5 (11.2-16.6)	15.5 (12.5-19.5)	17.5 (13.8-22.7)	20.5 (15.5-27.6)	22.8 (16.7-31.8)
45-day	4.69 (4.16-5.41)	6.47 (5.72-7.47)	8.89 (7.84-10.3)	10.9 (9.56-12.8)	13.8 (11.7-16.6)	16.1 (13.4-19.8)	18.5 (15.0-23.3)	21.0 (16.6-27.2)	24.6 (18.6-33.2)	27.5 (20.1-38.3)
60-day	5.48 (4.85-6.32)	7.51 (6.65-8.67)	10.3 (9.07-11.9)	12.6 (11.0-14.7)	15.9 (13.5-19.2)	18.6 (15.4-22.8)	21.3 (17.3-26.8)	24.3 (19.1-31.4)	28.4 (21.5-38.3)	31.7 (23.2-44.2)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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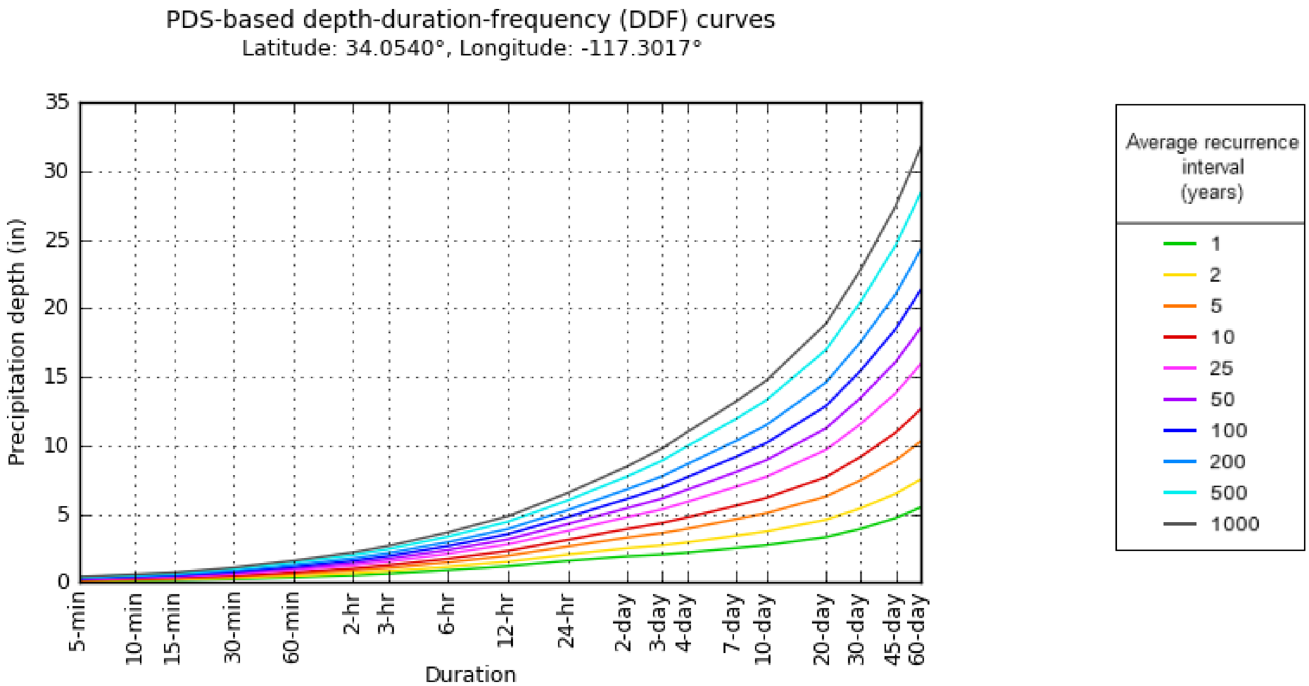
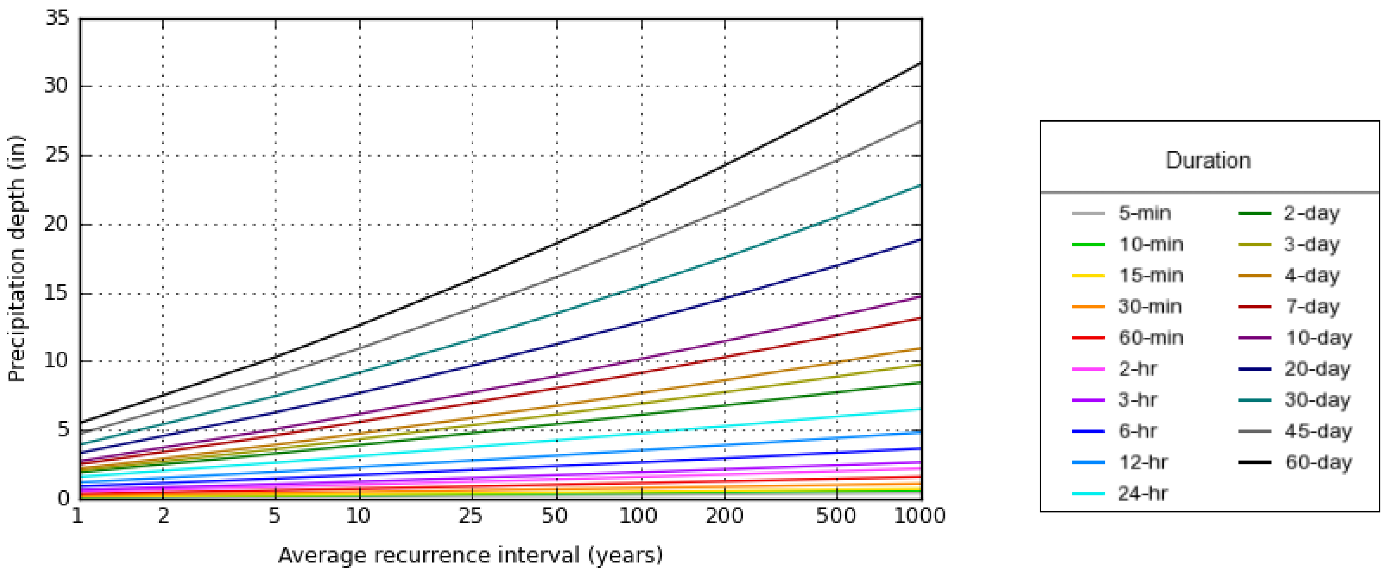
PF graphical





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Maps & aerials

Small scale terrain

Large scale terrain

Large scale map

Large scale aerial

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

1.3 ***Field Infiltration Testing***

Five field percolation tests were performed to approximate depths of 5 feet below existing grade. The approximate locations are shown on Figure 2. Field percolation testing was performed in general accordance with the guidelines set forth by the County of San Bernardino (2013). For the falling head test, a 2-inch-diameter slotted PVC pipe was placed in the boreholes to a depth of approximately 5 feet below existing grade and the annulus was backfilled with gravel to the surface including placement of approximately 2 inches of gravel at the bottom of the borehole. The infiltration wells were pre-soaked per the County guidelines. The tests were performed with an average head (depth of water) of approximately 2 feet above the bottom of the proposed infiltration surfaces. Based on the County of San Bernardino methodology, the observed infiltration rate, summarized in Table 1, has normalized the three-dimensional flow that occurs within the field test to a one-dimensional flow out of the bottom of the boring only. The measured infiltration rates are based on a factor of safety of 2.0 for feasibility. Infiltration tests are performed using relatively clean water free of particulates, silt, etc. Refer to the discussion provided in Section 4.9.

TABLE 1

Summary of Field Infiltration Testing

Infiltration Test Location	Measured Infiltration Rate* (inch/hr)
I-1	2.1
I-2	0.8
I-3	2.4
I-4	2.2
I-5	1.1

*Based on a factor of safety of 2.0 for feasibility

4.9 ***Subsurface Water Infiltration***

Recent regulatory changes have occurred that mandate that storm water be infiltrated below grade rather than collected in a conventional storm drain system. Typically, a combination of methods are implemented to reduce surface water runoff and increase infiltration including; permeable pavements/pavers for roadways and walkways, directing surface water runoff to grass-lined swales, retention areas, and/or drywells, etc.

It should be noted that collecting and concentrating surface water for the purpose of intentional infiltration below grade, conflicts with the geotechnical engineering objective of directing surface water away from slopes, structures and other improvements. The geotechnical stability and integrity of a site is reliant upon appropriately handling surface water. In general, the vast majority of geotechnical distress issues are directly related to improper drainage. In general, distress in the form of movement of improvements could occur as a result of soil saturation and loss of soil support, expansion, internal soil erosion, collapse and/or settlement.

Geotechnical stability and integrity of the project site is reliant upon appropriate handling of surface water. Due to site liquefaction potential, the intentional infiltration of storm water is not recommended.

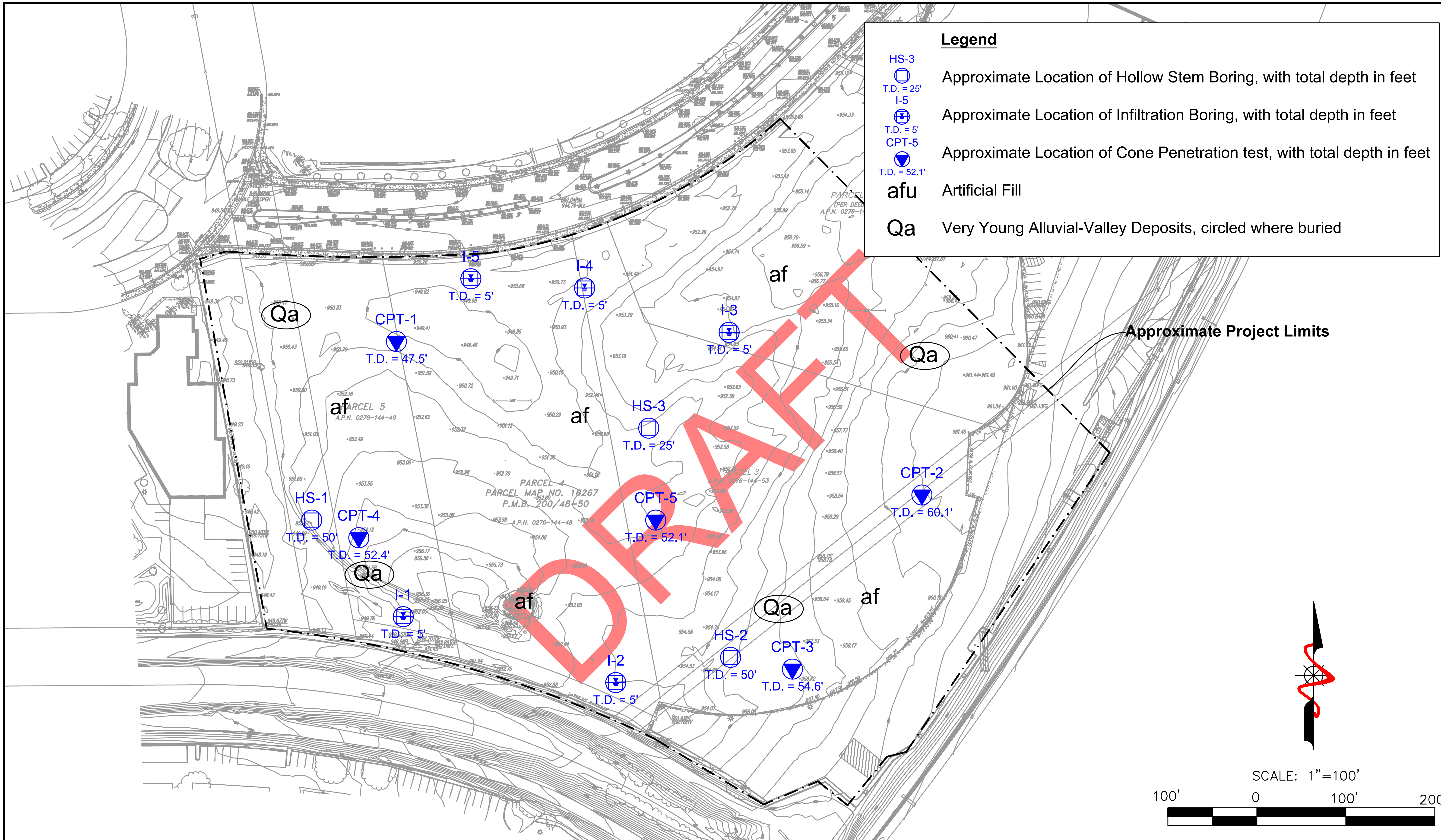

FIGURE 2
Boring Location Map

LGC Geotechnical, Inc.
131 Calle Iglesia, Ste. 200
San Clemente, CA 92672
TEL (949) 369-6141 FAX (949) 369-6142

PROJECT NAME	HPI-Ashley Way
PROJECT NO.	18078-01
ENG. / GEOL.	BTZ/KBC
SCALE	1" = 100'
DATE	July 2018

Ashley Way **DA 1**

Infiltration Test No.	Infiltration Rate (in/hr)	
I-1	2.1	
I-2	0.8	
Infiltration Rate (avergae) =	1.5	Used
Geotechnical Report recommendation =	2.00	

Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	1	0.25
		Predominant soil texture	0.25	1	0.25
		Site soil variability	0.25	1	0.25
		Depth to groundwater / impervious layer	0.25	1	0.25
		Suitability Assessment Safety Factor, $S_A = \sum p$			1
B	Design	Tributary area size	0.25	3	0.75
		Level of pretreatment/ expected sediment loads	0.25	2	0.5
		Redundancy	0.25	3	0.75
		Compaction during construction	0.25	3	0.75
		Design Safety Factor, $S_B = \sum p$			2.75
Combined Safety Factor, $S_{total} = S_A \times S_B$					2.75
Observed Infiltration Rate, inch/hr, $K_{observed}$ (corrected for test-specific bias)					1.5
Design Infiltration Rate, in/hr, Kdesign = $K_{0bserved} / S_{total}$					**0.53**

Briefly describe infiltration test and provide reference to test forms: Southern California Geotechnical performed infiltration testing in general accordance with ASTM Test Method D-3385-03, Standard Test Method for Infiltration Rate of Soils in Field Using Double Ring Infiltrometer. Please refer to SCG's infiltration report dated Decembere 13,2016 for Project no. 16G225-1.

Note: The minimum combined adjustment factor shall not be less than 2.0 and the maximum combined adjustment factor shall not exceed 9.0.

Santa Ana Watershed

BMP Design Volume, V_{BMP}

Company Name	FMCIVIL Engineers Inc.
Designed by	Chris Morlok, PE
Project	Ashley Way
Date	8/1/2018

DA 1 - INTERIM	**Surface Type**	**Area (SF)**
	Roof	220,196.00
	Concrete or Asphalt	168,738.00
	Ornamental Landscaping	91,389.00
	Total Area (SF)	480,323.00
	Total Area (Acres)	11.03

Impervious Ratio =	**(i)**	81.0%
C_{BMP} = Runoff Coefficient	**$0.858i^3-0.78i^2+0.774i+0.04$**	0.61
$P_{2yr,1hr}$	**NOAA - 2-yr 1-hr rainfall depth**	0.474
a_1 = San Bernardino Climate Region	**Valley = 1.4807** **Mountain = 1.909** **Desert = 1.2371**	1.4807
P_6 - Mean Storm Rainfall Depth	**$P_6 = a_1 * P_{2yr,1hr}$**	0.7019
a_2 = Drawdown rate of Basin	**1.582 for 24-hr** **1.963 for 48-hr**	1.9630
Project Area (SF)	**(DA)**	480,323.00
Design Capture Volume (cu.ft.)	**$DCV = DA * C_{BMP} * a_2 * P_6/12$**	33,685.67
Volume Provided, cu. Ft.		33,809.00

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F.2 - Preliminary Water Quality Management Plan

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Preliminary Water Quality Management Plan

For:

Ashley Way

APN: 0276-144-52, 0276-144-53, 0276-144-48,0276-144-48

Prepared for:

Howard Industrial Partners, LLC

155 North Riverview Drive

Anaheim Hills, CA 92808

714-769-9155

Prepared by:

FMCivil Engineers, Inc

29995 Technology Dr., Suite 306

Murrieta, CA 92563

951-973-0201

Submittal Date: August 6, 2018

Revision Date:

Approval Date:______________________

Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for Howard Industrial Partners, LLC by FMCivil Engineers, Inc. The WQMP is intended to comply with the requirements of the City of Colton,County of San Bernardino and the NPDES Area wide Stormwater Program requiring the preparation of a WQMP. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with San Bernardino County's Municipal Storm Water Management Program and the intent of the NPDES Permit for San Bernardino County and the incorporated cities of San Bernardino County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors in interest and the city/county shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

.

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):		Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0276-144-52, 0276-144-53, 0276-144-48,0276-144-48

Owner's Signature			
Owner Name: Tim Howard			
Title	Partner		
Company	Howard Industrial Partners		
Address	155 N. Riverview Drive, Anaheim Hills, CA 92808		
Email	Thoward@hipre.net		
Telephone #	714-769-9155		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):		Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0260-131-14, 0260-131-15

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of Regional Water Quality Control Board Order No. R8-2010-0036."

Engineer: Francisco Martinez, Jr.	
Title	Senior Civil Engineer
Company	FMCivil Engineers Inc.
Address	29995 Technology Dr, Suite 306 Murrieta, CA 92563
Email	chris.morlok@fmcivil.com
Telephone #	951-973-0204
Signature	
Date	

Table of Contents

Forms

Section 1 Discretionary Permit(s)

<table>
<tr><th colspan="6">Form 1-1 Project Information</th></tr>
<tr><td colspan="2">Project Name</td><td colspan="4">Ashley Way</td></tr>
<tr><td colspan="2">Project Owner Contact Name:</td><td colspan="4">Tim Howard</td></tr>
<tr><td>Mailing Address:</td><td>155 N. Riverview Dr., Anaheim Hills, CA 92808</td><td>E-mail Address:</td><td>Thoward@hipre.net</td><td>Telephone:</td><td>714-769-9155</td></tr>
<tr><td colspan="2">Permit/Application Number(s):</td><td colspan="2"></td><td>Tract/Parcel Map Number(s):</td><td></td></tr>
<tr><td colspan="2">Additional Information/ Comments:</td><td colspan="4"></td></tr>
<tr><td colspan="2">Description of Project:</td><td colspan="4">The overall site, which totals 11.0 +/- acres sits currently vacant, and is generally flat. The stormwater flows appear to drain South-East toward the Reche Canyon Channel which ultimately outlets to the Santa Ana River. The site will be developed into a warehouse building with parking lot and associated landscaping. The project will consist of the construction of approximately 220,800 square feet of warehouse building, 168,738 swaure feet of concrete/asphalt paving and approximately 91,389 square feet of associated landscaping, slopes and open space. The construction site would yield 81.0% impervious and 19.0% pervious area. An underground water quality infiltration chamber is proposed on-site to capture and infiltrate the capture volume for a 2-year storm.</td></tr>
<tr><td colspan="2">Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.</td><td colspan="4"></td></tr>
</table>

Section 2 Project Description

2.1 Project Information

This section of the WQMP should provide the information listed below. The information provided for Conceptual/ Preliminary WQMP should give sufficient detail to identify the major proposed site design and LID BMPs and other anticipated water quality features that impact site planning. Final Project WQMP must specifically identify all BMP incorporated into the final site design and provide other detailed information as described herein.

The purpose of this information is to help determine the applicable development category, pollutants of concern, watershed description, and long term maintenance responsibilities for the project, and any applicable water quality credits. This information will be used in conjunction with the information in Section 3, Site Description, to establish the performance criteria and to select the LID BMP or other BMP for the project or other alternative programs that the project will participate in, which are described in Section 4.

Form 2.1-1 Description of Proposed Project

1 Development Category (Select all that apply):			
☐ Significant re-development involving the addition or replacement of 5,000 ft² or more of impervious surface on an already developed site	☒ New development involving the creation of 10,000 ft² or more of impervious surface collectively over entire site	☐ Automotive repair shops with standard industrial classification (SIC) codes 5013, 5014, 5541, 7532- 7534, 7536-7539	☐ Restaurants (with SIC code 5812) where the land area of development is 5,000 ft² or more
☐ Hillside developments of 5,000 ft² or more which are located on areas with known erosive soil conditions or where the natural slope is 25 percent or more	☐ Developments of 2,500 ft² of impervious surface or more adjacent to (within 200 ft) or discharging directly into environmentally sensitive areas or waterbodies listed on the CWA Section 303(d) list of impaired waters.	☒ Parking lots of 5,000 ft² or more exposed to storm water	☐ Retail gasoline outlets that are either 5,000 ft² or more, or have a projected average daily traffic of 100 or more vehicles per day
☐ Non-Priority / Non-Category Project *May require source control LID BMPs and other LIP requirements. Please consult with local jurisdiction on specific requirements.*			

2 Project Area (ft2):	480,323	3 Number of Dwelling Units:		4 SIC Code:	4225
5 Is Project going to be phased? Yes ☐ No ☒ *If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.*					
6 Does Project include roads? Yes ☐ No ☒ *If yes, ensure that applicable requirements for transportation projects are addressed (see Appendix A of TGD for WQMP)*					

2.2 Property Ownership/Management

Describe the ownership/management of all portions of the project and site. State whether any infrastructure will transfer to public agencies (City, County, Caltrans, etc.) after project completion. State if a homeowners or property owners association will be formed and be responsible for the long-term maintenance of project stormwater facilities. Describe any lot-level stormwater features that will be the responsibility of individual property owners.

Form 2.2-1 Property Ownership/Management
Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities:
The entire site is proposed to be owned and maintained by the applicant if and until such time as the property transfers ownership; at which point the new owner will be responsible for all requirements set forth herein. Long term maintenance will be the responsibility of the property owner.

2.3 Potential Stormwater Pollutants

Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-3 in the TGD for WQMP).

Form 2.3-1 Pollutants of Concern

Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E ☒	N ☐	Wild birds/ animal waste/ garbage
Nutrients - Phosphorous	E ☒	N ☐	Fertilizers/ food waste/ garbage
Nutrients - Nitrogen	E ☒	N ☐	Fertilizers/ food waste/ garbage
Noxious Aquatic Plants	E ☒	N ☐	Landscape areas
Sediment	E ☒	N ☐	Driveways/ rooftops/ sidewalks
Metals	E ☒	N ☐	Car/ truck
Oil and Grease	E ☒	N ☐	Car/ truck
Trash/Debris	E ☒	N ☐	Parking lot/ poorly managed trash containers
Pesticides / Herbicides	E ☒	N ☐	Landscape use
Organic Compounds	E ☒	N ☐	Landscape use
Other: Oxygen Demanding Compounds	E ☒	N ☐	Car/ truck
Other: Petroleum Hydrocarbons	E ☒	N ☐	Car/ truck
Other: Solvents	E ☒	N ☐	Car/ truck
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

2.4 Water Quality Credits

A water quality credit program is applicable for certain types of development projects if it is not feasible to meet the requirements for on-site LID. Proponents for eligible projects, as described below, can apply for water quality credits that would reduce project obligations for selecting and sizing other treatment BMP or participating in other alternative compliance programs. Refer to Section 6.2 in the TGD for WQMP to determine if water quality credits are applicable for the project.

Form 2.4-1 Water Quality Credits			
1 Project Types that Qualify for Water Quality Credits: *Select all that apply*			
☐ Redevelopment projects that reduce the overall impervious footprint of the project site. [Credit = % impervious reduced]	Higher density development projects ☐Vertical density [20%] ☐7 units/ acre [5%]	☐ Mixed use development, (combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that demonstrate environmental benefits not realized through single use projects) [20%]	☐Brownfield redevelopment (redevelop real property complicated by presence or potential of hazardous contaminants) [25%]
☐ Redevelopment projects in established historic district, historic preservation area, or similar significant core city center areas [10%]	☐ Transit-oriented developments (mixed use residential or commercial area designed to maximize access to public transportation) [20%]	☐ In-fill projects (conversion of empty lots & other underused spaces < 5 acres, substantially surrounded by urban land uses, into more beneficially used spaces, such as residential or commercial areas) [10%]	☐ Live-Work developments (variety of developments designed to support residential and vocational needs) [20%]
2 Total Credit % **0** *(Total all credit percentages up to a maximum allowable credit of 50 percent)*			
Description of Water Quality Credit Eligibility (if applicable)	N/A		

Section 3 Site and Watershed Description

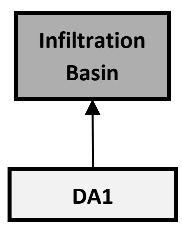
Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and sub-watershed DMAs) is conveyed to the site outlet(s). Refer to Section 3.2 in the TGD for WQMP. The form below is provided as an example. Then complete Forms 3.2 and 3.3 for each DA on the project site. ***If the project has more than one drainage area for stormwater management, then complete additional versions of these forms for each DA / outlet.***

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34° 1'23.35"N	Longitude 117°22'11.34"W	Thomas Bros Map page 646

1 San Bernardino County climatic region: ☒ Valley ☐ Mountain

2 Does the site have more than one drainage area (DA): Yes☐ No☒ *If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached*



Example only – modify for project specific WQMP using additional form

Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DA1 to Infiltration Basin	All drainage will be captured via onsite storm drain facilities and be conveyed to an infiltration basin where the DCV will be treated.

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
1 DMA drainage area (ft²)	480,323			
2 Existing site impervious area (ft²)	0			
3 Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	II			
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	B			
5 Longest flowpath length (ft)	798			
6 Longest flowpath slope (ft/ft)	0.008			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Barren			
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	Poor			

Form 3-3 Watershed Description for Drainage Area	
Receiving waters *Refer to Watershed Mapping Tool - http://permitrack.sbcounty.gov/wap/* *See 'Drainage Facilities" link at this website*	Santa Ana River (Reach 4)
Applicable TMDLs *Refer to Local Implementation Plan*	None
303(d) listed impairments *Refer to Local Implementation Plan and Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/ and State Water Resources Control Board website – http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml*	Santa Ana River (Reach 4) – Pathogens Santa Ana River (Reach 3) – Copper, Lead, Pathogens Santa Ana River (Reach 2) - Bacteria
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	None within 200-feet, Santa Ana River (Reach 4) approx. 1,900-feet west
Unlined Downstream Water Bodies *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	Santa Ana River (Reach 4)
Hydrologic Conditions of Concern	☐ Yes *Complete Hydrologic Conditions of Concern (HCOC) Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-10 in submittal* ☒ No
Watershed–based BMP included in a RWQCB approved WAP	☐ Yes *Attach verification of regional BMP evaluation criteria in WAP* • *More Effective than On-site LID* • *Remaining Capacity for Project DCV* • *Upstream of any Water of the US* • *Operational at Project Completion* • *Long-Term Maintenance Plan* ☒ No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMP

4.1.1 Pollution Prevention

Non-structural and structural source control BMP are required to be incorporated into all new development and significant redevelopment projects. Form 4.1-1 and 4.1-2 are used to describe specific source control BMPs used in the WQMP or to explain why a certain BMP is not applicable. Table 7-3 of the TGD for WQMP provides a list of applicable source control BMP for projects with specific types of potential pollutant sources or activities. The source control BMP in this table must be implemented for projects with these specific types of potential pollutant sources or activities.

The preparers of this WQMP have reviewed the source control BMP requirements for new development and significant redevelopment projects. The preparers have also reviewed the specific BMP required for project as specified in Forms 4.1-1 and 4.1-2. All applicable non-structural and structural source control BMP shall be implemented in the project.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One: Included	Check One: Not Applicable	Describe BMP Implementation OR, if not applicable, state reason
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	The owner shall familiarize himself with the contents of the WQMP and County & City Ordinances and brochures and furnish copies of City and County BMP factsheets to all future tenants through lease agreements.
N2	Activity Restrictions	☒	☐	Tenants shall not be allowed to discharge chemicals, chemical residues, wastewater or other prohibited discharges listed in the City and County Ordinances, to the outside, paved areas of the site; or store chemicals or other pollutant sources in non-spill contained or covered facilities.
N3	Landscape Management BMPs	☒	☐	Landscape crews contracted by the POA shall inspect the irrigation system and the health of the landscaping plant cover after each landscape procedure and shall report all repairs and problems to the POA. All routine landscaping maintenance shall be done in conformance with BMP fact sheet #SD-10 in Appendix 6.
N4	BMP Maintenance	☒	☐	BMP maintenance will be provided by the property owner and will take place at a minimum of twice a year and after any major rainfall event.
N5	Title 22 CCR Compliance (How development will comply)	☒	☐	The owner/tenant will file appropriate hazardous material disclosures, if any storage is conducted, and must comply with all the Title 22 CCR, Chapter 29 regulations.
N6	Local Water Quality Ordinances	☒	☐	The owner shall ensure that all business activities at the site comply with the City of Colton’s Stormwater Ordinance through the implementation of BMP’s.
N7	Spill Contingency Plan	☒	☐	Any hazardous material storage, if any, will require a business/ emergency response plan as required by the San Bernardino County Fire Hazmat.
N8	Underground Storage Tank Compliance	☐	☒	There are no UST’s on this site.
N9	Hazardous Materials Disclosure Compliance	☒	☐	The current owner and future owners shall prohibit the storage of hazardous materials.

Form 4.1-1 Non-Structural Source Control BMPs

N10	Uniform Fire Code Implementation	☒	☐	All fire code requirements shall be implemented at this site.
N11	Litter/Debris Control Program	☒	☐	A program shall be implemented to pick up litter and sweep and clean the existing trash enclosures on a daily basis. Trash enclosures are designed to divert all flows away from the enclosure. All dumpsters will have lids installed and will be inspected to ensure that the dumpsters remain covered and leak-proof. The owner shall ensure tenants contract with a refuse company to have the dumpsters emptied on a weekly basis, at a minimum.
N12	Employee Training	☒	☐	Property owner shall establish an educational program for site employees and contractors to inform and train personnel engaged in maintenance activities regarding the impact of dumping oil, paint, solvents, or other potentially harmful chemicals into the storm drain system; the use of fertilizers and pesticides in landscaping maintenance practices; and the impacts of litter and improper waste disposal.
N13	Housekeeping of Loading Docks	☒	☐	The loading/unloading of materials will take place at the docks; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. A program shall be implemented to train employees on applicable BMPs and general pollution prevention strategies and objectives. The dock area shall be swept daily and the maintenance policy for the site will address daily maintenance of the area.
N14	Catch Basin Inspection Program	☒	☐	The on-site catch basins shall be inspected monthly during the rainy season (October- May) and before and after each storm to ensure proper operation. The POA shall contract with a qualified landscape contractor to inspect and clean out accumulation of trash, litter and sediment and check for evidence of illegal dumping of waste materials into on-site drains.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	Parking lots shall be swept weekly to prevent sediment, garden waste, and trash, or other pollutants from entering on-site drains and public storm channels. Sweeping will be done by a landscape contractor or other contractor provided by the owner.

Form 4.1-1 Non-Structural Source Control BMPs

N16	Other Non-structural Measures for Public Agency Projects	☐	☒	This is a private project.
N17	Comply with all other applicable NPDES permits	☒	☐	The developer of this site shall comply with the state's General Construction Stormwater Permit by filing a NOI, SWPPP, and obtain a WDID #, prior to start of grading/construction. All future occupants requiring coverage under the NPDES General Industrial Activities Permit shall comply with the permit requirements by filing a notice of intent and SWPPP with the state and obtaining a WDID Discharge Permit Number, prior to commencement of industrial activities, covered under the permit.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	A painted message "No Dumping- Drains to River" shall be placed on each catch basin. The message shall be inspected annually & repainted as necessary.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	No outdoor material storage shall be allowed at this facility.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	All dumpsters shall have working lids which shall be kept closed, at all times. Trash enclosure shall comply with CASQA SD-32 and shall have doors.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	☒	☐	The irrigation system will include devices to prevent low head drainage, overspray and run off through the use of pressure regulating devices, check valves, rain shutoff valves, flow sensors, pressure drop sensors, proper spacing, low precipitation emission devises and ET or weather based controllers. Landscape and irrigation shall be consistent with the State Model Water Efficient landscape Ordinance and the City of Colton landscape Development Standards. Plants installed will be arranged according to similar hydrozones and meet the required water budget for the site. Landscape areas used for water quality swales or infiltration areas shall have proper plants for saturated soils, drought tolerance and erosion control qualities. Shade trees shall be used to intercept rainwater and reduce heat gain on paving.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	Proposed landscape will comply with depressed area requirements.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	Proposed slopes will be protected to prevent erosion.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☒	☐	Proposed docks are equipped with dock high doors so that truck trailers back up flush with building and loading/unloading activities are contained inside building.

Form 4.1-2 Structural Source Control BMPs				
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	No proposed bays on project site
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No car wash area proposed on project site
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	No outdoor processing areas proposed on project site
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No proposed wash areas proposed on project site
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	No fueling areas proposed on project site
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	No hillside landscaping proposed on project site
S14	Wash water control for food preparation areas	☐	☒	N/A
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	N/A

4.1.2 Preventative LID Site Design Practices

Site design practices associated with new LID requirements in the MS4 Permit should be considered in the earliest phases of a project. Preventative site design practices can result in smaller DCV for LID BMP and hydromodification control BMP by reducing runoff generation. Describe site design and drainage plan including:

- A narrative of site design practices utilized or rationale for not using practices
- A narrative of how site plan incorporates preventive site design practices
- Include an attached Site Plan layout which shows how preventative site design practices are included in WQMP

Refer to Section 5.2 of the TGD for WQMP for more details.

Form 4.1-3 Preventative LID Site Design Practices Checklist
Site Design Practices *If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets*
Minimize impervious areas: Yes ☒ No ☐ Explanation: The project site will minimize the impervious areas by incorporating landscaping in all feasible areas to the maximum extent practicable.
Maximize natural infiltration capacity: Yes ☒ No ☐ Explanation: The project site will utilize an underground storage and infiltration chamber system, which will maximize the natural infiltration capacity.
Preserve existing drainage patterns and time of concentration: Yes ☐ No ☒ Explanation: Existing drainage pattern and time of concentration will differ due to an increase in site imperviousness from an undeveloped site.
Disconnect impervious areas: Yes ☒ No ☐ Explanation: Proposed development runoff water is disconnected from the MS4 by directing the 85th percentile runoff water into the water quality BMP's, which retain the entire DCV for this project. Roof areas will drain to landscaping as feasible.
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: Current site condition does not include existing vegetation or sensitive areas to preserve.
Re-vegetate disturbed areas: Yes ☒ No ☐ Explanation: All areas not paved will be landscaped.
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: Areas beneath the underground chambers shall be native un-compacted material.
Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☒ No ☐ Explanation: Swales will be used in landscaped areas to convey overflow water, instead of landscaped drains with direct connection to the on-site storm drains.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☒ No ☐ Explanation: The project will stake off areas that will be used for landscaping to minimize compaction during construction.

4.2 Project Performance Criteria

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in the MS4 Permit. These targets include runoff volume for water quality control (referred to as LID design capture volume), and runoff volume, time of concentration, and peak runoff for protection of any downstream waterbody segments with a HCOC. ***If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.***

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), the San Bernardino County Stormwater Program requires use of the P_6 method (MS4 Permit Section XI.D.6a.ii) – Form 4.2-1
- For HCOC pre- and post-development hydrologic calculation, the San Bernardino County Stormwater Program requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi^2), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for HCOC performance criteria.

Refer to Section 4 in the TGD for WQMP for detailed guidance and instructions.

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1)		
1 Project area DA 1 (ft^2): 480,324	2 Imperviousness after applying preventative site design practices (Imp%): 81.0	3 Runoff Coefficient (Rc): 0.61 *R_c = 0.858(Imp%)^3-0.78(Imp%)^2+0.774(Imp%)+0.04*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.474 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.7019 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft^3): 33,685.67 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-2 Summary of HCOC Assessment (DA 1)

Does project have the potential to cause or contribute to an HCOC in a downstream channel: Yes ☐ No ☒

Go to: *http://permitrack.sbcounty.gov/wap/*

If "Yes", then complete HCOC assessment of site hydrology for 2yr storm event using Forms 4.2-3 through 4.2-5 and insert results below *(Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual)*

If "No," then proceed to Section 4.3 Project Conformance Analysis

N/A PROJECT SITE IS WITHIN HCOC EXEMPT AREAS

Condition	Runoff Volume (ft^3)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	**1** *Form 4.2-3 Item 12*	**2** *Form 4.2-4 Item 13*	**3** *Form 4.2-5 Item 10*
Post-developed	**4** *Form 4.2-3 Item 13*	**5** *Form 4.2-4 Item 14*	**6** *Form 4.2-5 Item 14*
Difference	**7** *Item 4 – Item 1*	**8** *Item 2 – Item 5*	**9** *Item 6 – Item 3*
Difference (as % of pre-developed)	**10** *%* *Item 7 / Item 1*	**11** *%* *Item 8 / Item 2*	**12** *%* *Item 9 / Item 3*

Form 4.2-3 HCOC Assessment for Runoff Volume (DA 1)

Weighted Curve Number Determination for: **Pre**-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type	N/A							
2a Hydrologic Soil Group (HSG)	N/A							
3a DMA Area, ft² *sum of areas of DMA should equal area of DA*	N/A							
4a Curve Number (CN) *use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*	N/A							
Weighted Curve Number Determination for: Post-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type	N/A							
2b Hydrologic Soil Group (HSG)	N/A							
3b DMA Area, ft² *sum of areas of DMA should equal area of DA*	N/A							
4b Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*	N/A							

5 Pre-Developed area-weighted CN: N/A	**7** Pre-developed soil storage capacity, S (in): *S = (1000 / Item 5) - 10*	**9** Initial abstraction, I_a (in): *I_a = 0.2 * Item 7*
6 Post-Developed area-weighted CN: N/A	**8** Post-developed soil storage capacity, S (in): *S = (1000 / Item 6) - 10*	**10** Initial abstraction, I_a (in): *I_a = 0.2 * Item 8*

11 Precipitation for 2 yr, 24 hr storm (in): N/A
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft³): N/A
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7)*

13 Post-developed Volume (ft³): N/A
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 10)^2 / ((Item 11 – Item 10 + Item 8)*

14 Volume Reduction needed to meet HCOC Requirement, (ft³): N/A
*V_{HCOC} = (Item 13 * 0.95) – Item 12*

Form 4.2-4 HCOC Assessment for Time of Concentration (DA 1)

Compute time of concentration for pre and post developed conditions for each DA *(For projects using the Hydrology Manual complete the form below)*

Variables	Pre-developed DA1 *Use additional forms if there are more than 4 DMA*				Post-developed DA1 *Use additional forms if there are more than 4 DMA*			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) *Use Form 3-2 Item 5 for pre-developed condition*	N/A							
2 Change in elevation (ft)	N/A							
3 Slope (ft/ft), *S_o = Item 2 / Item 1*	N/A							
4 Land cover	N/A							
5 Initial DMA Time of Concentration (min) *Appendix C-1 of the TGD for WQMP*	N/A							
6 Length of conveyance from DMA outlet to project site outlet (ft) *May be zero if DMA outlet is at project site outlet*	N/A							
7 Cross-sectional area of channel (ft^2)	N/A							
8 Wetted perimeter of channel (ft)	N/A							
9 Manning's roughness of channel (n)	N/A							
10 Channel flow velocity (ft/sec) *V_{fps} = (1.49 / Item 9) * (Item 7/Item 8)^0.67 * (Item 3)^0.5*	N/A							
11 Travel time to outlet (min) *T_t = Item 6 / (Item 10 * 60)*	N/A							
12 Total time of concentration (min) *T_c = Item 5 + Item 11*	N/A							

13 Pre-developed time of concentration (min): N/A *Minimum of Item 12 pre-developed DMA*

14 Post-developed time of concentration (min): N/A *Minimum of Item 12 post-developed DMA*

15 Additional time of concentration needed to meet HCOC requirement (min): N/A *T_{C-HCOC} = (Item 13 * 0.95) – Item 14*

Form 4.2-5 HCOC Assessment for Peak Runoff (DA 1)

Compute peak runoff for pre- and post-developed conditions

Variables		Pre-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*			Post-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*		
		DMA A	DMA B	DMA C	DMA A	DMA B	DMA C
1 Rainfall Intensity for storm duration equal to time of concentration *I_{peak} = 10^(LOG Form 4.2-1 Item 4 - 0.6 LOG Form 4.2-4 Item 5 /60)*		N/A					
2 Drainage Area of each DMA (Acres) *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*		N/A					
3 Ratio of pervious area to total area *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*		N/A					
4 Pervious area infiltration rate (in/hr) *Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*		N/A					
5 Maximum loss rate (in/hr) *F_m = Item 3 * Item 4* *Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*		N/A					
6 Peak Flow from DMA (cfs) *Q_p =Item 2 * 0.9 * (Item 1 - Item 5)*		N/A					
7 Time of concentration adjustment factor for other DMA to site discharge point *Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)*	DMA A	N/A					
	DMA B	N/A					
	DMA C	N/A					

8 Pre-developed Q_p at T_c for DMA A: N/A *Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]*	9 Pre-developed Q_p at T_c for DMA B: N/A *Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]*	10 Pre-developed Q_p at T_c for DMA C: N/A *Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]*
10 Peak runoff from pre-developed condition confluence analysis (cfs): N/A *Maximum of Item 8, 9, and 10 (including additional forms as needed)*		
11 Post-developed Q_p at T_c for DMA A: N/A *Same as Item 8 for post-developed values*	12 Post-developed Q_p at T_c for DMA B: N/A *Same as Item 9 for post-developed values*	13 Post-developed Q_p at T_c for DMA C: N/A *Same as Item 10 for post-developed values*
14 Peak runoff from post-developed condition confluence analysis (cfs): N/A *Maximum of Item 11, 12, and 13 (including additional forms as needed)*		
15 Peak runoff reduction needed to meet HCOC Requirement (cfs): N/A *Q_{p-HCOC} = (Item 14 * 0.95) – Item 10*		

4.3 Project Conformance Analysis

Complete the following forms for each project site DA to document that the proposed LID BMPs conform to the project DCV developed to meet performance criteria specified in the MS4 Permit (WQMP Template Section 4.2). For the LID DCV, the forms are ordered according to hierarchy of BMP selection as required by the MS4 Permit (see Section 5.3.1 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design and Hydrologic Source Controls (Form 4.3-2)
- Retention and Infiltration (Form 4.3-3)
- Harvested and Use (Form 4.3-4) or
- Biotreatment (Form 4.3-5).

At the end of each form, additional fields facilitate the determination of the extent of mitigation provided by the specific BMP category, allowing for use of the next category of BMP in the hierarchy, if necessary.

The first step in the analysis, using Section 5.3.2.1 of the TGD for WQMP, is to complete Forms 4.3-1 and 4.3-3) to determine if retention and infiltration BMPs are infeasible for the project. For each feasibility criterion in Form 4.3-1, if the answer is "Yes," provide all study findings that includes relevant calculations, maps, data sources, etc. used to make the determination of infeasibility.

Next, complete Forms 4.3-2 and 4.3-4 to determine the feasibility of applicable HSC and harvest and use BMPs, and, if their implementation is feasible, the extent of mitigation of the DCV.

If no site constraints exist that would limit the type of BMP to be implemented in a DA, evaluate the use of combinations of LID BMPs, including all applicable HSC BMPs to maximize on-site retention of the DCV. If no combination of BMP can mitigate the entire DCV, implement the single BMP type, or combination of BMP types, that maximizes on-site retention of the DCV within the minimum effective area.

If the combination of LID HSC, retention and infiltration, and harvest and use BMPs are unable to mitigate the entire DCV, then biotreatment BMPs may be implemented by the project proponent. If biotreatment BMPs are used, then they must be sized to provide sufficient capacity for effective treatment of the remainder of the volume-based performance criteria that cannot be achieved with LID BMPs (TGD for WQMP Section 5.4.4.2). **Under no circumstances shall any portion of the DCV be released from the site without effective mitigation and/or treatment**.

Form 4.3-1 Infiltration BMP Feasibility (DA 1)

Feasibility Criterion – Complete evaluation for each DA on the Project Site

[1] Would infiltration BMP pose significant risk for groundwater related concerns? Yes ☐ No ☒
Refer to Section 5.3.2.1 of the TGD for WQMP

If Yes, Provide basis: (attach)

[2] Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☐ No ☒
(Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert):

- The location is less than 50 feet away from slopes steeper than 15 percent
- The location is less than eight feet from building foundations or an alternative setback.
- A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.

If Yes, Provide basis: (attach)

[3] Would infiltration of runoff on a Project site violate downstream water rights? Yes ☐ No ☒

If Yes, Provide basis: (attach)

[4] Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils? Yes ☐ No ☒

If Yes, Provide basis: (attach)

[5] Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)? Yes ☐ No ☒

If Yes, Provide basis: (attach)

[6] Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒
See Section 3.5 of the TGD for WQMP and WAP

If Yes, Provide basis: (attach)

[7] Any answer from Item 1 through Item 3 is "Yes": Yes ☐ No ☒
If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Harvest and Use BMP. If no, then proceed to Item 8 below.

[8] Any answer from Item 4 through Item 6 is "Yes": Yes ☐ No ☒
If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Hydrologic Source Control BMP. If no, then proceed to Item 9, below.

[9] All answers to Item 1 through Item 6 are "No":
Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP. Proceed to Form 4.3-2, Hydrologic Source Control BMP.

4.3.1 Site Design Hydrologic Source Control BMP

Section XI.E. of the Permit emphasizes the use of LID preventative measures; and the use of LID HSC BMPs reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable HSC shall be provided except where they are mutually exclusive with each other, or with other BMPs. Mutual exclusivity may result from overlapping BMP footprints such that either would be potentially feasible by itself, but both could not be implemented. Please note that while there are no numeric standards regarding the use of HSC, if a project cannot feasibly meet BMP sizing requirements or cannot fully address HCOCs, feasibility of all applicable HSC must be part of demonstrating that the BMP system has been designed to retain the maximum feasible portion of the DCV. Complete Form 4.3-2 to identify and calculate estimated retention volume from implementing site design HSC BMP. Refer to Section 5.4.1 in the TGD for more detailed guidance.

Form 4.3-2 Site Design Hydrologic Source Control BMPs (DA 1)			
1 Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes ☐ No ☒ *If yes, complete Items 2-5; If no, proceed to Item 6*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Total impervious area draining to pervious area (ft^2)	N/A		
3 Ratio of pervious area receiving runoff to impervious area	N/A		
4 Retention volume achieved from impervious area dispersion (ft^3) *V = Item2 * Item 3 * (0.5/12), assuming retention of 0.5 inches of runoff*	N/A		
5 Sum of retention volume achieved from impervious area dispersion (ft^3):	*$V_{retention}$ =Sum of Item 4 for all BMPs*		
6 Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes ☐ No ☒ *If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
7 Ponding surface area (ft^2)	N/A		
8 Ponding depth (ft)	N/A		
9 Surface area of amended soil/gravel (ft^2)	N/A		
10 Average depth of amended soil/gravel (ft)	N/A		
11 Average porosity of amended soil/gravel	N/A		
12 Retention volume achieved from on-lot infiltration (ft^3) *$V_{retention}$ = (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)*	N/A		
13 Runoff volume retention from on-lot infiltration (ft^3): N/A	*$V_{retention}$ =Sum of Item 12 for all BMPs*		

Form 4.3-2 cont. Site Design Hydrologic Source Control BMPs (DA 1)

14 Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes ☐ No ☒ *If yes, complete Items 15-20. If no, proceed to Item 21*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
15 Rooftop area planned for ET BMP (ft^2)	N/A		
16 Average wet season ET demand (in/day) *Use local values, typical ~ 0.1*	N/A		
17 Daily ET demand (ft^3/day) *Item 15 * (Item 16 / 12)*	N/A		
18 Drawdown time (hrs) *Copy Item 6 in Form 4.2-1*	N/A		
19 Retention Volume (ft^3) *$V_{retention}$ = Item 17 * (Item 18 / 24)*	N/A		
20 Runoff volume retention from evapotranspiration BMPs (ft^3): N/A *$V_{retention}$ =Sum of Item 19 for all BMPs*			
21 Implementation of Street Trees: Yes ☐ No ☒ *If yes, complete Items 22-25. If no, proceed to Item 26*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
22 Number of Street Trees	N/A		
23 Average canopy cover over impervious area (ft^2)	N/A		
24 Runoff volume retention from street trees (ft^3) *$V_{retention}$ = Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches*	N/A		
25 Runoff volume retention from street tree BMPs (ft^3): N/A *$V_{retention}$ = Sum of Item 24 for all BMPs*			
26 Implementation of residential rain barrel/cisterns: Yes ☐ No ☒ *If yes, complete Items 27-29; If no, proceed to Item 30*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
27 Number of rain barrels/cisterns	N/A		
28 Runoff volume retention from rain barrels/cisterns (ft^3) *$V_{retention}$ = Item 27 * 3*	N/A		
29 Runoff volume retention from residential rain barrels/Cisterns (ft3): N/A *$V_{retention}$ =Sum of Item 28 for all BMPs*			
30 Total Retention Volume from Site Design Hydrologic Source Control BMPs: **0** *Sum of Items 5, 13, 20, 25 and 29*			

4.3.2 Infiltration BMPs

Use Form 4.3-3 to compute on-site retention of runoff from proposed retention and infiltration BMPs. Volume retention estimates are sensitive to the percolation rate used, which determines the amount of runoff that can be infiltrated within the specified drawdown time. The infiltration safety factor reduces field measured percolation to account for potential inaccuracy associated with field measurements, declining BMP performance over time, and compaction during construction. Appendix D of the TGD for WQMP provides guidance on estimating an appropriate safety factor to use in Form 4.3-3.

If site constraints limit the use of BMPs to a single type and implementation of retention and infiltration BMPs mitigate no more than 40% of the DCV, then they are considered infeasible and the Project Proponent may evaluate the effectiveness of BMPs lower in the LID hierarchy of use (Section 5.5.1 of the TGD for WQMP)

If implementation of infiltrations BMPs is feasible as determined using Form 4.3-1, then LID infiltration BMPs shall be implemented to the MEP (section 4.1 of the TGD for WQMP).

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Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design HSC BMP (ft^3): 33,685.67 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*

BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 1 DMA A BMP Type Underground Basin	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*	1.5		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2.75		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.55		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	3.25		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	2.2		
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	7,898		
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*			
10 Amended soil porosity			
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*			
12 Gravel porosity			
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*			
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	0		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	33,809		

16 Total Retention Volume from LID Infiltration BMPs: 34,470.45 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

17 Fraction of DCV achieved with infiltration BMP: 102.33% *Retention% = Item 16 / Form 4.2-1 Item 7*

18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐

If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.

4.3.3 Harvest and Use BMP

Harvest and use BMP may be considered if the full LID DCV cannot be met by maximizing infiltration BMPs. Use Form 4.3-4 to compute on-site retention of runoff from proposed harvest and use BMPs.

Volume retention estimates for harvest and use BMPs are sensitive to the on-site demand for captured stormwater. Since irrigation water demand is low in the wet season, when most rainfall events occur in San Bernardino County, the volume of water that can be used within a specified drawdown period is relatively low. The bottom portion of Form 4.3-4 facilitates the necessary computations to show infeasibility if a minimum incremental benefit of 40 percent of the LID DCV would not be achievable with MEP implementation of on-site harvest and use of stormwater (Section 5.5.4 of the TGD for WQMP).

N/A – DCV has been fully addressed with infiltration BMPs.

Form 4.3-4 Harvest and Use BMPs (DA 1)			
1 Remaining LID DCV not met by site design HSC or infiltration BMP (ft^3): 0 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16*			
BMP Type(s) *Compute runoff volume retention from proposed harvest and use BMP (Select BMPs from Table 5-4 of the TGD for WQMP) - Use additional forms for more BMPs*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Describe cistern or runoff detention facility	N/A		
3 Storage volume for proposed detention type (ft^3) *Volume of cistern*	N/A		
4 Landscaped area planned for use of harvested stormwater (ft^2)	N/A		
5 Average wet season daily irrigation demand (in/day) Use local values, typical ~ 0.1 in/day	N/A		
6 Daily water demand (ft^3/day) *Item 4 * (Item 5 / 12)*	N/A		
7 Drawdown time (hrs) *Copy Item 6 from Form 4.2-1*	N/A		
8 Retention Volume (ft^3) *$V_{retention}$ = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))*	N/A		
9 Total Retention Volume (ft^3) from Harvest and Use BMP N/A *Sum of Item 8 for all harvest and use BMP included in plan*			
10 Is the full DCV retained with a combination of LID HSC, retention and infiltration, and harvest & use BMPs? **N/A** Yes ☐ No ☐ *If yes, demonstrate conformance using Form 4.3-10. If no, then re-evaluate combinations of all LID BMP and optimize their implementation such that the maximum portion of the DCV is retained on-site (using a single BMP type or combination of BMP types). If the full DCV cannot be mitigated after this optimization process, proceed to Section 4.3.4.*			

4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration, and harvest and use BMPs. A key consideration when using biotreatment BMP is the effectiveness of the proposed BMP in addressing the pollutants of concern for the project (see Table 5-5 of the TGD for WQMP).

Use Form 4.3-5 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV w. Biotreatment computations are included as follows:

- Use Form 4.3-6 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-7 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-8 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

N/A – DCV has been fully addressed with infiltration BMPs.

Form 4.3-5 Selection and Evaluation of Biotreatment BMP (DA 1)		
1 Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment (ft^3): 0 *Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16- Form 4.3-4 Item 9*	List pollutants of concern *Copy from Form 2.3-1.* N/A	
2 Biotreatment BMP Selected *(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)*	Volume-based biotreatment *Use Forms 4.3-6 and 4.3-7 to compute treated volume* ☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention	Flow-based biotreatment *Use Form 4.3-8 to compute treated volume* ☐ Vegetated swale ☐ Vegetated filter strip ☐ Proprietary biotreatment
3 Volume biotreated in volume based biotreatment BMP (ft^3): *Form 4.3-6 Item 15 + Form 4.3-7 Item 13*	4 Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft^3): *Item 1 – Item 3*	5 Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % *Item 4 / Item 1*
6 Flow-based biotreatment BMP capacity provided (cfs): *Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)*		
7 Metrics for MEP determination: • Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: ☐ *If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribed minimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP.*		

N/A – DCV has been fully addressed with infiltration BMPs.

Form 4.3-6 Volume Based Biotreatment (DA 1) – Bioretention and Planter Boxes with Underdrains

Biotreatment BMP Type *(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*	N/A		
2 Amended soil infiltration rate *Typical ~ 5.0*	N/A		
3 Amended soil infiltration safety factor *Typical ~ 2.0*	N/A		
4 Amended soil design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	N/A		
5 Ponded water drawdown time (hr) *Copy Item 6 from Form 4.2-1*	N/A		
6 Maximum ponding depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12 * Item 4 * Item 5) or Item 6*	N/A		
8 Amended soil surface area (ft^2)	N/A		
9 Amended soil depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A		
10 Amended soil porosity, *n*	N/A		
11 Gravel depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A		
12 Gravel porosity, *n*	N/A		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	N/A		
14 Biotreated Volume (ft^3) *$V_{biotreated}$ = Item 8 * [(Item 7/2) + (Item 9 * Item 10) +(Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	N/A		
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: **N/A** *Sum of Item 14 for all volume-based BMPs included in this form*			

N/A – DCV has been fully addressed with infiltration BMPs.

Form 4.3-7 Volume Based Biotreatment (DA 1) – Constructed Wetlands and Extended Detention

Biotreatment BMP Type *Constructed wetlands, extended wet detention, extended dry detention, or other comparable proprietary BMP. If BMP includes multiple modules (e.g. forebay and main basin), provide separate estimates for storage and pollutants treated in each module.*	DA DMA BMP Type		DA DMA BMP Type *(Use additional forms for more BMPs)*	
	Forebay	Basin	Forebay	Basin
1 Pollutants addressed with BMP forebay and basin *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*	N/A			
2 Bottom width (ft)	N/A			
3 Bottom length (ft)	N/A			
4 Bottom area (ft^2) *A_{bottom} = Item 2 * Item 3*	N/A			
5 Side slope (ft/ft)	N/A			
6 Depth of storage (ft)	N/A			
7 Water surface area (ft^2) $A_{surface}$ *=(Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))*	N/A			
8 Storage volume (ft^3) *For BMP with a forebay, ensure fraction of total storage is within ranges specified in BMP specific fact sheets, see Table 5-6 of the TGD for WQMP for reference to BMP design details* V *=Item 6 / 3 * [Item 4 + Item 7 + (Item 4 * Item 7)^0.5]*	N/A			
9 Drawdown Time (hrs) *Copy Item 6 from Form 2.1*	N/A			
10 Outflow rate (cfs) *Q_{BMP} = (Item $8_{forebay}$ + Item 8_{basin}) / (Item 9 * 3600)*	N/A			
11 Duration of design storm event (hrs)	N/A			
12 Biotreated Volume (ft^3) *$V_{biotreated}$ = (Item $8_{forebay}$ + Item 8_{basin}) +(Item 10 * Item 11 * 3600)*	N/A			
13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : **N/A** *(Sum of Item 12 for all BMP included in plan)*				

N/A – DCV has been fully addressed with infiltration BMPs.

Form 4.3-8 Flow Based Biotreatment (DA 1)

Biotreatment BMP Type *Vegetated swale, vegetated filter strip, or other comparable proprietary BMP*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5*	N/A		
2 Flow depth for water quality treatment (ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A		
3 Bed slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A		
4 Manning's roughness coefficient	N/A		
5 Bottom width (ft) *b_w = (Form 4.3-5 Item 6 * Item 4) / (1.49 * Item 2^1.67 * Item 3^0.5)*	N/A		
6 Side Slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A		
7 Cross sectional area (ft^2) *A = (Item 5 * Item 2) + (Item 6 * Item 2^2)*	N/A		
8 Water quality flow velocity (ft/sec) *V = Form 4.3-5 Item 6 / Item 7*	N/A		
9 Hydraulic residence time (min) *Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A		
10 Length of flow based BMP (ft) *L = Item 8 * Item 9 * 60*	N/A		
11 Water surface area at water quality flow depth (ft^2) *SA_{top} = (Item 5 + (2 * Item 2 * Item 6)) * Item 10*	N/A		

4.3.5 Conformance Summary

Complete Form 4.3-9 to demonstrate how on-site LID DCV is met with proposed site design hydrologic source control, infiltration, harvest and use, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)

1 Total LID DCV for the Project DA-1 (ft^3): 33,685.67 *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design hydrologic source control LID BMP (ft^3): 0 *Copy Item 30 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): 33,809 *Copy Item 16 in Form 4.3-3*

4 On-site retention with LID harvest and use BMP (ft^3): 0 *Copy Item 9 in Form 4.3-4*

5 On-site biotreatment with volume based biotreatment BMP (ft^3): 0 *Copy Item 3 in Form 4.3-5*

6 Flow capacity provided by flow based biotreatment BMP (cfs): 0 *Copy Item 6 in Form 4.3-5*

7 LID BMP performance criteria are achieved if answer to any of the following is "Yes":

- Full retention of LID DCV with site design HSC, infiltration, or harvest and use BMP: Yes ☒ No ☐
  If yes, sum of Items 2, 3, and 4 is greater than Item 1
- Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☐ No ☒
  If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized
- On-site retention and infiltration is determined to be infeasible and biotreatment BMP provide biotreatment for all pollutants of concern for full LID DCV: Yes ☐ No ☒
  If yes, Form 4.3-1 Items 7 and 8 were both checked yes

8 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:

- Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: Yes ☐ No ☒
  Checked yes for Form 4.3-5 Item 7, Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, V_{alt} *= (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%*
- An approved Watershed Action Plan (WAP) demonstrates that water quality and hydrologic impacts of urbanization are more effective when managed in at an off-site facility: Yes ☐ No ☒
  Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed

4.3.6 Hydromodification Control BMP

Use Form 4.3-10 to compute the remaining runoff volume retention, after LID BMP are implemented, needed to address HCOC, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential HCOC. Describe hydromodification control BMP that address HCOC, which may include off-site BMP and/or in-stream controls. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

N/A – Project does not need to address HCOC

Form 4.3-10 Hydromodification Control BMPs (DA 1)	
1 Volume reduction needed for HCOC performance criteria (ft³): **N/A** *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	2 On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft³): *Sum of Form 4.3-9 Items 2, 3, and 4 Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving HCOC volume reduction*
3 Remaining volume for HCOC volume capture (ft³): *Item 1 – Item 2*	4 Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft³): *Existing downstream BMP may be used to demonstrate additional volume capture (if so, attach to this WQMP a hydrologic analysis showing how the additional volume would be retained during a 2-yr storm event for the regional watershed)*
5 If Item 4 is less than Item 3, incorporate in-stream controls on downstream waterbody segment to prevent impacts due to hydromodification ☐ *Attach in-stream control BMP selection and evaluation to this WQMP*	
6 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☐ No ☐ *If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:* • Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP ☐ *BMP upstream of a waterbody segment with a potential HCOC may be used to demonstrate increased time of concentration through hydrograph attenuation (if so, show that the hydraulic residence time provided in BMP for a 2-year storm event is equal or greater than the addition time of concentration requirement in Form 4.2-4 Item 15)* • Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities ☐ • Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐	
7 Form 4.2-2 Item 12 less than or equal to 5%: Yes ☐ No ☐ *If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:* • Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs ☐ *BMPs upstream of a waterbody segment with a potential HCOC may be used to demonstrate additional peak runoff reduction through hydrograph attenuation (if so, attach to this WQMP, a hydrograph analysis showing how the peak runoff would be reduced during a 2-yr storm event)* • Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐	

4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, harvest and use, or biotreat the DCV via on-site LID practices. A project proponent must develop an alternative compliance plan to address the remainder of the LID DCV. Depending on project type some projects may qualify for water quality credits that can be applied to reduce the DCV that must be treated prior to development of an alternative compliance plan (see Form 2.4-1, Water Quality Credits). Form 4.3-9 Item 8 includes instructions on how to apply water quality credits when computing the DCV that must be met through alternative compliance. Alternative compliance plans may include one or more of the following elements:

- On-site structural treatment control BMP - All treatment control BMP should be located as close to possible to the pollutant sources and should not be located within receiving waters;
- Off-site structural treatment control BMP - Pollutant removal should occur prior to discharge of runoff to receiving waters;
- Urban runoff fund or In-lieu program, if available

Depending upon the proposed alternative compliance plan, approval by the executive officer may or may not be required (see Section 6 of the TGD for WQMP).

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

All BMP included as part of the project WQMP are required to be maintained through regular scheduled inspection and maintenance (refer to Section 8, Post Construction BMP Requirements, in the TGD for WQMP). Fully complete Form 5-1 summarizing all BMP included in the WQMP. Attach additional forms as needed. The WQMP shall also include a detailed Operation and Maintenance Plan for all BMP and may require a Maintenance Agreement (consult the jurisdiction's LIP). If a Maintenance Agreement is required, it must also be attached to the WQMP.

Form 5-1 BMP Inspection and Maintenance

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Education on Storm Water BMP's	Project Owner (initially) and POA (after formation)	Building owners shall furnish copies of City and County BMP factsheets to all future tenants through lease agreements.	Beginning of new tenancy
Activity Restrictions	Project Owner (initially) and POA (after formation)	Tenants shall not be allowed to discharge chemicals, chemical residues, wastewater or other prohibited discharges listed in the City and County Ordinances, to the outside, paved areas of the site; or store chemicals or other pollutant sources in non-spill contained or covered facilities.	On-going
Landscape Management	Project Owner (initially) and POA (after formation)	Landscape crews contracted by the POA shall inspect the irrigation system and the health of the landscaping plant cover after each landscape procedure and shall report all repairs and problems to the POA. All routine landscaping maintenance shall be done in conformance with BMP fact sheet #SD-10 in Appendix 6.	Weekly
BMP Maintenance	Project Owner (initially) and POA (after formation)	BMP maintenance will be provided by the property owner and will take place at a minimum of twice a year and after any major rainfall event.	Semi-Annual/ Oct. 1st & Feb. 1st (each year)
Title 22 CCR Compliance	Project Owner (initially) and	The owner/tenant will file appropriate hazardous material disclosures, if any storage is conducted,	As needed

Form 5-1 BMP Inspection and Maintenance

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
	POA (after formation)	and must comply with all the Title 22 CCR, Chapter 29 regulations.	
Local Water Quality Ordinances	Project Owner (initially) and POA (after formation)	The owner shall ensure that all business activities at the site comply with the City of Colton's Stormwater Ordinance through the implementation of BMP's.	On-going
Spill Contingency Plan	Project Owner (initially) and POA (after formation)	Any hazardous material storage, if any, will require a business/ emergency response plan as required by the San Bernardino County Fire Hazmat.	As needed
Hazardous Materials Disclosure Compliance	Project Owner (initially) and POA (after formation)	The current owner and future owners shall prohibit the storage of hazardous materials.	Beginning of new tenancy
Uniform Fire Code Implementation	Project Owner (initially) and POA (after formation)	All fire code requirements shall be implemented at this site.	On-going
Litter/Debris Control Program	Project Owner (initially) and POA (after formation)	A program shall be implemented to pick up litter and sweep and clean the existing trash enclosures on a daily basis. Trash enclosures are designed to divert all flows away from the enclosure. All dumpsters will have lids installed and will be inspected to ensure that the dumpsters remain covered and leak-proof. The owner shall ensure tenants contract with a refuse company to have the dumpsters emptied on a weekly basis, at a minimum.	Weekly
Employee Training	Project Owner (initially) and	Property owner shall establish an educational program for site employees and contractors to inform and train personnel engaged in maintenance activities regarding the impact of dumping oil, paint, solvents, or other	Beginning of new tenancy

Form 5-1 BMP Inspection and Maintenance

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
	POA (after formation)	potentially harmful chemicals into the storm drain system; the use of fertilizers and pesticides in landscaping maintenance practices; and the impacts of litter and improper waste disposal.	
Housekeeping of Loading Docks	Project Owner (initially) and POA (after formation)	The loading/unloading of materials will take place at the docks; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or n other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. A program shall be implemented to train employees on applicable BMPs and general pollution prevention strategies and objectives. The dock area shall be swept daily and the maintenance policy for the site will address daily maintenance of the area.	Daily
Catch Basin Inspection Program	Project Owner (initially) and POA (after formation)	The on-site catch basins shall be inspected monthly during the rainy season (October-May) and before and after each storm to ensure proper operation. The POA shall contract with a qualified landscape contractor to inspect and clean out accumulation of trash, litter and sediment and check for evidence of illegal dumping of waste materials into on-site drains.	Monthly/ Seasonal
Vacuum Sweeping of Private Streets and Parking Lots	Project Owner (initially) and POA (after formation)	Parking lots shall be swept weekly to prevent sediment, garden waste, and trash, or other pollutants from entering on-site drains and public storm channels. Sweeping will be done by a landscape contractor or other contractor provided by the owner.	Weekly
Comply with all other applicable NPDES permits	Project Owner (initially) and	The developer of this site shall comply with the state's General Construction Stormwater Permit by filing a NOI, SWPPP, and obtain a WDID #, prior to start of grading/construction. All future	Prior to construction/ beginning of new tenancy

Form 5-1 BMP Inspection and Maintenance

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
	POA (after formation)	occupants requiring coverage under the NPDES General Industrial Activities Permit shall comply with the permit requirements by filing a notice of intent and SWPPP with the state and obtaining a WDID Discharge Permit Number, prior to commencement of industrial activities, covered under the permit.	
Provide storm drain system stencilling and signage	Project Owner (initially) and POA (after formation)	A painted message "No Dumping- Drains to River" shall be placed on each catch basin. The message shall be inspected annually & repainted as necessary.	On-going
Design and construct trash and waste storage areas to reduce pollution introduction	Project Owner (initially) and POA (after formation)	All dumpsters shall have working lids which shall be kept closed, at all times. Trash enclosure shall comply with CASQA SD-32 and shall have doors.	During Construction
Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	Project Owner (initially) and POA (after formation)	The irrigation system will include devices to prevent low head drainage, overspray and run off through the use of pressure regulating devices, check valves, rain shutoff valves, flow sensors, pressure drop sensors, proper spacing, low precipitation emission devises and ET or weather based controllers. Landscape and irrigation shall be consistent with the State Model Water Efficient landscape Ordinance and the City of Colton landscape Development Standards. Plants installed will be arranged according to similar hydrozones and meet the required water budget for the site. Landscape areas used for water quality swales or infiltration areas shall have proper plants for saturated soils, drought tolerance and erosion control qualities. Shade trees shall be used to intercept rainwater and reduce heat gain on paving.	During Construction

Form 5-1 BMP Inspection and Maintenance

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	Project Owner (initially) and POA (after formation)	Landscape complies with depressed area requirements.	During Construction
Protect slopes and channels and provide energy dissipation	Project Owner (initially) and POA (after formation)	Proposed slopes will be protected to prevent erosion.	As Needed
Covered Dock Areas	Project Owner (initially) and POA (after formation)	Proposed docks are equipped with dock high doors so that truck trailers back up flush with building and loading/unloading activities are contained inside building.	On-going

Section 6 WQMP Attachments

6.1. Site Plan and Drainage Plan

Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural Source Control BMP locations
- Site Design Hydrologic Source Control BMP locations
- LID BMP details
- Drainage delineations and flow information
- Drainage connections

6.2 Electronic Data Submittal

Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their local Local Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

6.3 Post Construction

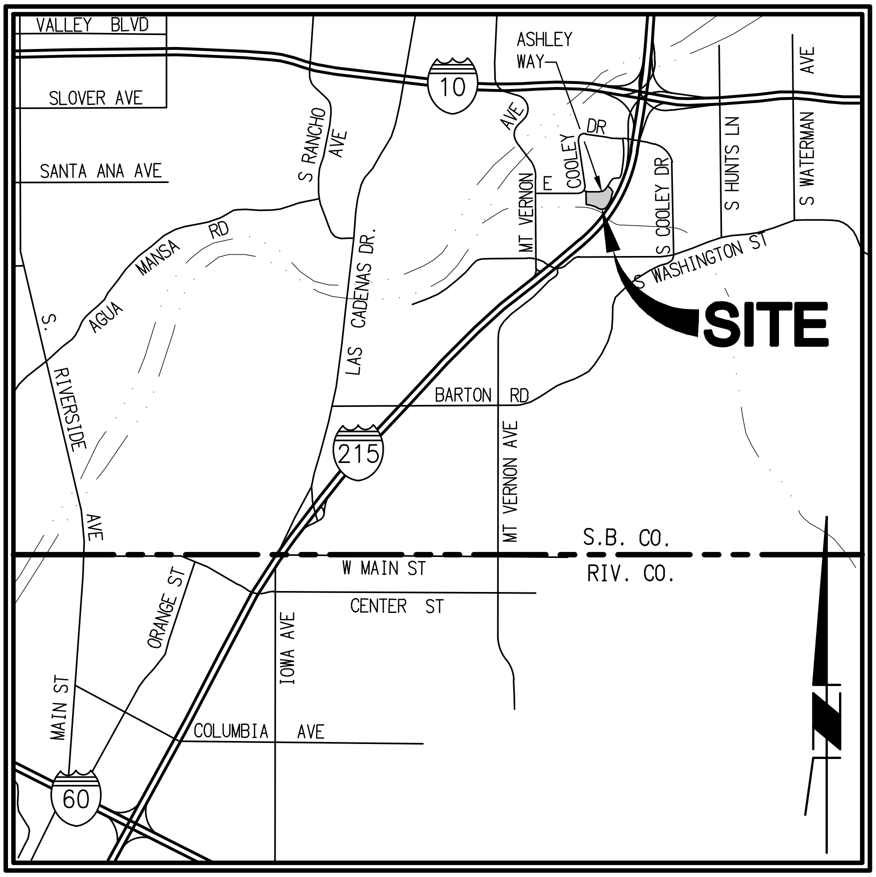
Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

6.4 Other Supporting Documentation

- BMP Educational Materials
- Activity Restriction – C, C&R's & Lease Agreements

APPENDIX A

VICINITY MAP and WQMP EXHIBIT



VICINITY MAP

T01S, R04W, SEC. 28

NOT TO SCALE

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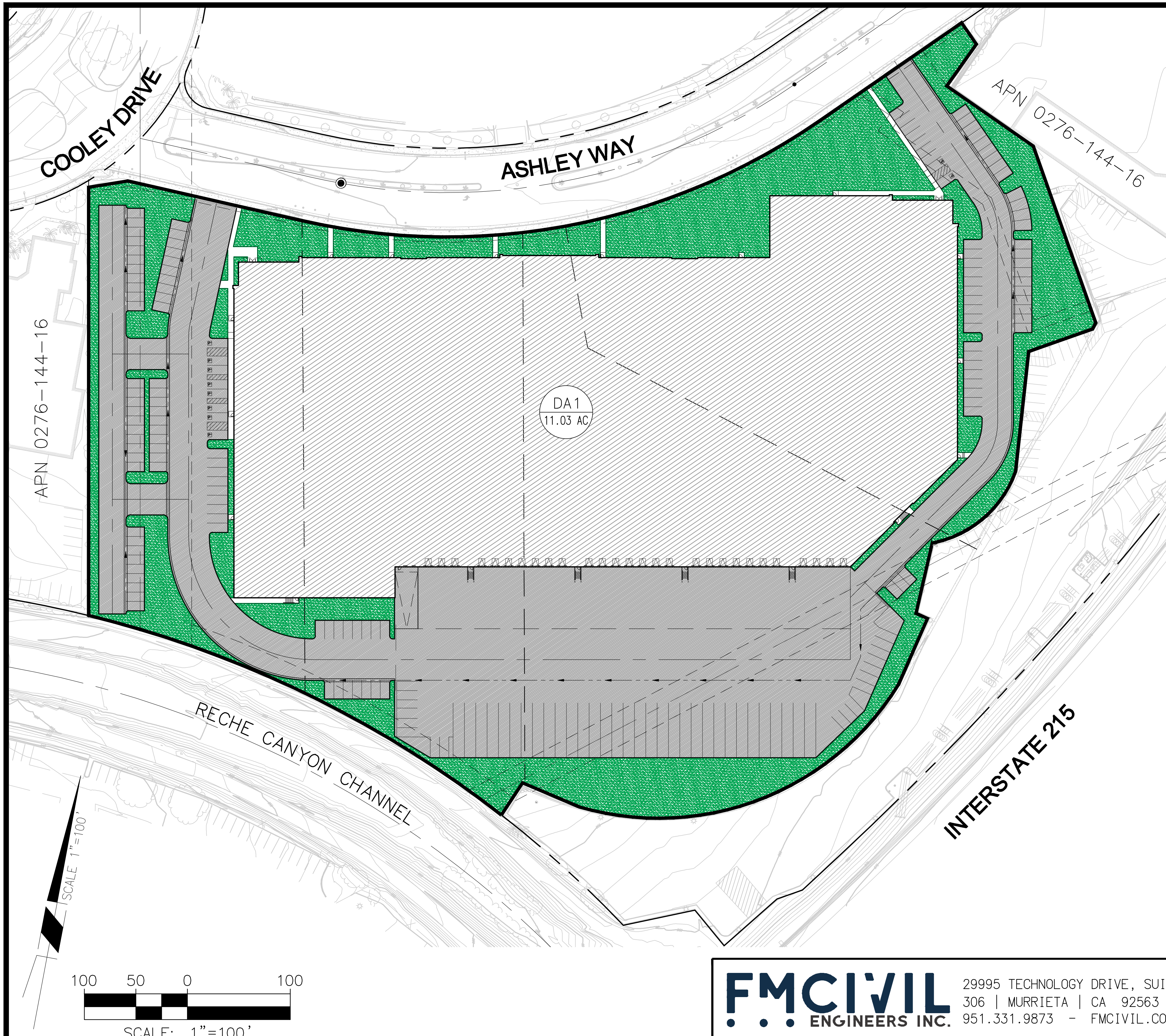
ASHLEY WAY

FIGURE 1
VICINITY MAP



LEGEND

Symbol	Description
DMA 1 / 12.4	DA AREA NUMBER; AREA IN ACRES
(yellow)	WATER QUALITY INFILTRATION BASIN
(green)	LANDSCAPE AREA
(hatched)	ROOF AREA
(gray)	PROPOSED ASPHALT DRIVE ISLE
(red)	TRASH ENCLOSURES
(blue)	DRAIN INLET STENCIL
(heavy line)	DMA BOUNDARY
(red dash-dot line)	PROPOSED STORM DRAIN
(arrows)	DIRECTION OF FLOW

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ASHLEY WAY

PWQMP SITE PLAN

1

OF 1 SHEETS

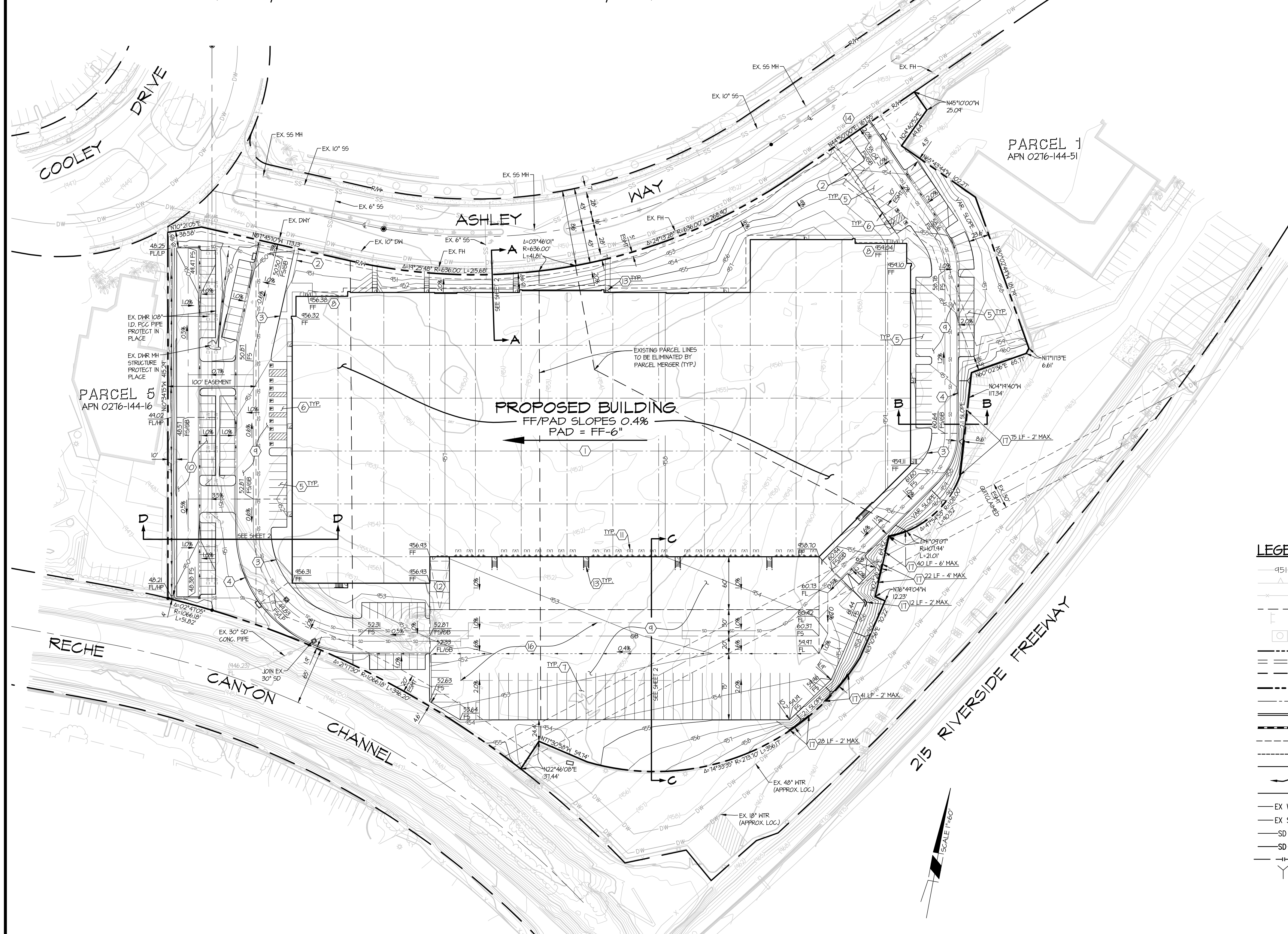
H:\PDATA\18-002 HIP ASHLEY 10.46\DOCS\WQMP\APPENDICES\APP A_VICINITY MAP AND WQMP EXHIBIT\CAD\18-002-WQMP SITE PLAN.DWG CHRIS 7/31/2018 11:36 AM

APPENDIX B

CONSTRUCTION PLANS

CONCEPTUAL GRADING PLAN

IN THE CITY OF COLTON, COUNTY OF SAN BERNARDINO, CALIFORNIA



APPLICANT/OWNER

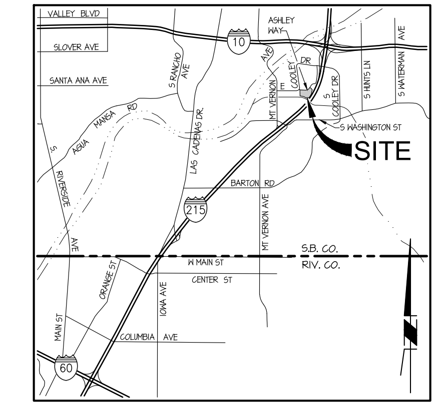
HOWARD INDUSTRIAL PARTNERS
1944 NORTH TUSTIN STREET, SUITE 122
ORANGE, CA 92865
CONTACT:TIM HOWARD
(TEL)714-769-9155

ENGINEER

FMCIVIL ENGINEERS INC.
29995 TECHNOLOGY DRIVE, SUITE 306
MURRIETA, CA 92563
CONTACT: FRANCISCO MARTINEZ
(TEL)951-331-9873

ARCHITECT

RGA
15231 ALTON PARKWAY, SUITE 100
IRVINE, CA 92618
CONTACT: JACOB HUBER
(TEL)949-341-0920



VICINITY MAP

T01S, R04W, SEC. 28
NOT TO SCALE

REDUCED SET

EARTHWORK ESTIMATE:

RAW CUT:	16,100 CY	
RAW FILL:	33,750 CY	
NET:	17,650 CY	IMPORT

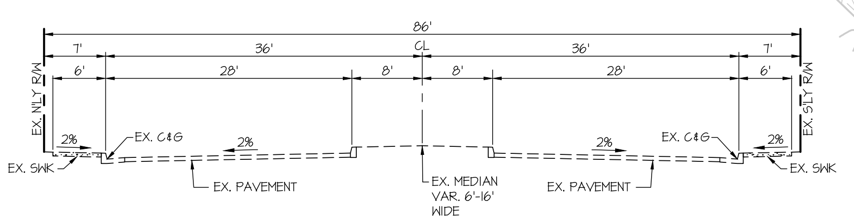
HAUL TRIPS:
ASSUMED (13 CY PER TRIP) = 1,367

LEGEND

- INDEX CONTOUR
- RETAINING WALL
- FENCE
- EDGE OF PAVEMENT
- SIGN
- MANHOLE
- RIGHT OF WAY
- EASEMENT
- PARCEL LINE
- PARCEL MAP BOUNDARY
- STREET CENTER LINE
- SCREEN WALL
- RETAINING WALL
- EXISTING LOT LINE
- RIDGE LINE
- RIBBON GUTTER
- FLOW ARROW
- PROPOSED EDGE OF PAVEMENT
- EX W — EXISTING WATER LINE
- EX SS — EXISTING SEWER LINE
- SD — EXISTING STORM DRAIN PIPE
- SD — PROPOSED STORM DRAIN PIPE
- CUT/FILL LINE
- SLOPE SYMBOL

SITE PLAN KEYNOTES

1. PAINTED CONCRETE TILT-UP WAREHOUSE / OFFICE / MANUFACTURING FACILITY. BUILDING TO BE DESIGNED PER ARCHITECT'S PLANS
2. ON SITE ACCESSIBLE SIDEWALK AND CURB RAMPS.
3. CONCRETE CURB
4. CONCRETE CURB & GUTTER
5. STANDARD PARKING STALL - STRIPE PER STANDARDS SHOWN ON ARCHITECT'S PLANS
6. HANDICAP PARKING STALL - STRIPE PER STANDARDS SHOWN ON ARCHITECT'S PLANS
7. TRAILER PARKING STALL - STRIPE PER STANDARDS SHOWN ON ARCHITECT'S PLANS
8. ACCESSIBLE BUILDING ENTRY WITH ADJACENT BICYCLE RACKS PER ARCHITECT'S PLANS
9. PORTLAND CONC. CEMENT (PCC) PAVED TRUCK YARD ARCHITECT'S PLANS
10. ASPHALT CONCRETE (AC) PAVED PARKING PER ARCHITECT'S PLANS
11. DOCK HIGH TRUCK DOOR PER ARCHITECT'S PLANS
12. GRADE LEVEL RAMP DOOR PER ARCHITECT'S PLANS
13. EXTERIOR MAN DOOR AND STAIRS W/GUARD POST PER ARCHITECT'S PLANS
14. COMMERCIAL DRIVEWAY APPROACH PER CITY STD. DWG. NO. 111
15. WATER QUALITY BASIN
16. UNDERGROUND STORM WATER CHAMBER SYSTEM
17. RETAINING WALL PER ARCHITECT'S PLANS



TYPICAL SECTION ASHLEY WAY

HOR. SCALE: 1"=10'

PREPARED BY:
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FRANCISCO MARTINEZ JR. — #84640 R.C.E. / 3/31/20 EXP. DATE

BENCHMARK

THE CALIFORNIA SPATIAL REFERENCE CENTER C.O.R.S. "CRFP", ELEVATION = 2365.54 FEET (NAVD 88).

BASIS OF BEARING

THE BASIS OF BEARING FOR THIS SURVEY IS THE CALIFORNIA COORDINATES SYSTEM (CCS 83), ZONE 5, 1983 DATUM, DEFINED BY SECTIONS 8801 TO 8819 OF THE CALIFORNIA PUBLIC RESOURCES CODE.

CITY OF COLTON

ASHLEY WAY
CONCEPTUAL GRADING PLAN

SCALE:	AS SHOWN
DATE:	JULY 2018
DESIGNED:	AJ
CHECKED:	FM
PLN CK REF:	

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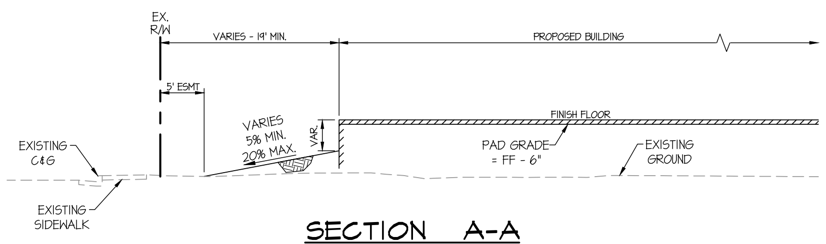
MURRIETA | CA 92563
951.331.9873 - FMCIVIL.COM

SHEET 1 OF 2 SHEETS

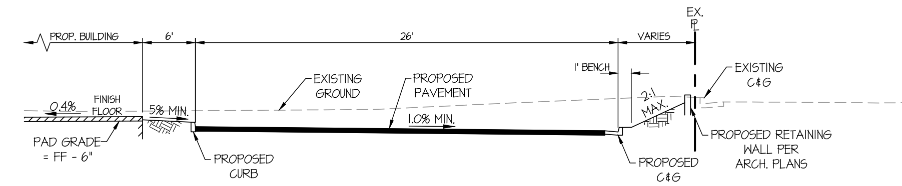
H: \PDATA\18-002 HIP ASHLEY 10.46\DWGS\PLNG\ENTITLEMENT\CONCEPT\18-002-TPM-002.DWG ALLAN 8/1/2018 3:13 PM

CONCEPTUAL GRADING PLAN

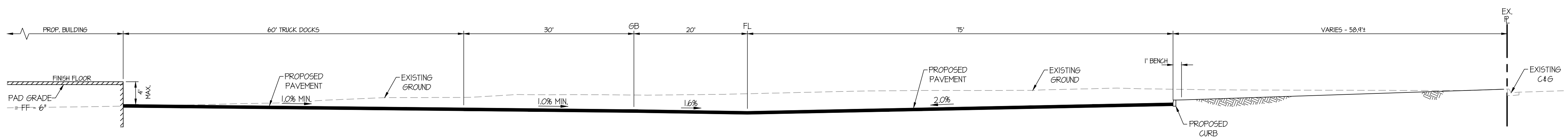
IN THE CITY OF COLTON, COUNTY OF SAN BERNARDINO, CALIFORNIA



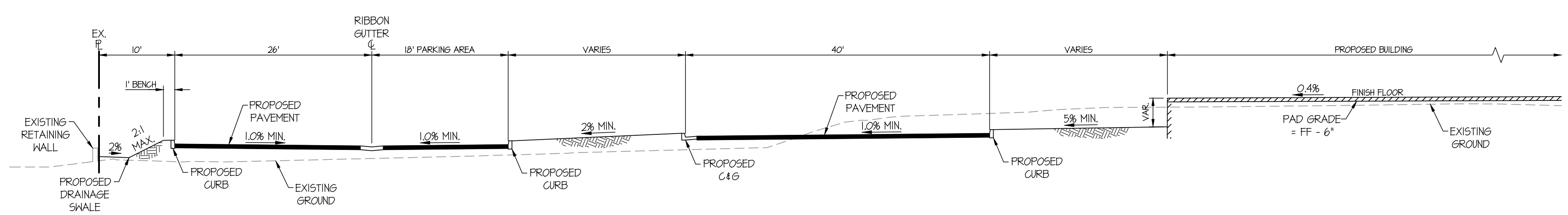
SECTION A-A
HOR. SCALE: 1"=10'



SECTION B-B
HOR. SCALE: 1"=10'



SECTION C-C
HOR. SCALE: 1"=10'



SECTION D-D
HOR. SCALE: 1"=10'

BENCHMARK

THE CALIFORNIA SPATIAL REFERENCE CENTER C.O.R.S. "CRFP", ELEVATION = 2365.54 FEET (NAVD 88).

BASIS OF BEARING

THE BASIS OF BEARING FOR THIS SURVEY IS THE CALIFORNIA COORDINATES SYSTEM (CCS 83), ZONE 5, 1983 DATUM, DEFINED BY SECTIONS 8801 TO 8819 OF THE CALIFORNIA PUBLIC RESOURCES CODE.

REGISTERED PROFESSIONAL ENGINEER — FRANCISCO MARTINEZ JR. — C-84640 — CIVIL — STATE OF CALIFORNIA

PREPARED BY:

FMCIVIL ENGINEERS INC.
29995 TECHNOLOGY DRIVE, SUITE 306 | MURRIETA | CA 92563
951.331.9873 - FMCIVIL.COM

FRANCISCO MARTINEZ JR. — #84640 3/31/20 — R.C.E. / EXP. DATE

CITY OF COLTON

ASHLEY WAY
CONCEPTUAL GRADING SECTIONS

SCALE:	AS SHOWN
DATE:	JULY 2018
DESIGNED:	AJ
CHECKED:	FM
PLN CK REF:	

FMCIVIL ENGINEERS INC.
29995 TECHNOLOGY DRIVE, SUITE 306
MURRIETA | CA 92563
951.331.9873 - FMCIVIL.COM

SHEET 2 OF 2 SHEETS

APPENDIX C

INFILTRATION BASIN PRELIM. DESIGN, SPECS, AND MAINTENANCE RECOMMENDATIONS

ADVANCED DRAINAGE SYSTEMS, INC.

Ashley Way

Colton, CA

STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-4500 OR APPROVED EQUAL.
2. CHAMBERS SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORT PANELS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
4. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
5. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
6. CHAMBERS SHALL BE DESIGNED AND ALLOWABLE LOADS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
7. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. THE CHAMBER MANUFACTURER SHALL SUBMIT THE FOLLOWING UPON REQUEST TO THE SITE DESIGN ENGINEER FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE:
    a. A STRUCTURAL EVALUATION SEALED BY A REGISTERED PROFESSIONAL ENGINEER THAT DEMONSTRATES THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY AASHTO FOR THERMOPLASTIC PIPE.
    b. A STRUCTURAL EVALUATION SEALED BY A REGISTERED PROFESSIONAL ENGINEER THAT DEMONSTRATES THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET. THE 50 YEAR CREEP MODULUS DATA SPECIFIED IN ASTM F2418 MUST BE USED AS PART OF THE AASHTO STRUCTURAL EVALUATION TO VERIFY LONG-TERM PERFORMANCE.
    c. STRUCTURAL CROSS SECTION DETAIL ON WHICH THE STRUCTURAL EVALUATION IS BASED.
8. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-4500 CHAMBER SYSTEM

1. STORMTECH MC-4500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTITIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-4500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR EXCAVATOR SITUATED OVER THE CHAMBERS.

    STORMTECH RECOMMENDS 3 BACKFILL METHODS:
    - STONESHOOTER LOCATED OFF THE CHAMBER BED.
    - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
    - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 9" (230 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 12" (300 mm) INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE 3/4-2" (20-50 mm) MEETING THE AASHTO M43 DESIGNATION OF #3 OR #4.
9. STONE SHALL BE BROUGHT UP EVENLY AROUND CHAMBERS SO AS NOT TO DISTORT THE CHAMBER SHAPE. STONE DEPTHS SHOULD NEVER DIFFER BY MORE THAN 12" (300 mm) BETWEEN ADJACENT CHAMBER ROWS.
10. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
11. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-4500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-4500 CHAMBERS IS LIMITED:
    - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
    - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
    - WEIGHT LIMITS FOR CONSRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

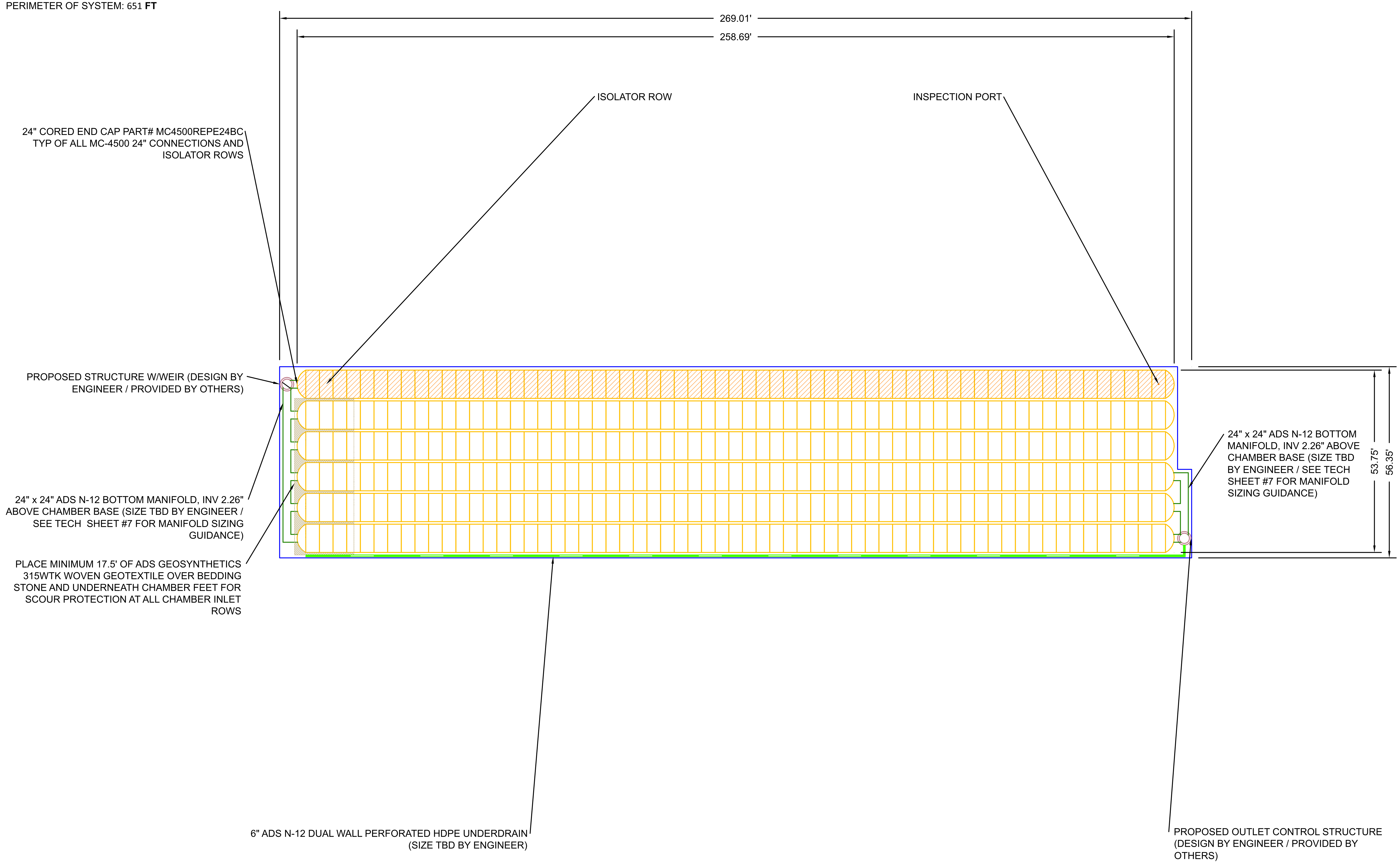
USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

CONCEPTUAL LAYOUT

COMPUTER GENERATED CONCEPTUAL LAYOUT - NOT FOR CONSTRUCTION

(378) STORMTECH MC-4500 CHAMBERS
(12) STORMTECH MC-4500 END CAPS
INSTALLED WITH 12 " COVER STONE, 9 " BASE STONE, 40% STONE VOID
INSTALLED SYSTEM VOLUME: 65001 CF
AREA OF SYSTEM: 15033 **FT²**
PERIMETER OF SYSTEM: 651 **FT**



Ashley Way
Colton, CA

DATE: 08/01/2018 | DRAWN: CM
PROJECT #: Tool | CHECKED: ---

REV	DRW	CHK	DESCRIPTION

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860-529-8188 | 888-892-2694 | WWW.STORMTECH.COM

ADS® ADVANCED DRAINAGE SYSTEMS, INC.
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

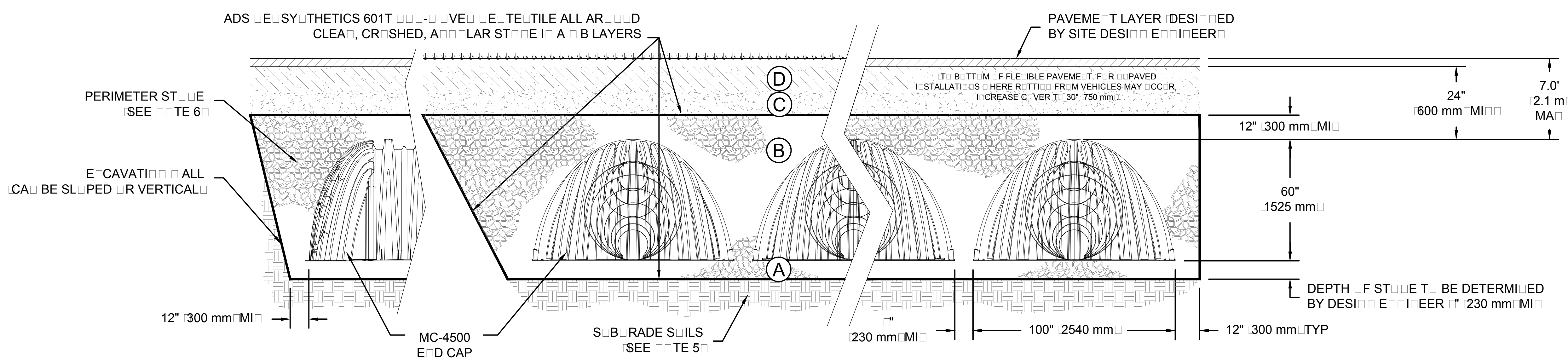
NOT TO SCALE

ACCEPTABLE FILL MATERIALS: STORMTECH MC-4500 CHAMBER SYSTEMS

MATERIAL L□CATI□□		DESCRIPTI□□	AASHT□ MATERIAL CLASSIFICATI□□S	C□MPACTI□□ / DE□SITY REQ□IREME□T
D	**FINAL FILL:** FILL MATERIAL F□R LAYER 'D' STARTS FR□M THE T□P □F THE 'C' LAYER T□ THE B□TT□M □F FLE□IBLE PAVEME□T □R □□PAVED FI□ISHED □RADE AB□VE. □□TE THAT PAVEME□T S□BBASE MAY BE PART □F THE 'D' LAYER	A□Y S□IL/R□C□ MATERIALS, □ATIVE S□ILS, □R PER E□□I□EER'S PLA□S. CHEC□ PLA□S F□R PAVEME□T S□B□RADE REQ□IREME□TS.	□/A	PREPARE PER SITE DESI□□ E□□I□EER'S PLA□S. PAVED I□STALLATI□□S MAY HAVE STRI□□E□T MATERIAL A□D PREPARATI□□ REQ□IREME□TS.
C	**INITIAL FILL:** FILL MATERIAL F□R LAYER 'C' STARTS FR□M THE T□P □F THE EMBEDME□T ST□□E ('B' LAYER) T□ 24" (600 mm) AB□VE THE T□P □F THE CHAMBER. □□TE THAT PAVEME□T S□BBASE MAY BE A PART □F THE 'C' LAYER.	□RA□□LAR □ELL-□RADED S□IL/A□□RE□ATE MI□T□RES, <35% FI□ES □R PR□CESSED A□□RE□ATE. M□ST PAVEME□T S□BBASE MATERIALS CA□ BE □SED I□ LIE□ □F THIS LAYER.	AASHT□ M145[1] A-1, A-2-4, A-3 □R AASHT□ M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 6□, 7, 7□, □, □□, □, 10	BE□I□ C□MPACTI□□S AFTER 24" (600 mm) □F MATERIAL □VER THE CHAMBERS IS REACHED. C□MPACT ADDITI□□AL LAYERS I□ 12" (300 mm) MA□ LIFTS T□ A MI□. □5% PR□CT□R DE□SITY F□R □ELL □RADED MATERIAL A□D □5% RELATIVE DE□SITY F□R PR□CESSED A□□RE□ATE MATERIALS.
B	**EMBEDMENT STONE:** FILL S□RR□□□DI□□ THE CHAMBERS FR□M THE F□□□DATI□□ ST□□E ('A' LAYER) T□ THE 'C' LAYER AB□VE.	CLEA□, CR□SHED, A□□□LAR ST□□E, □□MI□AL SI□E DISTRIB□TI□□ BET□EE□ 3/4-2 I□CH (20-50 mm)	AASHT□ M43[1] 3, 4	□□ C□MPACTI□□ REQ□IRED.
A	**FOUNDATION STONE:** FILL BEL□□ CHAMBERS FR□M THE S□B□RADE □P T□ THE F□□T (B□TT□M) □F THE CHAMBER.	CLEA□, CR□SHED, A□□□LAR ST□□E, □□MI□AL SI□E DISTRIB□TI□□ BET□EE□ 3/4-2 I□CH (20-50 mm)	AASHT□ M43[1] 3, 4	PLATE C□MPACT □R R□LL T□ ACHIEVE A FLAT SURFACE. [2] [3]

PLEASE □□TE:

1. THE LISTED AASHT□ DESI□□ATI□□S ARE F□R □RADATI□□S □□LY. THE ST□□E M□ST ALS□ BE CLEA□, CR□SHED, A□□□LAR. F□R E□AMPLE, A SPECIFICATI□□ F□R #4 ST□□E □□□LD STATE: "CLEA□, CR□SHED, A□□□LAR □□. 4 (AASHT□ M43) ST□□E".
2. ST□RMTECH C□MPACTI□□ REQ□IREME□TS ARE MET F□R 'A' L□CATI□□ MATERIALS □HE□ PLACED A□D C□MPACTED I□ □" (230 mm) (MA□) LIFTS □SI□□ T□□ F□LL C□VERA□ES □ITH A VIBRAT□RY C□MPACT□R.
3. □HERE I□FILTRATI□□ S□RFACES MAY BE C□MPR□MISED BY C□MPACTI□□, F□R STA□DARD DESI□□ L□AD C□□DITI□□S, A FLAT S□RFACE MAY BE ACHIEVED BY RA□I□□ □R DRA□□I□□ □ITH□□T C□MPACTI□□ EQ□IPME□T. F□R SPECIAL L□AD DESI□□S, C□□TACT ST□RMTECH F□R C□MPACTI□□ REQ□IREME□TS.



NOTES:

1. MC-4500 CHAMBERS SHALL C□□F□RM T□ THE REQ□IREME□TS □F ASTM F241□ "STA□DARD SPECIFICATI□□ F□R P□LYPR□PYLE□E (PP) C□RR□□ATED □ALL ST□RM□ATER C□LLECTI□□ CHAMBERS".
2. MC-4500 CHAMBERS SHALL BE DESI□□ED I□ ACC□RDA□CE □ITH ASTM F27□7 "STA□DARD PRACTICE F□R STR□CT□RAL DESI□□ □F THERM□PLASTIC C□RR□□ATED □ALL ST□RM□ATER C□LLECTI□□ CHAMBERS".
3. "ACCEPTABLE FILL MATERIALS" TABLE AB□VE PR□VIDES MATERIAL L□CATI□□S, DESCRIPTI□□S, □RADATI□□S, A□D C□MPACTI□□ REQ□IREME□TS F□R F□□□DATI□□, EMBEDME□T, A□D FILL MATERIALS.
4. THE "SITE DESI□□ E□□I□EER" REFERS T□ THE E□□I□EER RESP□□SIBLE F□R THE DESI□□ A□D LAY□□T □F THE ST□RMTECH CHAMBERS F□R THIS PR□□ECT.
5. THE SITE DESI□□ E□□I□EER IS RESP□□SIBLE F□R ASSESSI□□ THE BEARI□□ RESISTA□CE (ALL□□ABLE BEARI□□ CAPACITY) □F THE S□B□RADE S□ILS A□D THE DEPTH □F F□□□DATI□□ ST□□E □ITH C□□SIDERATI□□ F□R THE RA□□E □F E□PECTED S□IL M□IST□RE C□□DITI□□S.
6. PERIMETER ST□□E M□ST BE E□TE□DED H□RI□□□TALLY T□ THE E□CAVATI□□ □ALL F□R B□TH VERTICAL A□D SL□PED E□CAVATI□□ □ALLS.
7. □□CE LAYER 'C' IS PLACED, A□Y S□IL/MATERIAL CA□ BE PLACED I□ LAYER 'D' □P T□ THE FI□ISHED □RADE. M□ST PAVEME□T S□BBASE S□ILS CA□ BE □SED T□ REPLACE THE MATERIAL REQ□IREME□TS □F LAYER 'C' □R 'D' AT THE SITE DESI□□ E□□I□EER'S DISCRETI□□.

Ashley Way
Colton, CA

DATE: 08/01/2018 | DRA□□: CM
PR□□ECT □: Tool | CHEC□ED: ---

REV	DR□	CH□	DESCRIPTI□□

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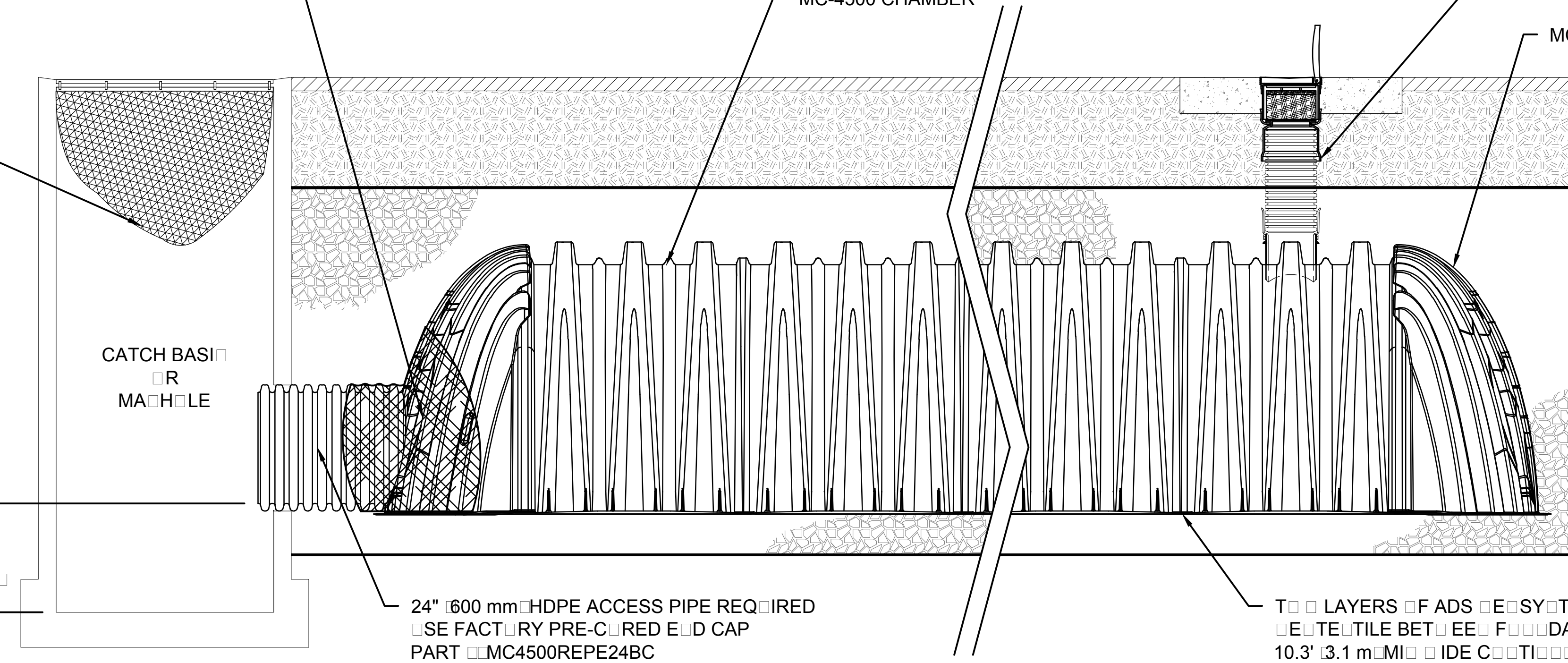
HILLIARD, □H 43026
1-□00-733-7473

THIS DRA□I□□ HAS BEE□ PREPARED BASED □□ I□F□RMATI□□ PR□VIDED T□ ADS □□DER THE DIRECTI□□ □F THE SITE DESI□□ E□□I□EER □R □THER PR□□ECT REPRESE□TATIVE. THE SITE DESI□□ E□□I□EER SHALL REVIE□ THIS DRA□I□□ PRI□R T□ C□□STR□CTI□□. IT IS THE □LTIMATE RESP□□SIBILITY □F THE SITE DESI□□ E□□I□EER T□ E□S□RE THAT THE PR□D□CT(S) DEPICTED A□D ALL ASS□CIATED DETAILS MEET ALL APPLICABLE LA□S, RE□□LATI□□S, A□D PR□□ECT REQ□IREME□TS.



MC-4500 ISOLATOR ROW DETAIL

□TS

INSPECTION & MAINTENANCE

STEP 1) I□SPECT IS□LAT□R R□□ F□R SEDIME□T

A. I□SPECTI□□ P□RTS (IF PRESE□T)
- A.1. REM□VE/□PE□ LID □□ □YL□PLAST I□LI□E DRAI□
- A.2. REM□VE A□D CLEA□ FLE□ST□RM FILTER IF I□STALLED
- A.3. □SI□□ A FLASHLI□HT A□D STADIA R□D, MEAS□RE DEPTH □F SEDIME□T A□D REC□RD □□ MAI□TE□A□CE L□□
- A.4. L□□ ER A CAMERA I□T□ IS□LAT□R R□□ F□R VIS□AL I□SPECTI□□ □F SEDIME□T LEVELS (□PTI□□AL)
- A.5. IF SEDIME□T IS AT, □R AB□VE, 3" (□0 mm) PR□CEED T□ STEP 2. IF □□T, PR□CEED T□ STEP 3.

B. ALL IS□LAT□R R□□ S
- B.1. REM□VE C□VER FR□M STR□CT□RE AT □PSTREAM E□D □F IS□LAT□R R□□
- B.2. □SI□□ A FLASHLI□HT, I□SPECT D□□□ THE IS□LAT□R R□□ THR□□□H □□TLET PIPE
  - i) MIRR□RS □□ P□LES □R CAMERAS MAY BE □SED T□ AV□ID A C□□FI□ED SPACE E□TRY
  - ii) F□LL□□ □SHA RE□□LATI□□S F□R C□□FI□ED SPACE E□TRY IF E□TERI□□ MA□H□LE
- B.3. IF SEDIME□T IS AT, □R AB□VE, 3" (□0 mm) PR□CEED T□ STEP 2. IF □□T, PR□CEED T□ STEP 3.

STEP 2) CLEA□ □□T IS□LAT□R R□□ □SI□□ THE □ETVAC PR□CESS

A. A FI□ED C□LVERT CLEA□I□□ □□□□LE □ ITH REAR FACI□□ SPREAD □F 45" (1.1 m) □R M□RE IS PREFERRED

B. APPLY M□LTIPLE PASSES □F □ETVAC □□TIL BAC□FL□SH □ ATER IS CLEA□

C. VAC□□M STR□CT□RE S□MP AS REQ□IRED

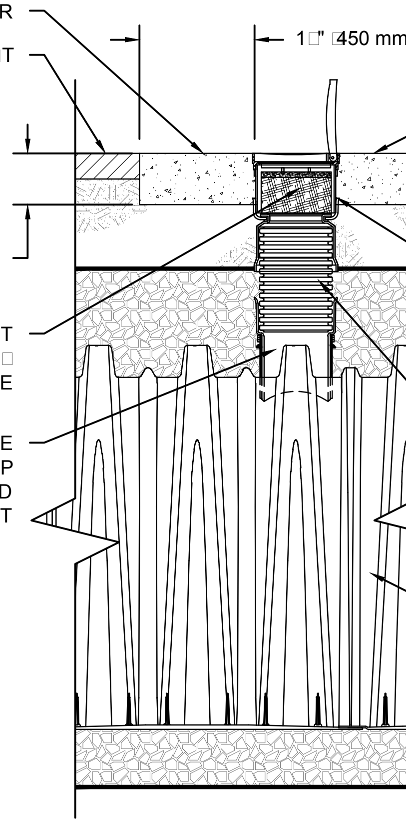
STEP 3) REPLACE ALL C□VERS, □RATES, FILTERS, A□D LIDS; REC□RD □BSERVATI□□S A□D ACTI□□S.

STEP 4) I□SPECT A□D CLEA□ BASI□S A□D MA□H□LES □PSTREAM □F THE ST□RMTECH SYSTEM.

NOTES

1. I□SPECT EVERY 6 M□□THS D□RI□□ THE FIRST YEAR □F □PERATI□□. AD□□ST THE I□SPECTI□□ I□TERVAL BASED □□ PREVI□□S □BSERVATI□□S □F SEDIME□T ACC□M□LATI□□ A□D HI□H □ ATER ELEVATI□□S.

2. C□□D□CT □ETTI□□ A□D VACT□RI□□ A□□□ALLY □R □HE□ I□SPECTI□□ SH□□ S THAT MAI□TE□A□CE IS □ECESSARY.



MC-4500 6" INSPECTION PORT DETAIL

□TS

REV	DR□	CH□	DESCRIPTI□□

Ashley Way
Colton, CA

DATE□ 08/01/2018 DRA□□ CM
PR□□ECT □□ Tool CHEC□ED □ ---

THIS DRA□I□□ HAS BEE□ PREPARED BASED □□ I□F□RMATI□□ PR□VIDED T□ ADS □□DER THE DIRECTI□□ □F THE SITE DESI□□ E□□I□EER □R □THER PR□□ECT REPRESE□TATIVE. THE SITE DESI□□ E□□I□EER SHALL REVIE□ THIS DRA□I□□ PRI□R T□ C□□STR□CTI□□. IT IS THE □LTIMATE RESP□□SIBILITY □F THE SITE DESI□□ E□□I□EER T□ E□S□RE THAT THE PR□D□CT(S) DEPICTED A□D ALL ASS□CIATED DETAILS MEET ALL APPLICABLE LA□S, RE□□LATI□□S, A□D PR□□ECT REQ□IREME□TS.

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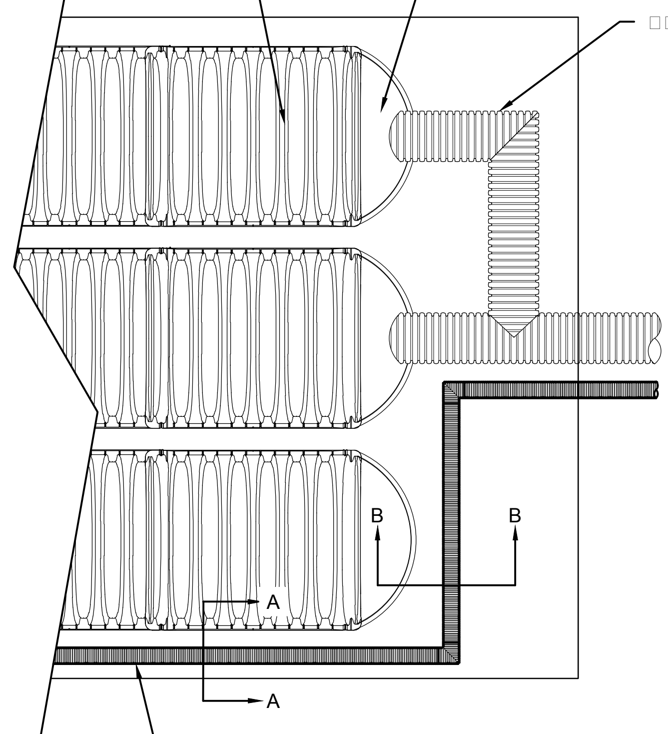
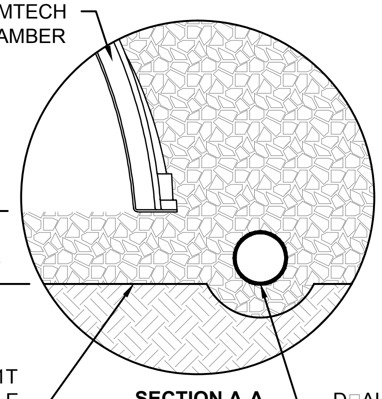
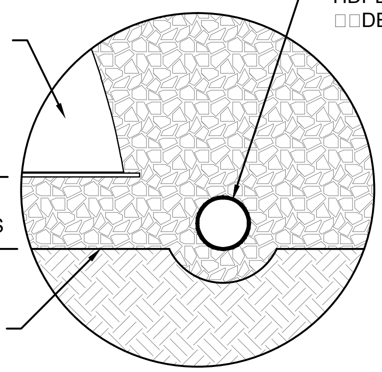
UNDERDRAIN DETAIL

□TS





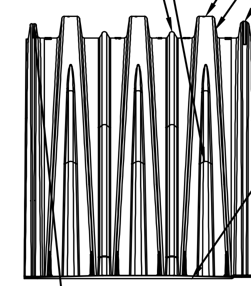
SECTION A-A

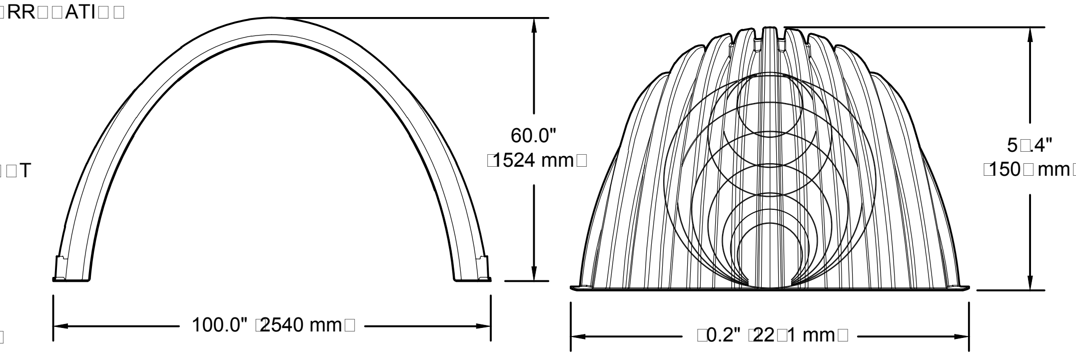


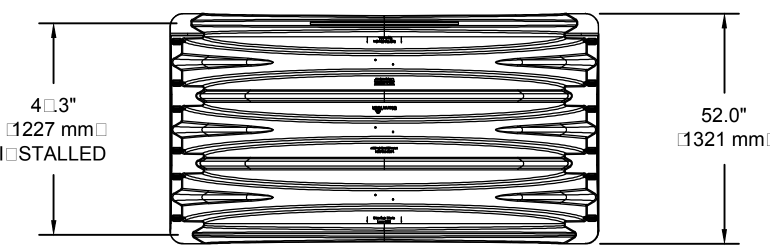
SECTION B-B

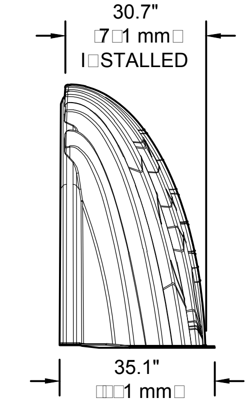
MC-4500 TECHNICAL SPECIFICATION

□TS









NOMINAL CHAMBER SPECIFICATIONS

SI□E □□ □H □ I□STALLED LE□□TH□	100.0" □ 60.0" □ 4□3"	□2540 mm □ 1524 mm □ 1227 mm□
CHAMBER ST□RA□E	106.5 C□BIC FEET	(3.01 m³)
MI□IM□M I□STALLED ST□RA□E□	162.6 C□BIC FEET	(4.60 m³)
□EI□HT	130.0 lbs.	□5□.0 □g□

NOMINAL END CAP SPECIFICATIONS

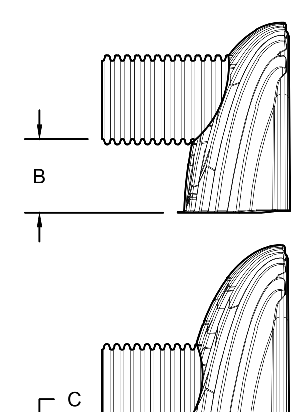
SI□E □□ □H □ I□STALLED LE□□TH□	□0.2" □ 5□4" □ 30.7"	□22□1 mm □ 150□mm □ 7□1 mm□
E□D CAP ST□RA□E	35.7 C□BIC FEET	(1.01 m³)
MI□IM□M I□STALLED ST□RA□E□	10□7 C□BIC FEET	(3.08 m³)
□EI□HT	135.0 lbs.	□61.2 □g□

□ASS□MES 12" □305 mm□ST□□E AB□VE, □" □22□mm□ST□□E F□□□DATI□□ A□D BET□ EE□ CHAMBERS, 12" □305 mm□ST□□E PERIMETER I□ FR□□T □F E□D CAPS A□D 40□ ST□□E P□R□SITY.

ST□BS AT B□TT□M □F E□D CAP F□R PART □□MBERS E□DI□□ □ITH "B"
ST□BS AT T□P □F E□D CAP F□R PART □□MBERS E□DI□□ □ITH "T"

PART #	STUB	B	C
MC4500REPE06T	6" □150 mm□	42.54" □1.0□1 m□	---
MC4500REPE06B		---	0.□6" □22 mm□
MC4500REPE0□T	□" □200 mm□	40.50" □1.02□m□	---
MC4500REPE0□B		---	1.01" □26 mm□
MC4500REPE10T	10" □250 mm□	3□.37" □□75 mm□	---
MC4500REPE10B		---	1.33" □34 mm□
MC4500REPE12T	12" □300 mm□	35.6□" □□07 mm□	---
MC4500REPE12B		---	1.55" □3□mm□
MC4500REPE15T	15" □375 mm□	32.72" □□31 mm□	---
MC4500REPE15B		---	1.70" □43 mm□
MC4500REPE1□TC	1□" □450 mm□	2□.36" □746 mm□	---
MC4500REPE1□BC		---	1.□7" □50 mm□
MC4500REPE24TC	24" □600 mm□	23.05" □5□5 mm□	---
MC4500REPE24BC		---	2.26" □57 mm□
MC4500REPE30BC	30" □750 mm□	---	2.□5" □75 mm□
MC4500REPE36BC	36" □□00 mm□	---	3.25" □□3 mm□
MC4500REPE42BC	42" □1050 mm□	---	3.55" □□0 mm□

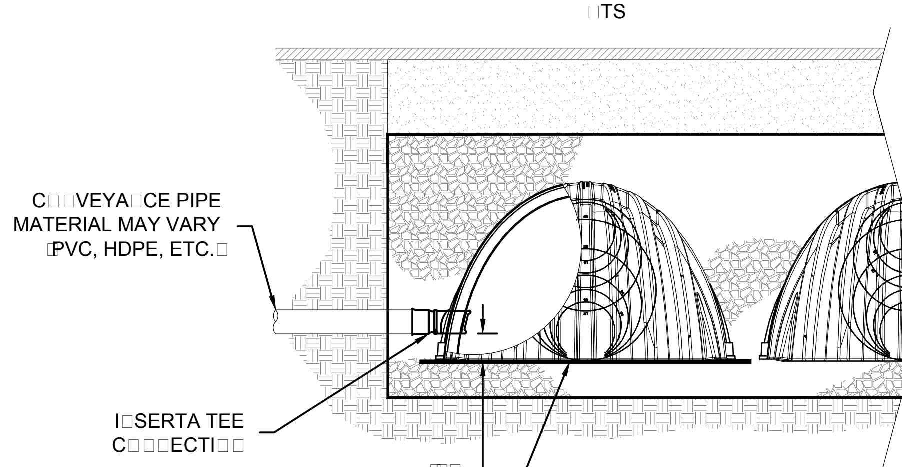
□□TE□ALL DIME□SI□□S ARE □□MI□AL



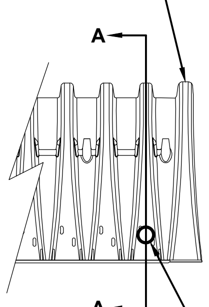
C□ST□M PREC□RED I□VERTS ARE AVAILABLE □P□□ REQ□EST. I□VE□T□RIED MA□IF□LDS I□CL□DE 12-24" □300-600 mm□SI□E □□ SI□E A□D 15-4□" □375-1200 mm□ECCE□TRIC MA□IF□LDS. C□ST□M I□VERT L□CATI□□S □□ THE MC-4500 E□D CAP C□T I□ THE FIELD ARE □□T REC□MME□DED F□R PIPE SI□ES □REATER THA□ 10" □250 mm□ THE I□VERT L□CATI□□ I□ C□L□M□ 'B' ARE THE HI□HTEST P□SSIBLE F□R THE PIPE SI□E.

INSERTA TEE DETAIL

□TS



SECTION A-A



SIDE VIEW

CHAMBER	MAX DIAMETER OF INSERTA TEE	HEIGHT FROM BASE OF CHAMBER (X)
SC-310	6" □150 mm□	4" □100 mm□
SC-740	10" □250 mm□	4" □100 mm□
DC-7□0	10" □250 mm□	4" □100 mm□
MC-3500	12" □300 mm□	6" □150 mm□
MC-4500	12" □300 mm□	□" □200 mm□
I□SERTA TEE FITTI□□S AVAILABLE F□R SDR 26, SDR 35, SCH 40 IPS □AS□ETED □ S□LVE□T □ELD, □-12, HP ST□RM, C-□00 □R D□CTILE IR□□		

NOTE:
PART □□MBERS □ILL VARY BASED □□ I□LET PIPE MATERIALS. C□□TACT ST□RMTECH F□R M□RE I□F□RMATI□□.

Ashley Way
Colton, CA

DATE□	08/01/2018	DRA□□	CM
PR□□ECT □□	Tool	CHEC□ED□	---

REV	DR□	CH□	DESCRIPTI□□

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□60-52□-1□□ | □□□-□2-26□4 | □□□.ST□RMTECH.C□M

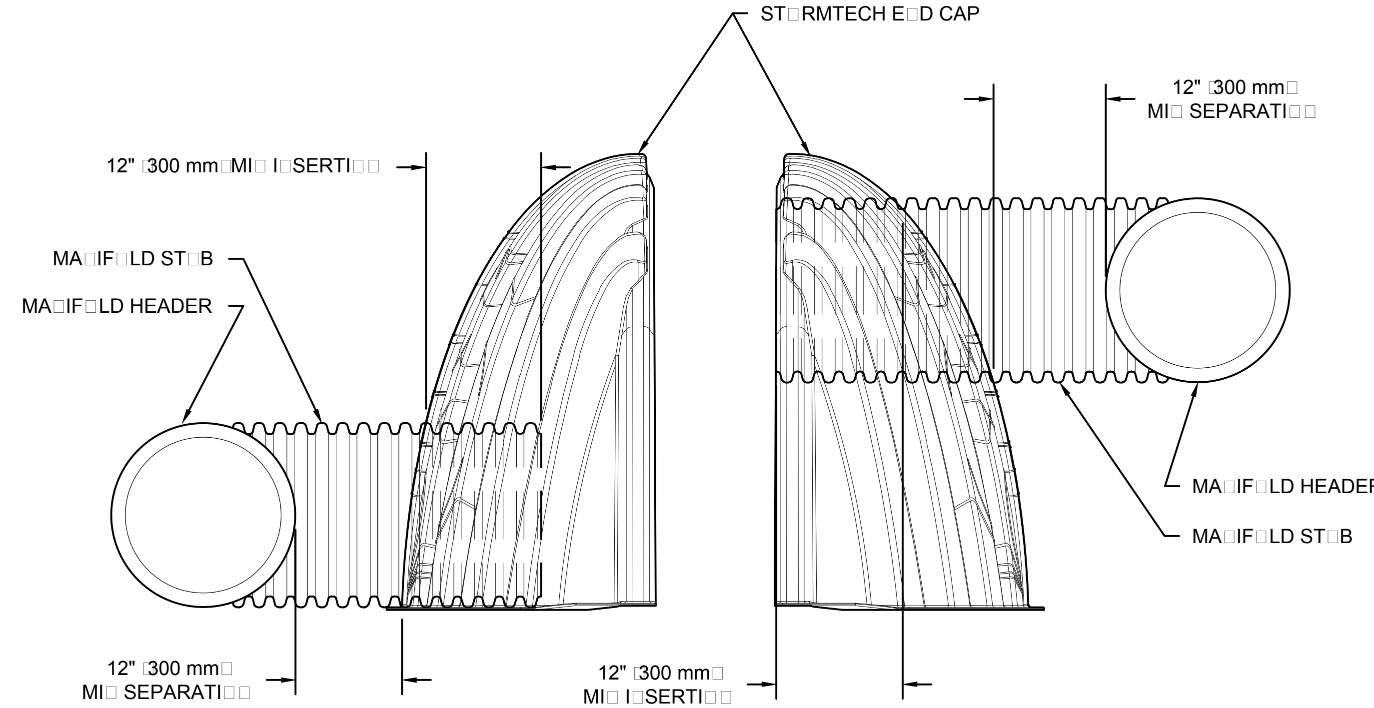
ADS ADVANCED DRAINAGE SYSTEMS, INC.
4640 TR□EMA□ BLVD
HILLIARD, □H 43026
1-□00-733-7473

THIS DRA□I□□ HAS BEE□ PREPARED BASED □□ I□F□RMATI□□ PR□VIDED T□ ADS □□DER THE DIRECTI□□ □F THE SITE DESI□□ E□□I□EER □R □THER PR□□ECT REPRESE□TATIVE. THE SITE DESI□□ E□□I□EER SHALL REVIE□ THIS DRA□I□□ PRI□R T□ C□□STR□CTI□□. IT IS THE □LTIMATE RESP□□SIBILITY □F THE SITE DESI□□ E□□I□EER T□ E□S□RE THAT THE PR□D□CT□S□ DEPICTED A□D ALL ASS□CIATED DETAILS MEET ALL APPLICABLE LA□S, RE□□LATI□□S, A□D PR□□ECT REQ□IREME□TS.

SHEET
5 □F 6

MC-SERIES END CAP INSERTION DETAIL

□TS



□□TE□MA□IF□LD ST□B M□ST BE LAID H□RI□□□TAL F□R A PR□PER FIT I□ E□D CAP □PE□I□□.

Ashley Way
Colton, CA

DATE□	08/01/2018	DRA□□□	CM
PR□□ECT □□	Tool	CHEC□ED□	---

REV	DR□	CH□	DESCRIPTI□□

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SHEET
6 □F 6

Project:

Chamber Model -	MC-4500	
Units -	Imperial	Click Here for Metric
Number of Chambers -	378	
Number of End Caps -	12	
Voids in the stone (porosity) -	40	%
Base of STONE Elevation -	0.00	ft
Amount of Stone Above Chambers -	12	in
Amount of Stone Below Chambers -	9	in
	15003	

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☐ Include Perimeter Stone in Calculations

StormTech MC-4500 Cumulative Storage Volumes

Height of System (inches)	Incremental Single Chamber (cubic feet)	Incremental Single End Cap (cubic feet)	Incremental Chambers (cubic feet)	Incremental End Cap (cubic feet)	Incremental Stone (cubic feet)	Incremental Ch, EC and Stone (cubic feet)	Cumulative System (cubic feet)	Elevation (feet)
81	0.00	0.00	0.00	0.00	473.57	473.57	62772.05	6.75
80	0.00	0.00	0.00	0.00	473.57	473.57	62298.47	6.67
79	0.00	0.00	0.00	0.00	473.57	473.57	61824.90	6.58
78	0.00	0.00	0.00	0.00	473.57	473.57	61351.33	6.50
77	0.00	0.00	0.00	0.00	473.57	473.57	60877.76	6.42
76	0.00	0.00	0.00	0.00	473.57	473.57	60404.19	6.33
75	0.00	0.00	0.00	0.00	473.57	473.57	59930.62	6.25
74	0.00	0.00	0.00	0.00	473.57	473.57	59457.05	6.17
73	0.00	0.00	0.00	0.00	473.57	473.57	58983.48	6.08
72	0.00	0.00	0.00	0.00	473.57	473.57	58509.91	6.00
71	0.00	0.00	0.00	0.00	473.57	473.57	58036.34	5.92
70	0.00	0.00	0.00	0.00	473.57	473.57	57562.77	5.83
69	0.04	0.00	15.48	0.00	467.38	482.86	57089.19	5.75
68	0.12	0.01	43.88	0.12	455.97	499.97	56606.33	5.67
67	0.16	0.03	62.27	0.32	448.54	511.12	56106.36	5.58
66	0.21	0.05	78.90	0.57	441.78	521.25	55595.24	5.50
65	0.27	0.07	101.43	0.81	432.67	534.92	55073.98	5.42
64	0.45	0.09	171.15	1.05	404.69	576.90	54539.07	5.33
63	0.67	0.11	251.47	1.36	372.44	625.27	53962.17	5.25
62	0.80	0.14	302.03	1.70	352.08	655.81	53336.91	5.17
61	0.91	0.17	343.27	2.01	335.46	680.74	52681.10	5.08
60	1.00	0.19	379.10	2.30	321.01	702.41	52000.36	5.00
59	1.09	0.22	411.01	2.58	308.13	721.73	51297.95	4.92
58	1.16	0.24	439.80	2.90	296.49	739.19	50576.22	4.83
57	1.23	0.27	466.46	3.24	285.69	755.39	49837.04	4.75
56	1.30	0.30	491.28	3.57	275.63	770.48	49081.65	4.67
55	1.36	0.32	514.47	3.88	266.23	784.58	48311.16	4.58
54	1.42	0.35	536.27	4.17	257.39	797.84	47526.58	4.50
53	1.47	0.37	556.92	4.45	249.02	810.39	46728.74	4.42
52	1.53	0.39	576.51	4.73	241.08	822.31	45918.35	4.33
51	1.57	0.42	595.16	5.01	233.50	833.67	45096.04	4.25
50	1.62	0.44	612.88	5.28	226.30	844.47	44262.37	4.17
49	1.67	0.46	629.83	5.55	219.42	854.80	43417.90	4.08
48	1.71	0.48	646.04	5.81	212.83	864.68	42563.09	4.00
47	1.75	0.50	661.53	6.06	206.53	874.13	41698.41	3.92
46	1.79	0.53	676.35	6.30	200.51	883.16	40824.29	3.83
45	1.83	0.55	690.68	6.54	194.68	891.90	39941.12	3.75
44	1.86	0.56	704.38	6.77	189.11	900.26	39049.22	3.67
43	1.90	0.58	717.57	7.00	183.74	908.31	38148.96	3.58
42	1.93	0.60	730.23	7.22	178.59	916.04	37240.64	3.50
41	1.96	0.62	742.42	7.44	173.63	923.49	36324.60	3.42
40	2.00	0.64	754.15	7.66	168.85	930.66	35401.11	3.33
39	2.03	0.66	765.45	7.87	164.24	937.56	34470.45	3.25
38	2.05	0.67	776.33	8.08	159.81	944.22	33532.89	3.17
37	2.08	0.69	786.81	8.28	155.53	950.63	32588.67	3.08
36	2.11	0.71	796.85	8.49	151.43	956.77	31638.05	3.00
35	2.13	0.72	806.59	8.69	147.46	962.74	30681.27	2.92
34	2.16	0.74	815.98	8.88	143.63	968.49	29718.53	2.83
33	2.18	0.76	825.00	9.07	139.94	974.01	28750.05	2.75
32	2.21	0.77	833.69	9.26	136.39	979.34	27776.03	2.67
31	2.23	0.79	842.05	9.44	132.97	984.47	26796.69	2.58
30	2.25	0.80	850.07	9.62	129.69	989.39	25812.23	2.50
29	2.27	0.82	857.81	9.85	126.51	994.17	24822.84	2.42
28	2.29	0.84	865.24	10.09	123.44	998.77	23828.67	2.33
27	2.31	0.85	872.37	10.15	120.56	1003.08	22829.90	2.25
26	2.33	0.86	879.21	10.30	117.77	1007.28	21826.82	2.17
25	2.34	0.87	885.77	10.46	115.08	1011.31	20819.54	2.08
24	2.36	0.89	892.05	10.62	112.50	1015.17	19808.23	2.00
23	2.38	0.90	898.05	10.78	110.04	1018.87	18793.06	1.92
22	2.39	0.91	903.79	10.92	107.69	1022.40	17774.20	1.83
21	2.41	0.92	909.26	11.07	105.44	1025.77	16751.80	1.75
20	2.42	0.93	914.48	11.21	103.29	1028.99	15726.02	1.67
19	2.43	0.95	919.44	11.35	101.26	1032.04	14697.04	1.58
18	2.44	0.96	924.15	11.48	99.32	1034.95	13665.00	1.50
17	2.46	0.97	928.61	11.61	97.48	1037.70	12630.05	1.42
16	2.47	0.98	932.82	11.73	95.75	1040.30	11592.35	1.33
15	2.48	0.99	936.79	11.85	94.11	1042.76	10552.04	1.25
14	2.49	1.00	940.56	11.97	92.56	1045.09	9509.28	1.17
13	2.50	1.01	944.13	12.08	91.09	1047.30	8464.19	1.08
12	2.51	1.02	947.46	12.19	89.71	1049.36	7416.90	1.00
11	2.51	1.02	950.56	12.29	88.43	1051.29	6367.54	0.92
10	2.53	1.03	955.18	12.39	86.54	1054.11	5316.25	0.83
9	0.00	0.00	0.00	0.00	473.57	473.57	4262.14	0.75
8	0.00	0.00	0.00	0.00	473.57	473.57	3788.57	0.67
7	0.00	0.00	0.00	0.00	473.57	473.57	3315.00	0.58
6	0.00	0.00	0.00	0.00	473.57	473.57	2841.43	0.50
5	0.00	0.00	0.00	0.00	473.57	473.57	2367.85	0.42
4	0.00	0.00	0.00	0.00	473.57	473.57	1894.28	0.33
3	0.00	0.00	0.00	0.00	473.57	473.57	1420.71	0.25
2	0.00	0.00	0.00	0.00	473.57	473.57	947.14	0.17
1	0.00	0.00	0.00	0.00	473.57	473.57	473.57	0.08

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Isolator® Row O&M Manual

StormTech® Chamber System for Stormwater Management

1.0 The Isolator® Row

1.1 INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a patented technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

1.2 THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC-310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

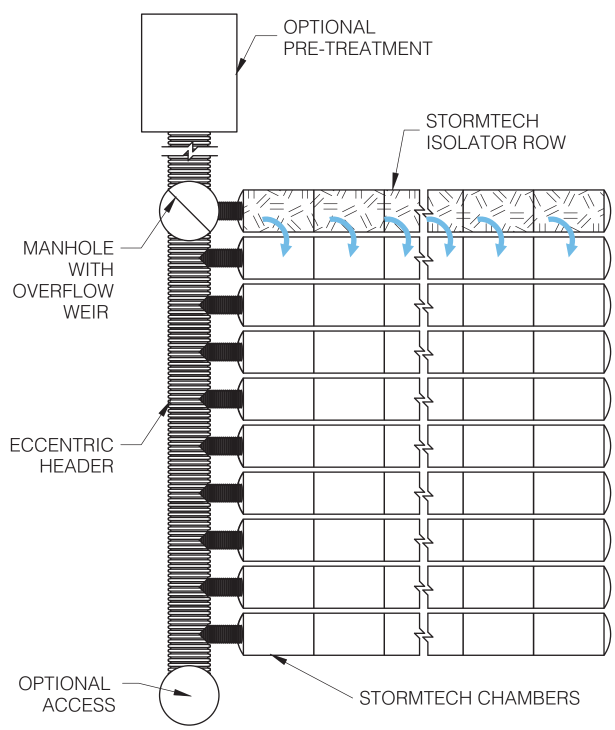
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

StormTech Isolator Row with Overflow Spillway
(not to scale)



2.0 Isolator Row Inspection/Maintenance

StormTech®

2.1 INSPECTION

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

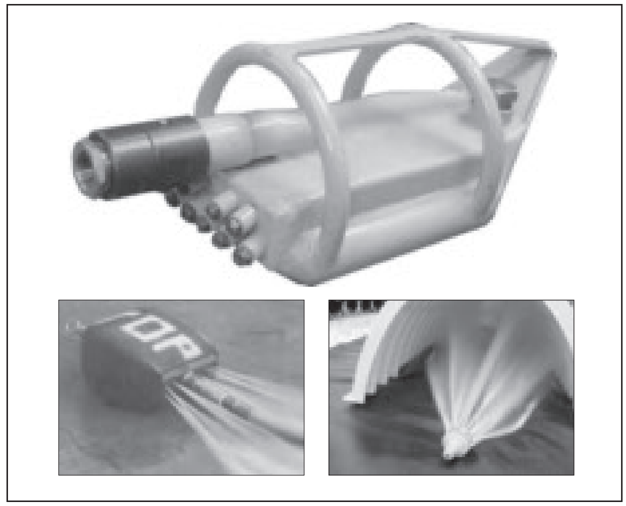
At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

2.2 MAINTENANCE

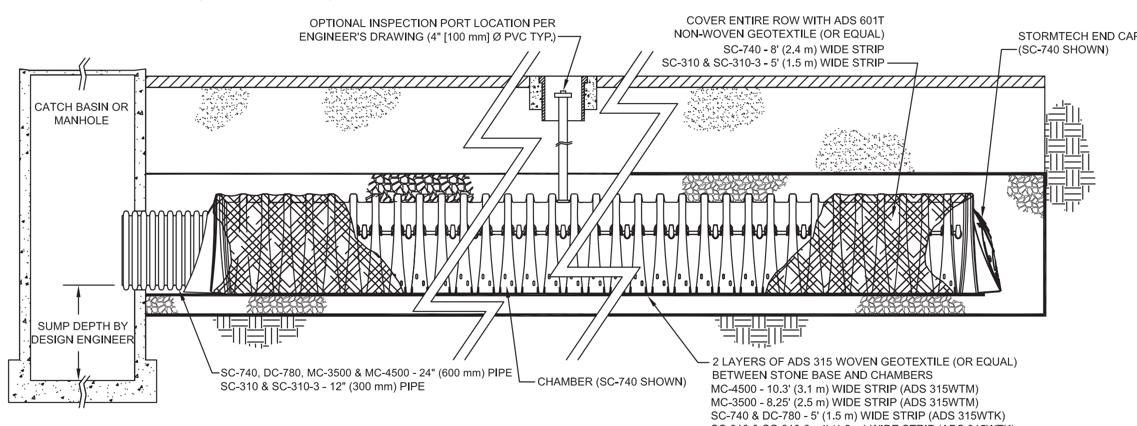
The Isolator Row was designed to reduce the cost of periodic maintenance. By “isolating” sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.



Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45” are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)

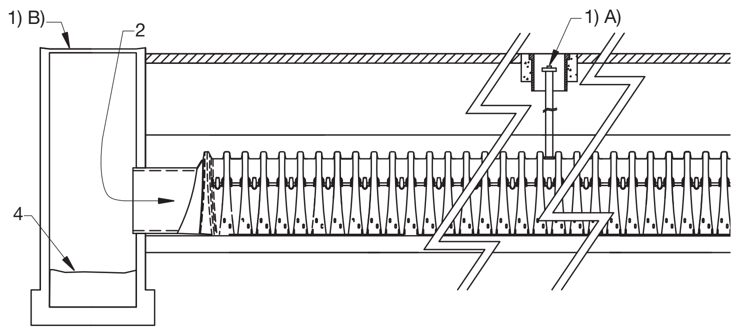


NOTE: NON-WOVEN FABRIC IS ONLY REQUIRED OVER THE INLET PIPE CONNECTION INTO THE END CAP FOR DC-780, MC-3500 AND MC-4500 CHAMBER MODELS AND IS NOT REQUIRED OVER THE ENTIRE ISOLATOR ROW.

3.0 Isolator Row Step By Step Maintenance Procedures

Step 1) Inspect Isolator Row for sediment
- A) Inspection ports (if present)
  - i. Remove lid from floor box frame
  - ii. Remove cap from inspection riser
  - iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.
  - iv. If sediment is at, or above, 3 inch depth proceed to Step 2. If not proceed to step 3.
- B) All Isolator Rows
  - i. Remove cover from manhole at upstream end of Isolator Row
  - ii. Using a flashlight, inspect down Isolator Row through outlet pipe
    1. Mirrors on poles or cameras may be used to avoid a confined space entry
    2. Follow OSHA regulations for confined space entry if entering manhole
  - iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3.

StormTech Isolator Row (not to scale)



Step 2) Clean out Isolator Row using the JetVac process
- A) A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

Step 3) Replace all caps, lids and covers, record observations and actions

Step 4) Inspect & clean catch basins and manholes upstream of the StormTech system

Sample Maintenance Log

Date	Stadia Rod Readings		Sediment Depth (1) - (2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/01	6.3 ft.	none		New installation. Fixed point is CI frame at grade	djm
9/24/01		6.2	0.1 ft.	Some grit felt	sm
6/20/03		5.8	0.5 ft.	Mucky feel, debris visible in manhole and in Isolator row, maintenance due	rv
7/7/03	6.3 ft.		0	System jetted and vacuumed	djm

StormTech®

Detention • Retention • Water Quality

A division of ADS

70 Inwood Road, Suite 3 | Rocky Hill | Connecticut | 06067

860.529.8188 | 888.892.2694 | fax 866.328.8401 | www.stormtech.com

#11011 03/16

APPENDIX D

DCV CALCULATIONS
FACTOR OF SAFETY CALCULATIONS

Santa Ana Watershed

BMP Design Volume, V_{BMP}

Company Name	FMCIVIL Engineers Inc.
Designed by	Chris Morlok, PE
Project	Ashley Way
Date	8/1/2018

DA 1 - INTERIM

Surface Type	**Area (SF)**
Roof	220,196.00
Concrete or Asphalt	168,738.00
Ornamental Landscaping	91,389.00
Total Area (SF)	480,323.00
Total Area (Acres)	11.03

Impervious Ratio =	**(i)**	81.0%
C_{BMP} = Runoff Coefficient	**$0.858i^3-0.78i^2+0.774i+0.04$**	0.61
$P_{2yr,1hr}$	**NOAA - 2-yr 1-hr rainfall depth**	0.474
a_1 = San Bernardino Climate Region	**Valley = 1.4807 Mountain = 1.909 Desert = 1.2371**	1.4807
P_6 - Mean Storm Rainfall Depth	**$P_6 = a_1 * P_{2yr,1hr}$**	0.7019
a_2 = Drawdown rate of Basin	**1.582 for 24-hr 1.963 for 48-hr**	1.9630
Project Area (SF)	**(DA)**	480,323.00
Design Capture Volume (cu.ft.)	**$DCV = DA * C_{BMP} * a_2 * P_6/12$**	33,685.67
Volume Provided, cu. Ft.		33,809.00

Ashley Way **DA 1**

Infiltration Test No.	Infiltration Rate (in/hr)	
I-1	2.1	
I-2	0.8	
Infiltration Rate (avergae) =	1.5	Used
Geotechnical Report recommendation =	2.00	

Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	1	0.25
		Predominant soil texture	0.25	1	0.25
		Site soil variability	0.25	1	0.25
		Depth to groundwater / impervious layer	0.25	1	0.25
		Suitability Assessment Safety Factor, $S_A = \sum p$			1
B	Design	Tributary area size	0.25	3	0.75
		Level of pretreatment/ expected sediment loads	0.25	2	0.5
		Redundancy	0.25	3	0.75
		Compaction during construction	0.25	3	0.75
		Design Safety Factor, $S_B = \sum p$			2.75
Combined Safety Factor, $S_{total} = S_A x S_B$					2.75
Observed Infiltration Rate, inch/hr, $K_{observed}$ (corrected for test-specific bias)					1.5
Design Infiltration Rate, in/hr, Kdesign = $K_{0bserved} / S_{total}$					**0.53**

Briefly describe infiltration test and provide reference to test forms: Southern California Geotechnical performed infiltration testing in general accordance with ASTM Test Method D-3385-03, Standard Test Method for Infiltration Rate of Soils in Field Using Double Ring Infiltrometer. Please refer to SCG's infiltration report dated Decembere 13,2016 for Project no. 16G225-1.

Note: The minimum combined adjustment factor shall not be less than 2.0 and the maximum combined adjustment factor shall not exceed 9.0.

APPENDIX E

SOILS AND INFILTRATION DATA

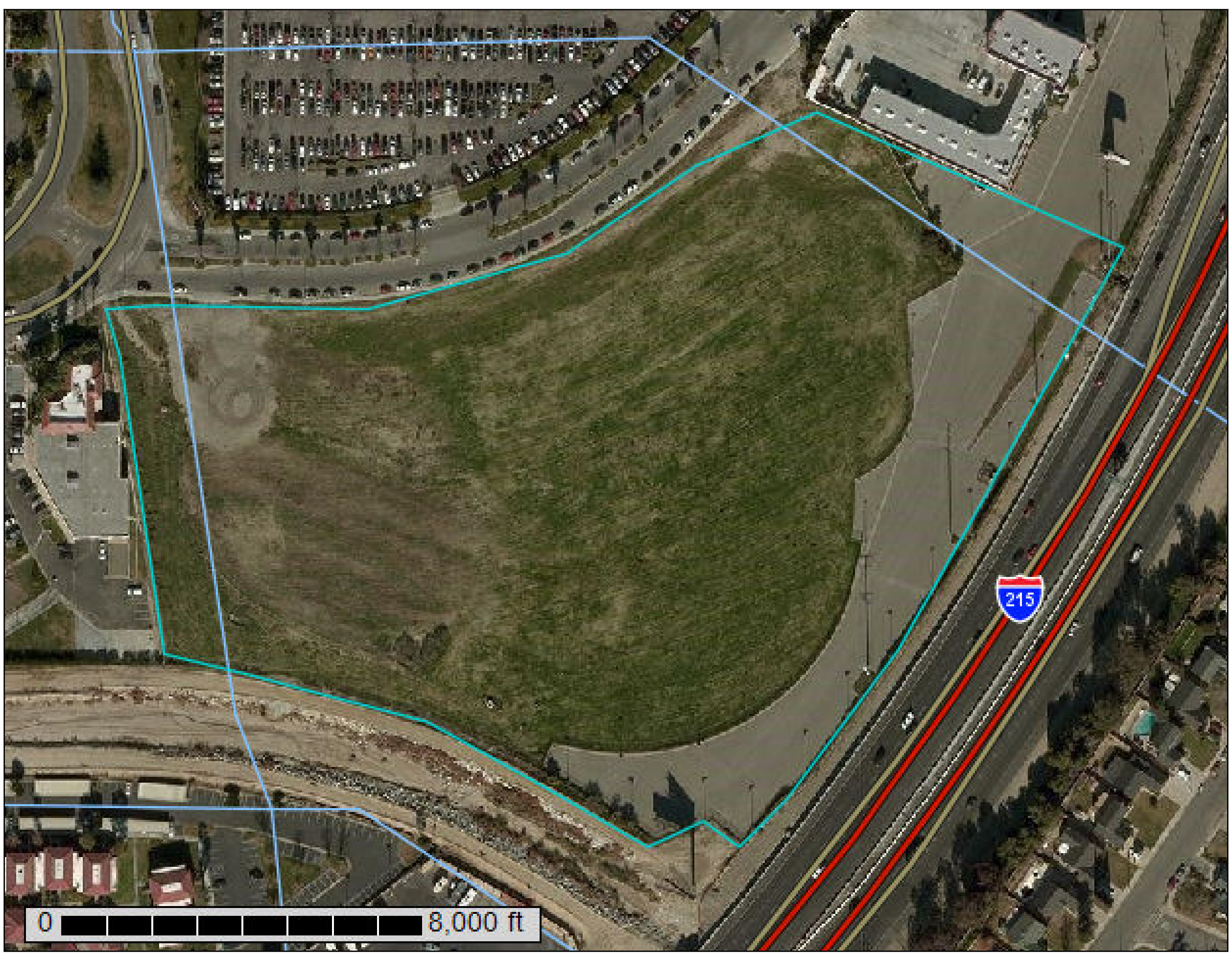
United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for San Bernardino County Southwestern Part, California

FMCIVIL ENGINEERS INC.



May 29, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:2,170 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 30, 60, 120, 180

Feet: 0, 100, 200, 400, 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Bernardino County Southwestern Part, California
Survey Area Data: Version 9, Sep 11, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jan 5, 2015—Jan 18, 2015

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
HaD	Hanford coarse sandy loam, 9 to 15 percent slopes	1.8	13.6%
ScA	San Emigdio fine sandy loam, 0 to 2 percent slopes	1.4	10.8%
ScC	San Emigdio fine sandy loam, 2 to 9 percent slopes	10.1	75.7%
Totals for Area of Interest		**13.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

San Bernardino County Southwestern Part, California

HaD—Hanford coarse sandy loam, 9 to 15 percent slopes

Map Unit Setting

National map unit symbol: hck4
Elevation: 150 to 900 feet
Mean annual precipitation: 10 to 20 inches
Mean annual air temperature: 63 degrees F
Frost-free period: 250 to 280 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hanford and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hanford

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

H1 - 0 to 12 inches: sandy loam
H2 - 12 to 60 inches: sandy loam

Properties and qualities

Slope: 9 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Greenfield, sandy loam

Percent of map unit: 10 percent
Hydric soil rating: No

Ramona, sandy loam

Percent of map unit: 5 percent
Hydric soil rating: No

ScA—San Emigdio fine sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hckp
Elevation: 1,000 to 2,000 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 230 to 280 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

San emigdio and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of San Emigdio

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 60 inches: fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.3 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c

Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Metz, coarse sandy loam
Percent of map unit: 5 percent
Hydric soil rating: No

Hanford, cosl
Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed
Percent of map unit: 5 percent
Hydric soil rating: No

ScC—San Emigdio fine sandy loam, 2 to 9 percent slopes

Map Unit Setting
National map unit symbol: hckq
Elevation: 1,000 to 2,000 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 230 to 280 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
San emigdio and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of San Emigdio

Setting
Landform: Alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile
H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 60 inches: fine sandy loam

Properties and qualities
Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.3 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Hanford, coarse sandy loam

Percent of map unit: 10 percent
Hydric soil rating: No

San emigdio, sandy loam

Percent of map unit: 5 percent
Hydric soil rating: No

References

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1.3 *Field Infiltration Testing*

Five field percolation tests were performed to approximate depths of 5 feet below existing grade. The approximate locations are shown on Figure 2. Field percolation testing was performed in general accordance with the guidelines set forth by the County of San Bernardino (2013). For the falling head test, a 2-inch-diameter slotted PVC pipe was placed in the boreholes to a depth of approximately 5 feet below existing grade and the annulus was backfilled with gravel to the surface including placement of approximately 2 inches of gravel at the bottom of the borehole. The infiltration wells were pre-soaked per the County guidelines. The tests were performed with an average head (depth of water) of approximately 2 feet above the bottom of the proposed infiltration surfaces. Based on the County of San Bernardino methodology, the observed infiltration rate, summarized in Table 1, has normalized the three-dimensional flow that occurs within the field test to a one-dimensional flow out of the bottom of the boring only. The measured infiltration rates are based on a factor of safety of 2.0 for feasibility. Infiltration tests are performed using relatively clean water free of particulates, silt, etc. Refer to the discussion provided in Section 4.9.

TABLE 1

Summary of Field Infiltration Testing

Infiltration Test Location	Measured Infiltration Rate* (inch/hr)
I-1	2.1
I-2	0.8
I-3	2.4
I-4	2.2
I-5	1.1

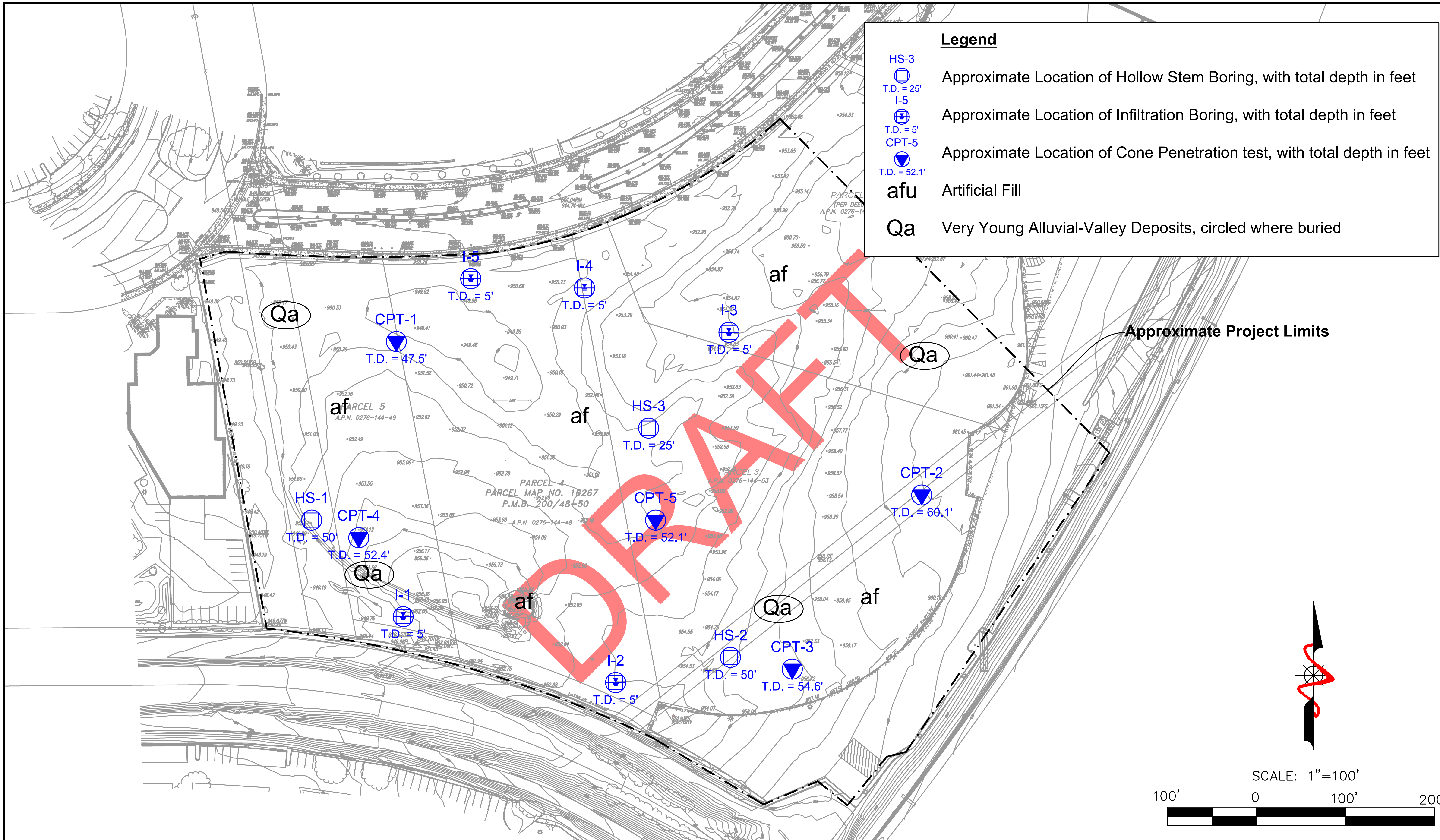
*Based on a factor of safety of 2.0 for feasibility

4.9 *Subsurface Water Infiltration*

Recent regulatory changes have occurred that mandate that storm water be infiltrated below grade rather than collected in a conventional storm drain system. Typically, a combination of methods are implemented to reduce surface water runoff and increase infiltration including; permeable pavements/pavers for roadways and walkways, directing surface water runoff to grass-lined swales, retention areas, and/or drywells, etc.

It should be noted that collecting and concentrating surface water for the purpose of intentional infiltration below grade, conflicts with the geotechnical engineering objective of directing surface water away from slopes, structures and other improvements. The geotechnical stability and integrity of a site is reliant upon appropriately handling surface water. In general, the vast majority of geotechnical distress issues are directly related to improper drainage. In general, distress in the form of movement of improvements could occur as a result of soil saturation and loss of soil support, expansion, internal soil erosion, collapse and/or settlement.

Geotechnical stability and integrity of the project site is reliant upon appropriate handling of surface water. Due to site liquefaction potential, the intentional infiltration of storm water is not recommended.



LGC Geotechnical, Inc.
131 Calle Iglesia, Ste. 200
San Clemente, CA 92672
TEL (949) 369-6141 FAX (949) 369-6142

FIGURE 2
Boring Location Map

PROJECT NAME	HPI-Ashley Way
PROJECT NO.	18078-01
ENG. / GEOL.	BTZ/KBC
SCALE	1" = 100'
DATE	July 2018

APPENDIX F

CASQA INFORMATION

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	
Nutrients	☑
Trash	
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

Description

Spills and leaks, if not properly controlled, can adversely impact the storm drain system and receiving waters. Due to the type of work or the materials involved, many activities that occur either at a municipal facility or as a part of municipal field programs have the potential for accidental spills and leaks. Proper spill response planning and preparation can enable municipal employees to effectively respond to problems when they occur and minimize the discharge of pollutants to the environment.

Approach

- An effective spill response and control plan should include:
  - Spill/leak prevention measures;
  - Spill response procedures;
  - Spill cleanup procedures;
  - Reporting; and
  - Training
- A well thought out and implemented plan can prevent pollutants from entering the storm drainage system and can be used as a tool for training personnel to prevent and control future spills as well.

Pollution Prevention

- Develop and implement a Spill Prevention Control and Response Plan. The plan should include:

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- A description of the facility, the address, activities and materials involved
- Identification of key spill response personnel
- Identification of the potential spill areas or operations prone to spills/leaks
- Identification of which areas should be or are bermed to contain spills/leaks
- Facility map identifying the key locations of areas, activities, materials, structural BMPs, etc.
- Material handling procedures
- Spill response procedures including:
  - Assessment of the site and potential impacts
  - Containment of the material
  - Notification of the proper personnel and evacuation procedures
  - Clean up of the site
  - Disposal of the waste material and
  - Proper record keeping

- Product substitution – use less toxic materials (i.e. use water based paints instead of oil based paints)
- Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of materials that are brought into the facility or into the field.

Suggested Protocols

Spill/Leak Prevention Measures

- If possible, move material handling indoors, under cover, or away from storm drains or sensitive water bodies.
- Properly label all containers so that the contents are easily identifiable.
- Berm storage areas so that if a spill or leak occurs, the material is contained.
- Cover outside storage areas either with a permanent structure or with a seasonal one such as a tarp so that rain can not come into contact with the materials.
- Check containers (and any containment sumps) often for leaks and spills. Replace containers that are leaking, corroded, or otherwise deteriorating with containers in good condition. Collect all spilled liquids and properly dispose of them.

- Store, contain and transfer liquid materials in such a manner that if the container is ruptured or the contents spilled, they will not discharge, flow or be washed into the storm drainage system, surface waters, or groundwater.

- Place drip pans or absorbent materials beneath all mounted taps and at all potential drip and spill locations during the filling and unloading of containers. Any collected liquids or soiled absorbent materials should be reused/recycled or properly disposed of.

- For field programs, only transport the minimum amount of material needed for the daily activities and transfer materials between containers at a municipal yard where leaks and spill are easier to control.

- If paved, sweep and clean storage areas monthly, do not use water to hose down the area unless all of the water will be collected and disposed of properly.

- Install a spill control device (such as a tee section) in any catch basins that collect runoff from any storage areas if the materials stored are oil, gas, or other materials that separate from and float on water. This will allow for easier cleanup if a spill occurs.

- If necessary, protect catch basins while conducting field activities so that if a spill occurs, the material will be contained.

Training

- Educate employees about spill prevention, spill response and cleanup on a routine basis.

- Well-trained employees can reduce human errors that lead to accidental releases or spills:

  - The employees should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

  - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan if one is available.

- Training of staff from all municipal departments should focus on recognizing and reporting potential or current spills/leaks and who they should contact.

- Employees responsible for aboveground storage tanks and liquid transfers for large bulk containers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.

Spill Response and Prevention

- Identify key spill response personnel and train employees on who they are.

- Store and maintain appropriate spill cleanup materials in a clearly marked location near storage areas; and train employees to ensure familiarity with the site's spill control plan and/or proper spill cleanup procedures.

- Locate spill cleanup materials, such as absorbents, where they will be readily accessible (e.g. near storage and maintenance areas, on field trucks).

- Follow the Spill Prevention Control and Countermeasure Plan if one is available.
- If a spill occurs, notify the key spill response personnel immediately. If the material is unknown or hazardous, the local fire department may also need to be contacted.
- If safe to do so, attempt to contain the material and block the nearby storm drains so that the area impacted is minimized. If the material is unknown or hazardous wait for properly trained personnel to contain the materials.
- Perform an assessment of the area where the spill occurred and the downstream area that it could impact. Relay this information to the key spill response and clean up personnel.

Spill Cleanup Procedures

- Small non-hazardous spills
  - Use a rag, damp cloth or absorbent materials for general clean up of liquids
  - Use brooms or shovels for the general clean up of dry materials
  - If water is used, it must be collected and properly disposed of. The wash water can not be allowed to enter the storm drain.
  - Dispose of any waste materials properly
  - Clean or dispose of any equipment used to clean up the spill properly
- Large non-hazardous spills
  - Use absorbent materials for general clean up of liquids
  - Use brooms, shovels or street sweepers for the general clean up of dry materials
  - If water is used, it must be collected and properly disposed of. The wash water can not be allowed to enter the storm drain.
  - Dispose of any waste materials properly
  - Clean or dispose of any equipment used to clean up the spill properly
- For hazardous or very large spills, a private cleanup company or Hazmat team may need to be contacted to assess the situation and conduct the cleanup and disposal of the materials.
- Chemical cleanups of material can be achieved with the use of absorbents, gels, and foams. Remove the adsorbent materials promptly and dispose of according to regulations.
- If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.

Reporting

- Report any spills immediately to the identified key municipal spill response personnel.

- Report spills in accordance with applicable reporting laws. Spills that pose an immediate threat to human health or the environment must be reported immediately to the Office of Emergency Service (OES)

- Spills that pose an immediate threat to human health or the environment may also need to be reported within 24 hours to the Regional Water Quality Control Board.

- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour)

- After the spill has been contained and cleaned up, a detailed report about the incident should be generated and kept on file (see the section on Reporting below). The incident may also be used in briefing staff about proper procedures

Other Considerations

- State regulations exist for facilities with a storage capacity of 10,000 gallons or more of petroleum to prepare a Spill Prevention Control and Countermeasure Plan (SPCC) Plan (Health & Safety Code Chapter 6.67).

- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.

- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, if permitted to do so, prohibiting any hard connections to the storm drain.

Requirements

Costs

- Will vary depending on the size of the facility and the necessary controls.

- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of wastes, contaminated soil and water is very expensive

Maintenance

- This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills, which results in increased labor costs

Supplemental Information

Further Detail of the BMP

Reporting

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the response and containment of a spill. A good record keeping system helps the municipality minimize incident recurrence, correctly respond with appropriate containment and cleanup activities, and comply with legal requirements.

A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm drain.

These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge
- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

Separate record keeping systems should be established to document housekeeping and preventive maintenance inspections, and training activities. All housekeeping and preventive maintenance inspections should be documented. Inspection documentation should contain the following information:

- The date and time the inspection was performed
- Name of the inspector
- Items inspected
- Problems noted
- Corrective action required
- Date corrective action was taken

Other means to document and record inspection results are field notes, timed and dated photographs, videotapes, and drawings and maps.

Examples

The City of Palo Alto includes spill prevention and control as a major element of its highly effective program for municipal vehicle maintenance shops.

References and Resources

King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm

Orange County Stormwater Program
http://www.ocwatersheds.com/stormwater/swp_introduction.asp

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP)
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

Parking/Storage Area Maintenance SC-43

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

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Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The following protocols are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook).
- Keep accurate maintenance logs to evaluate BMP implementation.

Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low concentrations.

- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.

Controlling Litter

- Post “No Littering” signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel and dispose of litter in the trash.

Surface cleaning

- Use dry cleaning methods (e.g. sweeping or vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- If water is used follow the procedures below:
  - Block the storm drain or contain runoff.
  - Wash water should be collected and pumped to the sanitary sewer or discharged to a pervious surface, do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- When cleaning heavy oily deposits:
  - Use absorbent materials on oily spots prior to sweeping or washing.
  - Dispose of used absorbents appropriately.

Surface Repair

- Pre-heat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination form contacting stormwater runoff.
- Cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc., where applicable. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.

- Use only as much water as necessary for dust control, to avoid runoff.

- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of the parking facilities and stormwater conveyance systems associated with them on a regular basis.

- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.

- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.

- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, nad implement accordingly.

- Have spill cleanup materials readily available and in a known location.

- Cleanup spills immediately and use dry methods if possible.

- Properly dispose of spill cleanup material.

Other Considerations

- Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

Requirements

Costs

Cleaning/sweeping costs can be quite large, construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot to minimize cleaning with water.

- Clean out oil/water/sand separators regularly, especially after heavy storms.

- Clean parking facilities on a regular basis to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination form contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Use only as much water as necessary for dust control, to avoid runoff.

References and Resources

http://www.stormwatercenter.net/

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality control Board. July 1998 (Revised February 2002 by the California Coastal Commission).

Orange County Stormwater Program
http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA) http://www.basma.org

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP)
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

Description

Promote efficient and safe housekeeping practices (storage, use, and cleanup) when handling potentially harmful materials such as fertilizers, pesticides, cleaning solutions, paint products, automotive products, and swimming pool chemicals. Related information is provided in BMP fact sheets SC-11 Spill Prevention, Control & Cleanup and SC-34 Waste Handling & Disposal.

Approach

Pollution Prevention

- Purchase only the amount of material that will be needed for foreseeable use. In most cases this will result in cost savings in both purchasing and disposal. See SC-61 Safer Alternative Products for additional information.

- Be aware of new products that may do the same job with less environmental risk and for less or the equivalent cost. Total cost must be used here; this includes purchase price, transportation costs, storage costs, use related costs, clean up costs and disposal costs.

Suggested Protocols

General

- Keep work sites clean and orderly. Remove debris in a timely fashion. Sweep the area.

- Dispose of wash water, sweepings, and sediments, properly.

- Recycle or dispose of fluids properly.

- Establish a daily checklist of office, yard and plant areas to confirm cleanliness and adherence to proper storage and security. Specific employees should be assigned specific inspection responsibilities and given the authority to remedy any problems found.

- Post waste disposal charts in appropriate locations detailing for each waste its hazardous nature (poison, corrosive, flammable), prohibitions on its disposal (dumpster, drain, sewer) and the recommended disposal method (recycle, sewer, burn, storage, landfill).

- Summarize the chosen BMPs applicable to your operation and post them in appropriate conspicuous places.

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

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- Require a signed checklist from every user of any hazardous material detailing amount taken, amount used, amount returned and disposal of spent material.

- Do a before audit of your site to establish baseline conditions and regular subsequent audits to note any changes and whether conditions are improving or deteriorating.

- Keep records of water, air and solid waste quantities and quality tests and their disposition.

- Maintain a mass balance of incoming, outgoing and on hand materials so you know when there are unknown losses that need to be tracked down and accounted for.

- Use and reward employee suggestions related to BMPs, hazards, pollution reduction, work place safety, cost reduction, alternative materials and procedures, recycling and disposal.

- Have, and review regularly, a contingency plan for spills, leaks, weather extremes etc. Make sure all employees know about it and what their role is so that it comes into force automatically.

Training

- Train all employees, management, office, yard, manufacturing, field and clerical in BMPs and pollution prevention and make them accountable.

- Train municipal employees who handle potentially harmful materials in good housekeeping practices.

- Train personnel who use pesticides in the proper use of the pesticides. The California Department of Pesticide Regulation license pesticide dealers, certify pesticide applicators and conduct onsite inspections.

- Train employees and contractors in proper techniques for spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.

- Keep your Spill Prevention Control and Countermeasure (SPCC) plant up-to-date, and implement accordingly.

- Have spill cleanup materials readily available and in a known location.

- Cleanup spills immediately and use dry methods if possible.

- Properly dispose of spill cleanup material.

Other Considerations

- There are no major limitations to this best management practice.

- There are no regulatory requirements to this BMP. Existing regulations already require municipalities to properly store, use, and dispose of hazardous materials

Requirements

Costs

- Minimal cost associated with this BMP. Implementation of good housekeeping practices may result in cost savings as these procedures may reduce the need for more costly BMPs.

Maintenance

- Ongoing maintenance required to keep a clean site. Level of effort is a function of site size and type of activities.

Supplemental Information

Further Detail of the BMP

- The California Integrated Waste Management Board's Recycling Hotline, 1-800-553-2962, provides information on household hazardous waste collection programs and facilities.

Examples

There are a number of communities with effective programs. The most pro-active include Santa Clara County and the City of Palo Alto, the City and County of San Francisco, and the Municipality of Metropolitan Seattle (Metro).

References and Resources

British Columbia Lake Stewardship Society. Best Management Practices to Protect Water Quality from Non-Point Source Pollution. March 2000. http://www.nalms.org/bclss/bmphome.html#bmp

King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities, Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July, 1998, Revised by California Coastal Commission, February 2002.

Orange County Stormwater Program
http://www.ocwatersheds.com/stormwater/swp_introduction.asp

San Mateo STOPPP - (http://stoppp.tripod.com/bmp.html)

Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	
Oxygen Demanding	☑

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Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

Approach

Pollution Prevention

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.

- Choose low water using flowers, trees, shrubs, and groundcover.

- Consider alternative landscaping techniques such as naturescaping and xeriscaping.

- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

Suggested Protocols

Mowing, Trimming, and Weeding

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.

- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.

- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.

- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.

- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).

- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.

- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.

- Consider using low water use groundcovers when planting or replanting.

Waste Management

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.

- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

Irrigation

- Where practical, use automatic timers to minimize runoff.

- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.

- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.

- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.

- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.

- Apply water at rates that do not exceed the infiltration rate of the soil.

Fertilizer and Pesticide Management

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:

  - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.

  - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.

  - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.

  - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.

  - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).

  - Small mammals and birds can be excluded using fences, netting, tree trunk guards.

  - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.

- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup

- Have spill cleanup materials readily available and in a know in location

- Cleanup spills immediately and use dry methods if possible.

- Properly dispose of spill cleanup material.

Other Considerations

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.

- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.

- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

Requirements

Costs

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Waste Management

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

Contractors and Other Pesticide Users

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

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Los Angeles County Stormwater Quality Model Programs. Public Agency Activities http://ladpw.org/wmd/npdes/model_links.cfm

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Photo Credit: Geoff Brosseau

Objectives

- Contain
- Educate
- Reduce/Minimize

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff that may contain certain pollutants. Maintaining catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis will remove pollutants, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Approach

Suggested Protocols

Catch Basins/Inlet Structures

- Municipal staff should regularly inspect facilities to ensure the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC-75 Waste Handling and Disposal).
- Clean catch basins, storm drain inlets, and other conveyance structures in high pollutant load areas just before the wet season to remove sediments and debris accumulated during the summer.

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- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Record the amount of waste collected.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed of. Do not dewater near a storm drain or stream.
- Except for small communities with relatively few catch basins that may be cleaned manually, most municipalities will require mechanical cleaners such as eductors, vacuums, or bucket loaders.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect flushed effluent and pump to the sanitary sewer for treatment.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge from cleaning a storm drain pump station or other facility to reach the storm drain system.
- Conduct quarterly routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.
- Sample collected sediments to determine if landfill disposal is possible, or illegal discharges in the watershed are occurring.

Open Channel

- Consider modification of storm channel characteristics to improve channel hydraulics, to increase pollutant removals, and to enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies

(SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS

Illicit Connections and Discharges

- During routine maintenance of conveyance system and drainage structures field staff should look for evidence of illegal discharges or illicit connections:
  - Is there evidence of spills such as paints, discoloring, etc.
  - Are there any odors associated with the drainage system
  - Record locations of apparent illegal discharges/illicit connections
  - Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of up gradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
  - Once the origin of flow is established, require illicit discharger to eliminate the discharge.
- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

- The State Department of Fish and Game has a hotline for reporting violations called Cal TIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).

- The California Department of Toxic Substances Control's Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.

- Only properly trained individuals are allowed to handle hazardous materials/wastes.

- Train municipal employees from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report illegal dumping.

- Train municipal employees and educate businesses, contractors, and the general public in proper and consistent methods for disposal.

- Train municipal staff regarding non-stormwater discharges (See SC-10 Non-Stormwater Discharges).

Spill Response and Prevention

- Refer to SC-11, Prevention, Control & Cleanup

- Have spill cleanup materials readily available and in a known location.

- Cleanup spills immediately and use dry methods if possible.

- Properly dispose of spill cleanup material.

Other Considerations

- Cleanup activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.

- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and disposal of flushed effluent to sanitary sewer may be prohibited in some areas.

- Regulations may include adoption of substantial penalties for illegal dumping and disposal.

- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

- Private property access rights may be needed to track illegal discharges up gradient.

- Requirements of municipal ordinance authority for suspected source verification testing for illicit connections necessary for guaranteed rights of entry.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget. A careful study of cleaning effectiveness should be undertaken before increased cleaning is implemented. Catch basin cleaning costs are less expensive if vacuum street sweepers are available; cleaning catch basins manually can cost approximately twice as much as cleaning the basins with a vacuum attached to a sweeper.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary. Encouraging reporting of illicit discharges by employees can offset costs by saving expense on inspectors and directing resources more efficiently. Some programs have used funds available from “environmental fees” or special assessment districts to fund their illicit connection elimination programs.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.

- Identifying illicit discharges requires teams of at least two people (volunteers can be used), plus administrative personnel, depending on the complexity of the storm sewer system.

- Arrangements must be made for proper disposal of collected wastes.

- Requires technical staff to detect and investigate illegal dumping violations, and to coordinate public education.

Supplemental Information

Further Detail of the BMP

Storm Drain flushing

Sanitary sewer flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in sanitary sewer systems. The same principles that make sanitary sewer flushing effective can be used to flush storm drains. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as to an open channel, to another point where flushing will be initiated, or over to the sanitary sewer and on to the treatment facilities, thus preventing re-suspension and overflow of a portion of the solids during storm events. Flushing prevents “plug flow” discharges of concentrated pollutant loadings and sediments. The deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce the impacts of stormwater pollution, a second inflatable device, placed well downstream, may be used to re-collect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to re-collect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75 percent for organics and 55-65 percent for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm drain flushing.

Flow Management

Flow management has been one of the principal motivations for designing urban stream corridors in the past. Such needs may or may not be compatible with the stormwater quality goals in the stream corridor.

Downstream flood peaks can be suppressed by reducing through flow velocity. This can be accomplished by reducing gradient with grade control structures or increasing roughness with boulders, dense vegetation, or complex banks forms. Reducing velocity correspondingly increases flood height, so all such measures have a natural association with floodplain open space. Flood elevations laterally adjacent to the stream can be lowered by increasing through flow velocity.

However, increasing velocity increases flooding downstream and inherently conflicts with channel stability and human safety. Where topography permits, another way to lower flood elevation is to lower the level of the floodway with drop structures into a large but subtly excavated bowl where flood flows we allowed to spread out.

Stream Corridor Planning

Urban streams receive and convey stormwater flows from developed or developing watersheds. Planning of stream corridors thus interacts with urban stormwater management programs. If local programs are intended to control or protect downstream environments by managing flows delivered to the channels, then it is logical that such programs should be supplemented by management of the materials, forms, and uses of the downstream riparian corridor. Any proposal for steam alteration or management should be investigated for its potential flow and stability effects on upstream, downstream, and laterally adjacent areas. The timing and rate of flow from various tributaries can combine in complex ways to alter flood hazards. Each section of channel is unique, influenced by its own distribution of roughness elements, management activities, and stream responses.

Flexibility to adapt to stream features and behaviors as they evolve must be included in stream reclamation planning. The amenity and ecology of streams may be enhanced through the landscape design options of 1) corridor reservation, 2) bank treatment, 3) geomorphic restoration, and 4) grade control.

Corridor reservation - Reserving stream corridors and valleys to accommodate natural stream meandering, aggradation, degradation, and over bank flows allows streams to find their own form and generate less ongoing erosion. In California, open stream corridors in recent urban developments have produced recreational open space, irrigation of streamside plantings, and the aesthetic amenity of flowing water.

Bank treatment - The use of armoring, vegetative cover, and flow deflection may be used to influence a channel's form, stability, and biotic habitat. To prevent bank erosion, armoring can be done with rigid construction materials, such as concrete, masonry, wood planks and logs, riprap, and gabions. Concrete linings have been criticized because of their lack of provision of biotic habitat. In contrast, riprap and gabions make relatively porous and flexible linings. Boulders, placed in the bed reduce velocity and erosive power.

Riparian vegetation can stabilize the banks of streams that are at or near a condition of equilibrium. Binding networks of roots increase bank shear strength. During flood flows, resilient vegetation is forced into erosion-inhibiting mats. The roughness of vegetation leads to lower velocity, further reducing erosive effects. Structural flow deflection can protect banks from erosion or alter fish habitat. By concentrating flow, a deflector causes a pool to be scoured in the bed.

Geomorphic restoration – Restoration refers to alteration of disturbed streams so their form and behavior emulate those of undisturbed streams. Natural meanders are retained, with grading to gentle slopes on the inside of curves to allow point bars and riffle-pool sequences to develop. Trees are retained to provide scenic quality, biotic productivity, and roots for bank stabilization, supplemented by plantings where necessary.

A restorative approach can be successful where the stream is already approaching equilibrium. However, if upstream urbanization continues new flow regimes will be generated that could disrupt the equilibrium of the treated system.

Grade Control - A grade control structure is a level shelf of a permanent material, such as stone, masonry, or concrete, over which stream water flows. A grade control structure is called a sill, weir, or drop structure, depending on the relation of its invert elevation to upstream and downstream channels.

A sill is installed at the preexisting channel bed elevation to prevent upstream migration of nick points. It establishes a firm base level below which the upstream channel can not erode.

A weir or check dam is installed with invert above the preexisting bed elevation. A weir raises the local base level of the stream and causes aggradation upstream. The gradient, velocity, and erosive potential of the stream channel are reduced. A drop structure lowers the downstream invert below its preexisting elevation, reducing downstream gradient and velocity. Weirs and drop structure control erosion by dissipating energy and reducing slope velocity.

When carefully applied, grade control structures can be highly versatile in establishing human and environmental benefits in stabilized channels. To be successful, application of grade control structures should be guided by analysis of the stream system both upstream and downstream from the area to he reclaimed.

Examples

The California Department of Water Resources began the Urban Stream Restoration Program in 1985. The program provides grant funds to municipalities and community groups to implement stream restoration projects. The projects reduce damages from streambank aid watershed instability arid floods while restoring streams' aesthetic, recreational, and fish and wildlife values.

In Buena Vista Park, upper floodway slopes are gentle and grassed to achieve continuity of usable park land across the channel of small boulders at the base of the slopes.

The San Diego River is a large, vegetative lined channel, which was planted in a variety of species to support riparian wildlife while stabilizing the steep banks of the floodway.

References and Resources

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United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line: http://www.epa.gov/npdes/menuofbmps/poll_16.htm

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- ☑ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

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Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.

- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.

- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.

- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.

- Promote natural vegetation by using parking lot islands and other landscaped areas.

- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.

- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “ redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

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- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.

- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:

  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff

  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect

  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible

  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth

- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “ redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Storm Drain Signage — SD-13

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include “NO DUMPING

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– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

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Design Objectives

Maximize Infiltration

Provide Retention

Slow Runoff

Minimize Impervious Land Coverage

☑ Prohibit Dumping of Improper Materials

☑ Contain Pollutants

Collect and Convey

Description

Several measures can be taken to prevent operations at maintenance bays and loading docks from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the stormwater conveyance system.

Approach

In designs for maintenance bays and loading docks, containment is encouraged. Preventative measures include overflow containment structures and dead-end sumps. However, in the case of loading docks from grocery stores and warehouse/distribution centers, engineered infiltration systems may be considered.

Suitable Applications

Appropriate applications include commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for vehicle maintenance and repair are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code requirements.

Designing New Installations

Designs of maintenance bays should consider the following:

- Repair/maintenance bays and vehicle parts with fluids should be indoors; or designed to preclude urban run-on and runoff.
- Repair/maintenance floor areas should be paved with Portland cement concrete (or equivalent smooth impervious surface).

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- Repair/maintenance bays should be designed to capture all wash water leaks and spills. Provide impermeable berms, drop inlets, trench catch basins, or overflow containment structures around repair bays to prevent spilled materials and wash-down waters form entering the storm drain system. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.

- Other features may be comparable and equally effective.

The following designs of loading/unloading dock areas should be considered:

- Loading dock areas should be covered, or drainage should be designed to preclude urban run-on and runoff.

- Direct connections into storm drains from depressed loading docks (truck wells) are prohibited.

- Below-grade loading docks from grocery stores and warehouse/distribution centers of fresh food items should drain through water quality inlets, or to an engineered infiltration system, or an equally effective alternative. Pre-treatment may also be required.

- Other features may be comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

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Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.

- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

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- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

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Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Design Considerations

- Soil for Infiltration
- Slope
- Aesthetics

Targeted Constituents

☑	Sediment	■
☑	Nutrients	■
☑	Trash	■
☑	Metals	■
☑	Bacteria	■
☑	Oil and Grease	■
☑	Organics	■

Legend ***(Removal Effectiveness)***

- ● Low
- ■ High
- ▲ Medium

Description

An infiltration basin is a shallow impoundment that is designed to infiltrate stormwater. Infiltration basins use the natural filtering ability of the soil to remove pollutants in stormwater runoff. Infiltration facilities store runoff until it gradually exfiltrates through the soil and eventually into the water table. This practice has high pollutant removal efficiency and can also help recharge groundwater, thus helping to maintain low flows in stream systems. Infiltration basins can be challenging to apply on many sites, however, because of soils requirements. In addition, some studies have shown relatively high failure rates compared with other management practices.

California Experience

Infiltration basins have a long history of use in California, especially in the Central Valley. Basins located in Fresno were among those initially evaluated in the National Urban Runoff Program and were found to be effective at reducing the volume of runoff, while posing little long-term threat to groundwater quality (EPA, 1983; Schroeder, 1995). Proper siting of these devices is crucial as underscored by the experience of Caltrans in siting two basins in Southern California. The basin with marginal separation from groundwater and soil permeability failed immediately and could never be rehabilitated.

Advantages

- Provides 100% reduction in the load discharged to surface waters.
- The principal benefit of infiltration basins is the approximation of pre-development hydrology during which a

significant portion of the average annual rainfall runoff is infiltrated and evaporated rather than flushed directly to creeks.

- If the water quality volume is adequately sized, infiltration basins can be useful for providing control of channel forming (erosion) and high frequency (generally less than the 2-year) flood events.

Limitations

- May not be appropriate for industrial sites or locations where spills may occur.
- Infiltration basins require a minimum soil infiltration rate of 0.5 inches/hour, not appropriate at sites with Hydrologic Soil Types C and D.
- If infiltration rates exceed 2.4 inches/hour, then the runoff should be fully treated prior to infiltration to protect groundwater quality.
- Not suitable on fill sites or steep slopes.
- Risk of groundwater contamination in very coarse soils.
- Upstream drainage area must be completely stabilized before construction.
- Difficult to restore functioning of infiltration basins once clogged.

Design and Sizing Guidelines

- Water quality volume determined by local requirements or sized so that 85% of the annual runoff volume is captured.
- Basin sized so that the entire water quality volume is infiltrated within 48 hours.
- Vegetation establishment on the basin floor may help reduce the clogging rate.

Construction/Inspection Considerations

- Before construction begins, stabilize the entire area draining to the facility. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction or remove the top 2 inches of soil after the site is stabililized. Stabilize the entire contributing drainage area, including the side slopes, before allowing any runoff to enter once construction is complete.
- Place excavated material such that it can not be washed back into the basin if a storm occurs during construction of the facility.
- Build the basin without driving heavy equipment over the infiltration surface. Any equipment driven on the surface should have extra-wide ("low pressure") tires. Prior to any construction, rope off the infiltration area to stop entrance by unwanted equipment.
- After final grading, till the infiltration surface deeply.
- Use appropriate erosion control seed mix for the specific project and location.

Performance

As water migrates through porous soil and rock, pollutant attenuation mechanisms include precipitation, sorption, physical filtration, and bacterial degradation. If functioning properly, this approach is presumed to have high removal efficiencies for particulate pollutants and moderate removal of soluble pollutants. Actual pollutant removal in the subsurface would be expected to vary depending upon site-specific soil types. This technology eliminates discharge to surface waters except for the very largest storms; consequently, complete removal of all stormwater constituents can be assumed.

There remain some concerns about the potential for groundwater contamination despite the findings of the NURP and Nightingale (1975; 1987a,b,c; 1989). For instance, a report by Pitt et al. (1994) highlighted the potential for groundwater contamination from intentional and unintentional stormwater infiltration. That report recommends that infiltration facilities not be sited in areas where high concentrations are present or where there is a potential for spills of toxic material. Conversely, Schroeder (1995) reported that there was no evidence of groundwater impacts from an infiltration basin serving a large industrial catchment in Fresno, CA.

Siting Criteria

The key element in siting infiltration basins is identifying sites with appropriate soil and hydrogeologic properties, which is critical for long term performance. In one study conducted in Prince George's County, Maryland (Galli, 1992), all of the infiltration basins investigated clogged within 2 years. It is believed that these failures were for the most part due to allowing infiltration at sites with rates of less than 0.5 in/hr, basing siting on soil type rather than field infiltration tests, and poor construction practices that resulted in soil compaction of the basin invert.

A study of 23 infiltration basins in the Pacific Northwest showed better long-term performance in an area with highly permeable soils (Hilding, 1996). In this study, few of the infiltration basins had failed after 10 years. Consequently, the following guidelines for identifying appropriate soil and subsurface conditions should be rigorously adhered to.

- Determine soil type (consider RCS soil type 'A, B or C' only) from mapping and consult USDA soil survey tables to review other parameters such as the amount of silt and clay, presence of a restrictive layer or seasonal high water table, and estimated permeability. The soil should not have more than 30% clay or more than 40% of clay and silt combined. Eliminate sites that are clearly unsuitable for infiltration.

- Groundwater separation should be at least 3 m from the basin invert to the measured ground water elevation. There is concern at the state and regional levels of the impact on groundwater quality from infiltrated runoff, especially when the separation between groundwater and the surface is small.

- Location away from buildings, slopes and highway pavement (greater than 6 m) and wells and bridge structures (greater than 30 m). Sites constructed of fill, having a base flow or with a slope greater than 15% should not be considered.

- Ensure that adequate head is available to operate flow splitter structures (to allow the basin to be offline) without ponding in the splitter structure or creating backwater upstream of the splitter.

- Base flow should not be present in the tributary watershed.

Secondary Screening Based on Site Geotechnical Investigation

- At least three in-hole conductivity tests shall be performed using USBR 7300-89 or Bouwer-Rice procedures (the latter if groundwater is encountered within the boring), two tests at different locations within the proposed basin and the third down gradient by no more than approximately 10 m. The tests shall measure permeability in the side slopes and the bed within a depth of 3 m of the invert.

- The minimum acceptable hydraulic conductivity as measured in any of the three required test holes is 13 mm/hr. If any test hole shows less than the minimum value, the site should be disqualified from further consideration.

- Exclude from consideration sites constructed in fill or partially in fill unless no silts or clays are present in the soil boring. Fill tends to be compacted, with clays in a dispersed rather than flocculated state, greatly reducing permeability.

- The geotechnical investigation should be such that a good understanding is gained as to how the stormwater runoff will move in the soil (horizontally or vertically) and if there are any geological conditions that could inhibit the movement of water.

Additional Design Guidelines

(1) Basin Sizing - The required water quality volume is determined by local regulations or sufficient to capture 85% of the annual runoff.

(2) Provide pretreatment if sediment loading is a maintenance concern for the basin.

(3) Include energy dissipation in the inlet design for the basins. Avoid designs that include a permanent pool to reduce opportunity for standing water and associated vector problems.

(4) Basin invert area should be determined by the equation:

$$A = \frac{WQV}{kt}$$

where A = Basin invert area (m^2)

WQV = water quality volume (m^3)

k = 0.5 times the lowest field-measured hydraulic conductivity (m/hr)

t = drawdown time (48 hr)

(5) The use of vertical piping, either for distribution or infiltration enhancement shall not be allowed to avoid device classification as a Class V injection well per 40 CFR146.5(e)(4).

Maintenance

Regular maintenance is critical to the successful operation of infiltration basins. Recommended operation and maintenance guidelines include:

- Inspections and maintenance to ensure that water infiltrates into the subsurface completely (recommended infiltration rate of 72 hours or less) and that vegetation is carefully managed to prevent creating mosquito and other vector habitats.
- Observe drain time for the design storm after completion or modification of the facility to confirm that the desired drain time has been obtained.
- Schedule semiannual inspections for beginning and end of the wet season to identify potential problems such as erosion of the basin side slopes and invert, standing water, trash and debris, and sediment accumulation.
- Remove accumulated trash and debris in the basin at the start and end of the wet season.
- Inspect for standing water at the end of the wet season.
- Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and regrade when the accumulated sediment volume exceeds 10% of the basin.
- If erosion is occurring within the basin, revegetate immediately and stabilize with an erosion control mulch or mat until vegetation cover is established.
- To avoid reversing soil development, scarification or other disturbance should only be performed when there are actual signs of clogging, rather than on a routine basis. Always remove deposited sediments before scarification, and use a hand-guided rotary tiller, if possible, or a disc harrow pulled by a very light tractor.

Cost

Infiltration basins are relatively cost-effective practices because little infrastructure is needed when constructing them. One study estimated the total construction cost at about $2 per ft (adjusted for inflation) of storage for a 0.25-acre basin (SWRPC, 1991). As with other BMPs, these published cost estimates may deviate greatly from what might be incurred at a specific site. For instance, Caltrans spent about $\$18/ft^3$ for the two infiltration basins constructed in southern California, each of which had a water quality volume of about 0.34 ac.-ft. Much of the higher cost can be attributed to changes in the storm drain system necessary to route the runoff to the basin locations.

Infiltration basins typically consume about 2 to 3% of the site draining to them, which is relatively small. Additional space may be required for buffer, landscaping, access road, and fencing. Maintenance costs are estimated at 5 to 10% of construction costs.

One cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly maintained, infiltration basins have a high failure rate. Thus, it may be necessary to replace the basin with a different technology after a relatively short period of time.

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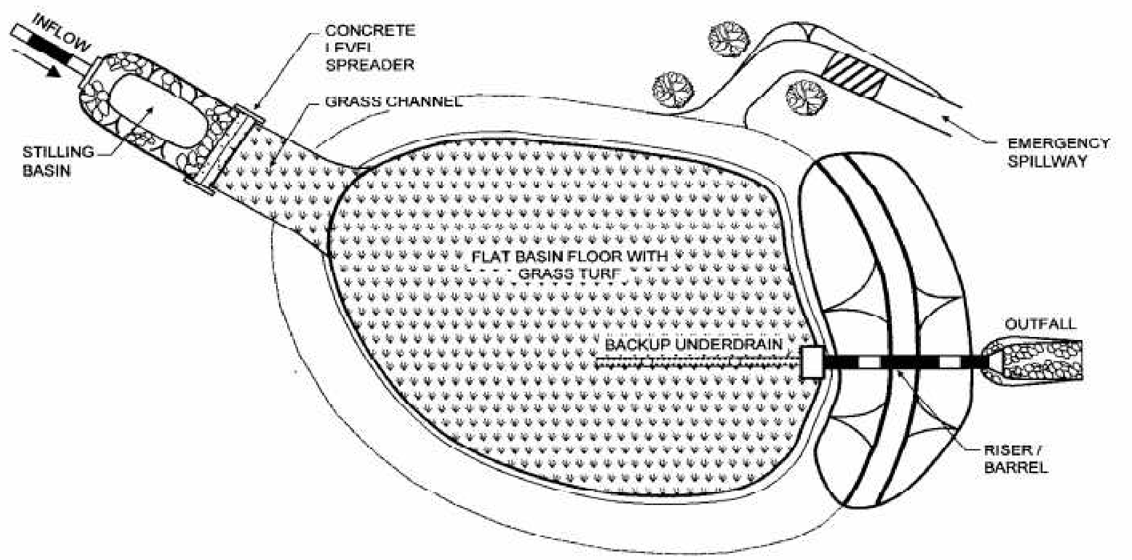
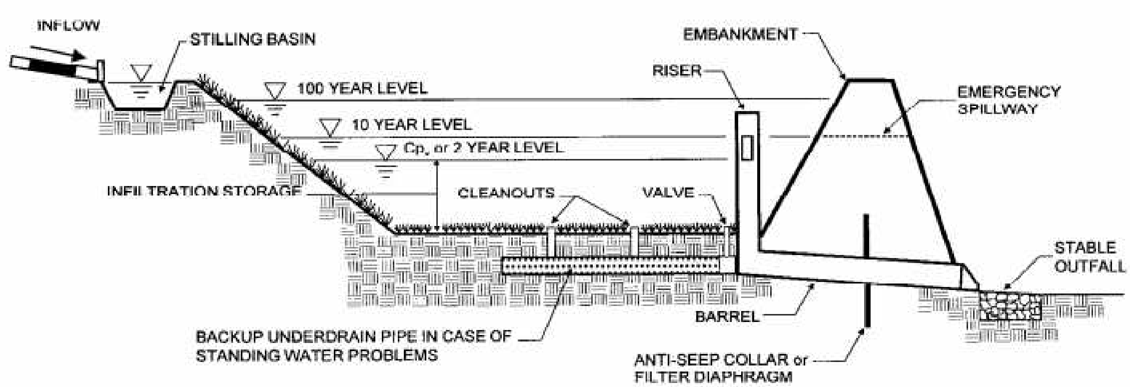


PLAN VIEW



PROFILE

Description

Drain inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris. There are a multitude of inserts of various shapes and configurations, typically falling into one of three different groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are one box; that is, the setting area and filtration through media occur in the same box. Some products consist of one or more trays or mesh grates. The trays may hold different types of media. Filtration media vary by manufacturer. Types include polypropylene, porous polymer, treated cellulose, and activated carbon.

California Experience

The number of installations is unknown but likely exceeds a thousand. Some users have reported that these systems require considerable maintenance to prevent plugging and bypass.

Advantages

- Does not require additional space as inserts as the drain inlets are already a component of the standard drainage systems.
- Easy access for inspection and maintenance.
- As there is no standing water, there is little concern for mosquito breeding.
- A relatively inexpensive retrofit option.

Limitations

Performance is likely significantly less than treatment systems that are located at the end of the drainage system such as ponds and vaults. Usually not suitable for large areas or areas with trash or leaves than can plug the insert.

Design and Sizing Guidelines

Refer to manufacturer's guidelines. Drain inserts come any many configurations but can be placed into three general groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are

Design Considerations

- Use with other BMPs
- Fit and Seal Capacity within Inlet

Targeted Constituents

- ☑ Sediment
- ☑ Nutrients
- ☑ Trash
- ☑ Metals
- Bacteria
- ☑ Oil and Grease
- ☑ Organics

Removal Effectiveness

See New Development and Redevelopment Handbook-Section 5.

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one box; that is, the setting area and filtration through media occurs in the same box. One manufacturer has a double-box. Stormwater enters the first box where setting occurs. The stormwater flows into the second box where the filter media is located. Some products consist of one or more trays or mesh grates. The trays can hold different types of media. Filtration media vary with the manufacturer: types include polypropylene, porous polymer, treated cellulose, and activated carbon.

Construction/Inspection Considerations

Be certain that installation is done in a manner that makes certain that the stormwater enters the unit and does not leak around the perimeter. Leakage between the frame of the insert and the frame of the drain inlet can easily occur with vertical (drop) inlets.

Performance

Few products have performance data collected under field conditions.

Siting Criteria

It is recommended that inserts be used only for retrofit situations or as pretreatment where other treatment BMPs presented in this section area used.

Additional Design Guidelines

Follow guidelines provided by individual manufacturers.

Maintenance

Likely require frequent maintenance, on the order of several times per year.

Cost

- The initial cost of individual inserts ranges from less than $100 to about $2,000. The cost of using multiple units in curb inlet drains varies with the size of the inlet.

- The low cost of inserts may tend to favor the use of these systems over other, more effective treatment BMPs. However, the low cost of each unit may be offset by the number of units that are required, more frequent maintenance, and the shorter structural life (and therefore replacement).

References and Sources of Additional Information

Hrachovec, R., and G. Minton, 2001, Field testing of a sock-type catch basin insert, Planet CPR, Seattle, Washington

Interagency Catch Basin Insert Committee, Evaluation of Commercially-Available Catch Basin Inserts for the Treatment of Stormwater Runoff from Developed Sites, 1995

Larry Walker Associates, June 1998, NDMP Inlet/In-Line Control Measure Study Report

Manufacturers literature

Santa Monica (City), Santa Monica Bay Municipal Stormwater/Urban Runoff Project - Evaluation of Potential Catch basin Retrofits, Woodward Clyde, September 24, 1998

Woodward Clyde, June 11, 1996, Parking Lot Monitoring Report, Santa Clara Valley Nonpoint Source Pollution Control Program.

Round Curb Inlet Filter (R-GISB)

PROVEN STORMWATER TREATMENT TECHNOLOGY

Bio Clean

A Forterra Company

Overview

The Bio Clean Round Curb Inlet Filter (R-GISB) is a favorite amongst cities and municipalities nationwide. Many agencies have chosen this system as their standard due to its quick cleaning time and large storage capacity.

Its patented 'Shelf System' allows cleaning to be done in less than 15 minutes, and its larger storage capacity of 3.85 cubic feet allows for maximized cleaning intervals and minimized attention required by maintenance crews.

The modularized design of the 'Shelf System' for curb inlets makes it adaptable to any size or type catch basin.

Its multi-stage filtration screens allow this device to meet "full trash capture" requirements by removing 100% of trash & debris 5 mm and greater. Made of marine grade fiberglass and high grade stainless steel these filters come in standard and custom designs.

This filtration system addresses a wide array of pollutants including trash and debris, sediments, TSS, nutrients, metals, and hydrocarbons.

www.BioCleanEnvironmental.com

Includes the Patented 'Shelf System'

Higher Storage Capacity & 15 Minute Service Time

Advantages

- 8 Year Warranty
- Works in Any Size Catch Basin
- No Nets or Geofabrics
- 15+ Year User Life
- Meets **LEED** Requirements
- Patented Shelf System
- Fiberglass Construction

Performance

- 74%-86% Removal of TSS
- 54% Removal of Oils & Grease
- 57%-71% Removal of Phosphorus
- 56%-60% Removal of Nitrogen

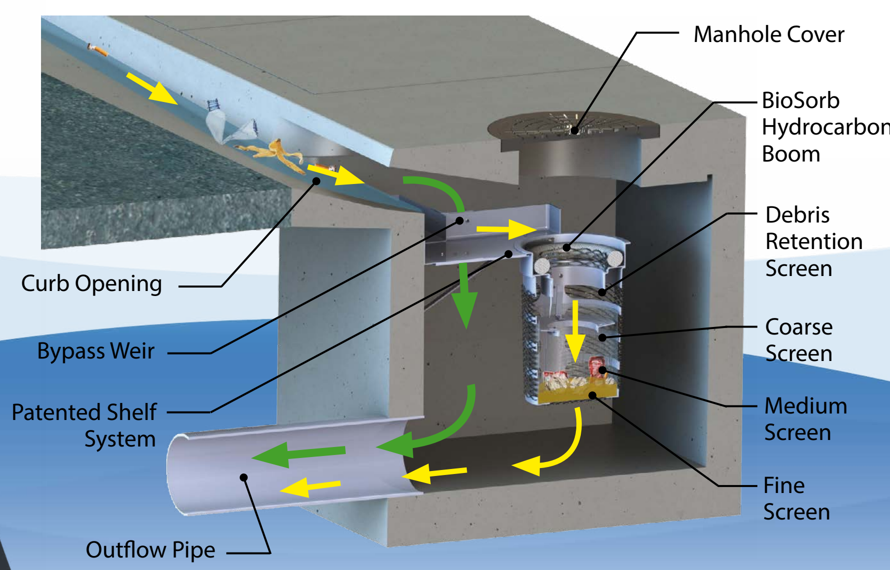
Specifications

Model #	Treatment Flow (CFS)	Bypass Flow (CFS)
BC-RGISB-22-24	2.4	Unlimited

Operation

Bypass Flow Path

Treatment Flow Path



Round Curb Inlet Filter (R-GISB)

PROVEN STORMWATER TREATMENT TECHNOLOGY

Media Filter

The Bio Clean Round Curb Inlet Media Filter (RGISB-MF) is an advanced level filtration device designed with a multi-layered media filter for increased removal efficiencies.

Performance

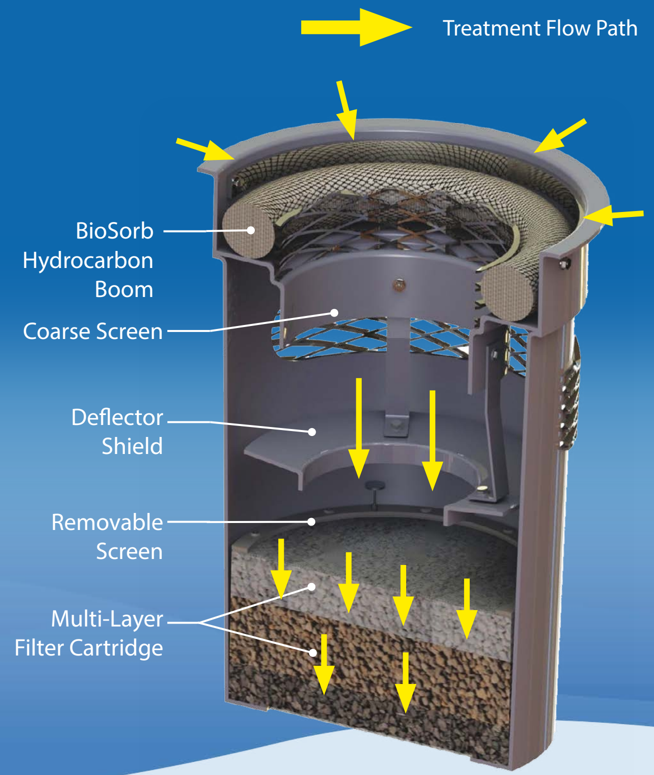
- 85% Removal of Fine TSS
- 69% Removal of Dissolved Phosphorus
- 95% Removal of Copper
- 87% Removal of Lead
- 95% Removal of Zinc
- 90% to 95% Removal of Oils & Grease
- 68% Removal of Fecal Coliform (bacteria)

Specifications

Model #	Media Treatment Flow (CFS)	Screen Treatment Flow (CFS)	Bypass Flow (CFS)
BC-RGISB-MF-22-24	0.12	2	Unlimited

Higher Flow Rate Models Available

Operation



Installation & Maintenance

- Cleaned Without Catch Basin Entry ✔
- Cleaned Easily With Vac Truck ✔
- 15 Minute Service Time ✔

Application

- Parking Lots
- Roadways

Easily Removed without Entry into Basin

Always Positioned Under Manhole Opening

Approvals

City and County of Honolulu

County of San Diego

County of Orange

Meets Full Capture Requirements

398 Via El Centro
Oceanside, CA 92058
p 760.433.7640 f 760.433.3176
www.BioCleanEnvironmental.com

Bio Clean
A Forterra Company

APPENDIX G

OTHER SUPPORT DOCUMENTATION

NOAA Atlas 14, Volume 6, Version 2
Location name: Colton, California, USA*
Latitude: 34.0541°, Longitude: -117.3017°
Elevation: 960.2 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.096 (0.080-0.117)	0.125 (0.104-0.152)	0.162 (0.135-0.197)	0.193 (0.159-0.237)	0.235 (0.187-0.298)	0.267 (0.208-0.347)	0.301 (0.228-0.400)	0.335 (0.247-0.460)	0.382 (0.270-0.547)	0.419 (0.286-0.621)
10-min	0.138 (0.115-0.168)	0.179 (0.149-0.217)	0.232 (0.193-0.283)	0.276 (0.227-0.339)	0.337 (0.268-0.428)	0.383 (0.298-0.498)	0.431 (0.327-0.574)	0.480 (0.354-0.659)	0.548 (0.387-0.784)	0.601 (0.409-0.891)
15-min	0.167 (0.139-0.203)	0.216 (0.180-0.263)	0.281 (0.233-0.342)	0.334 (0.275-0.410)	0.407 (0.324-0.517)	0.463 (0.360-0.602)	0.521 (0.395-0.694)	0.581 (0.428-0.797)	0.663 (0.468-0.948)	0.727 (0.495-1.08)
30-min	0.252 (0.210-0.305)	0.326 (0.271-0.395)	0.423 (0.351-0.515)	0.503 (0.414-0.618)	0.612 (0.487-0.778)	0.697 (0.542-0.906)	0.784 (0.595-1.04)	0.874 (0.644-1.20)	0.997 (0.704-1.43)	1.09 (0.745-1.62)
60-min	0.366 (0.305-0.444)	0.474 (0.394-0.575)	0.616 (0.511-0.750)	0.732 (0.602-0.899)	0.892 (0.709-1.13)	1.01 (0.790-1.32)	1.14 (0.866-1.52)	1.27 (0.938-1.75)	1.45 (1.02-2.08)	1.59 (1.09-2.36)
2-hr	0.524 (0.437-0.635)	0.672 (0.559-0.815)	0.866 (0.718-1.05)	1.02 (0.843-1.26)	1.24 (0.988-1.58)	1.41 (1.10-1.83)	1.58 (1.20-2.11)	1.76 (1.30-2.41)	2.00 (1.41-2.87)	2.19 (1.49-3.25)
3-hr	0.644 (0.537-0.781)	0.823 (0.685-0.999)	1.06 (0.878-1.29)	1.25 (1.03-1.54)	1.51 (1.20-1.92)	1.72 (1.34-2.23)	1.92 (1.46-2.56)	2.14 (1.58-2.93)	2.43 (1.72-3.48)	2.66 (1.81-3.94)
6-hr	0.897 (0.747-1.09)	1.14 (0.951-1.39)	1.47 (1.22-1.79)	1.73 (1.43-2.13)	2.09 (1.66-2.66)	2.37 (1.84-3.08)	2.65 (2.01-3.53)	2.94 (2.17-4.04)	3.34 (2.36-4.78)	3.65 (2.49-5.41)
12-hr	1.19 (0.989-1.44)	1.52 (1.26-1.84)	1.95 (1.62-2.37)	2.30 (1.89-2.82)	2.78 (2.21-3.53)	3.14 (2.44-4.08)	3.52 (2.67-4.68)	3.90 (2.87-5.34)	4.42 (3.12-6.32)	4.82 (3.28-7.14)
24-hr	1.58 (1.40-1.82)	2.03 (1.80-2.35)	2.62 (2.32-3.04)	3.11 (2.72-3.62)	3.76 (3.18-4.52)	4.25 (3.53-5.23)	4.76 (3.85-5.99)	5.27 (4.16-6.83)	5.97 (4.52-8.05)	6.51 (4.76-9.08)
2-day	1.91 (1.69-2.20)	2.50 (2.21-2.89)	3.28 (2.89-3.79)	3.91 (3.42-4.56)	4.76 (4.04-5.74)	5.43 (4.50-6.67)	6.10 (4.94-7.68)	6.79 (5.35-8.79)	7.73 (5.85-10.4)	8.46 (6.19-11.8)
3-day	2.04 (1.80-2.35)	2.71 (2.40-3.13)	3.60 (3.18-4.17)	4.33 (3.79-5.05)	5.34 (4.52-6.43)	6.12 (5.08-7.52)	6.92 (5.60-8.71)	7.75 (6.11-10.0)	8.88 (6.72-12.0)	9.77 (7.15-13.6)
4-day	2.17 (1.93-2.51)	2.92 (2.58-3.37)	3.92 (3.46-4.53)	4.74 (4.15-5.53)	5.87 (4.97-7.08)	6.76 (5.61-8.31)	7.67 (6.21-9.66)	8.62 (6.79-11.2)	9.92 (7.51-13.4)	11.0 (8.01-15.3)
7-day	2.50 (2.22-2.89)	3.40 (3.01-3.92)	4.60 (4.05-5.32)	5.59 (4.89-6.52)	6.96 (5.89-8.38)	8.03 (6.66-9.88)	9.14 (7.40-11.5)	10.3 (8.11-13.3)	11.9 (9.00-16.0)	13.2 (9.62-18.3)
10-day	2.72 (2.41-3.13)	3.72 (3.29-4.29)	5.05 (4.45-5.84)	6.16 (5.39-7.19)	7.70 (6.52-9.28)	8.91 (7.39-11.0)	10.2 (8.23-12.8)	11.5 (9.03-14.8)	13.3 (10.0-17.9)	14.7 (10.8-20.5)
20-day	3.31 (2.93-3.81)	4.57 (4.04-5.27)	6.26 (5.52-7.25)	7.68 (6.72-8.96)	9.66 (8.18-11.6)	11.2 (9.32-13.8)	12.9 (10.4-16.2)	14.6 (11.5-18.9)	17.0 (12.8-22.9)	18.8 (13.8-26.3)
30-day	3.92 (3.47-4.52)	5.42 (4.80-6.26)	7.46 (6.58-8.63)	9.17 (8.02-10.7)	11.6 (9.80-13.9)	13.5 (11.2-16.6)	15.5 (12.5-19.5)	17.5 (13.8-22.7)	20.5 (15.5-27.6)	22.8 (16.7-31.8)
45-day	4.69 (4.16-5.41)	6.47 (5.72-7.47)	8.89 (7.84-10.3)	10.9 (9.56-12.8)	13.8 (11.7-16.6)	16.1 (13.4-19.8)	18.5 (15.0-23.3)	21.0 (16.6-27.2)	24.6 (18.6-33.2)	27.5 (20.1-38.3)
60-day	5.48 (4.85-6.32)	7.51 (6.65-8.67)	10.3 (9.07-11.9)	12.6 (11.0-14.7)	15.9 (13.5-19.2)	18.6 (15.4-22.8)	21.3 (17.3-26.8)	24.3 (19.1-31.4)	28.4 (21.5-38.3)	31.7 (23.2-44.2)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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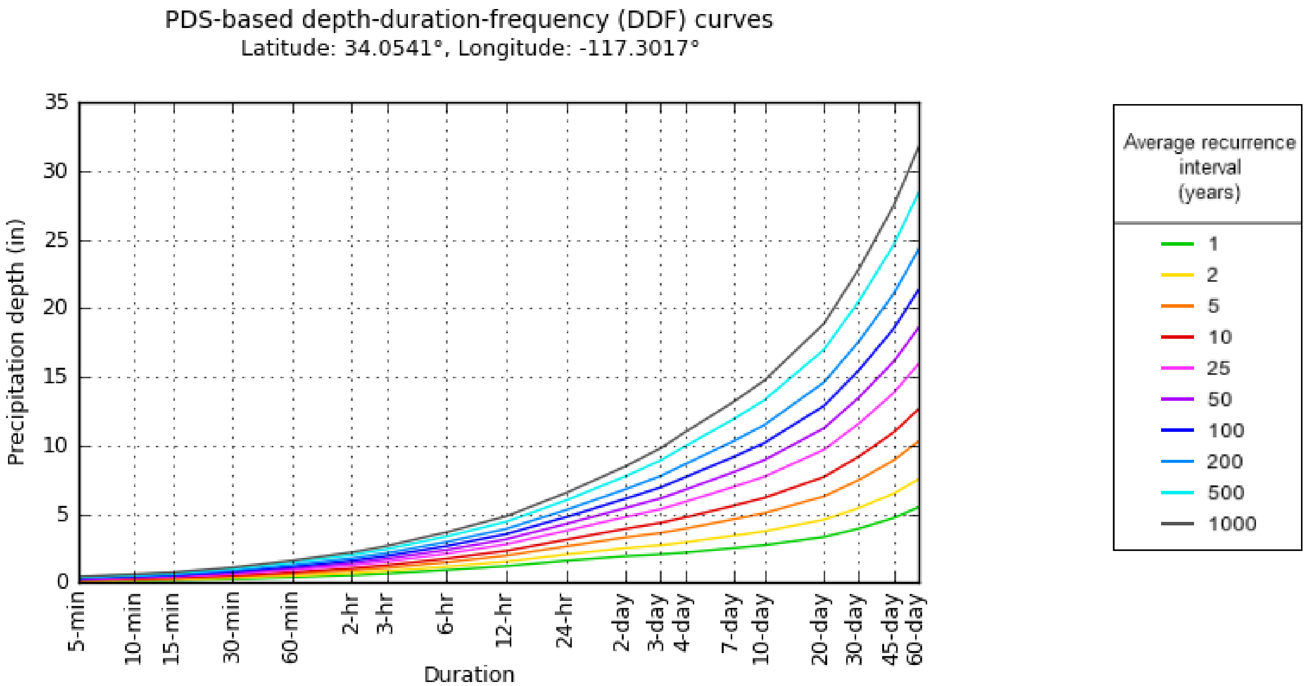
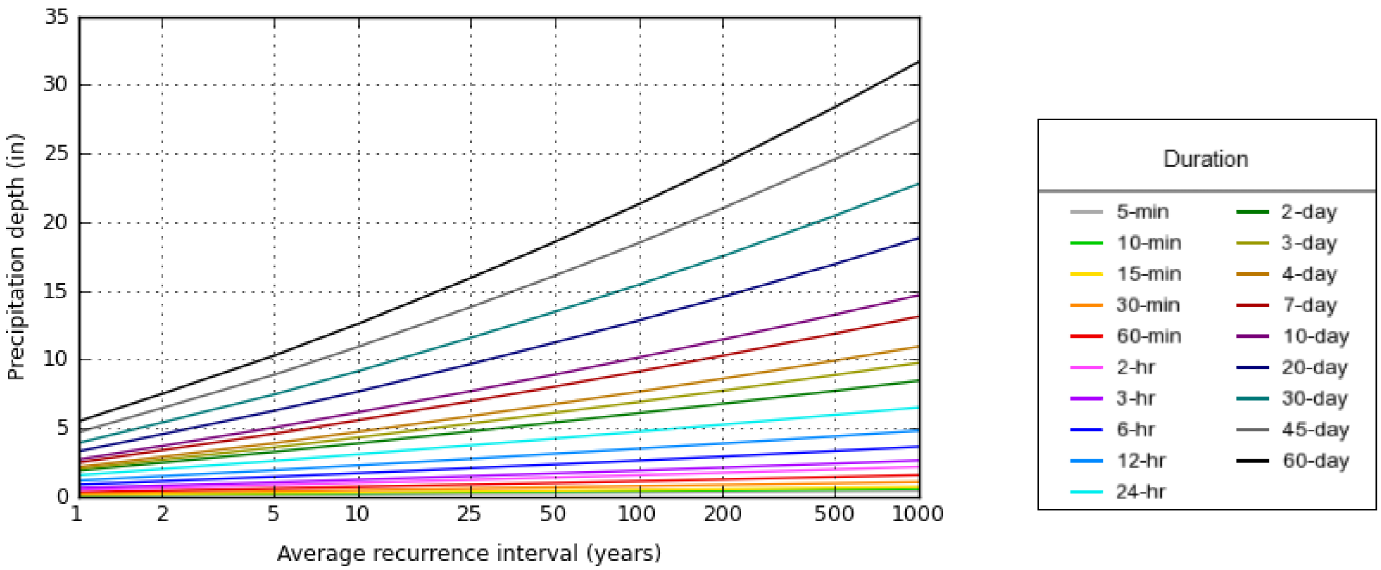
PF graphical





NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Tue Jul 24 00:29:29 2018

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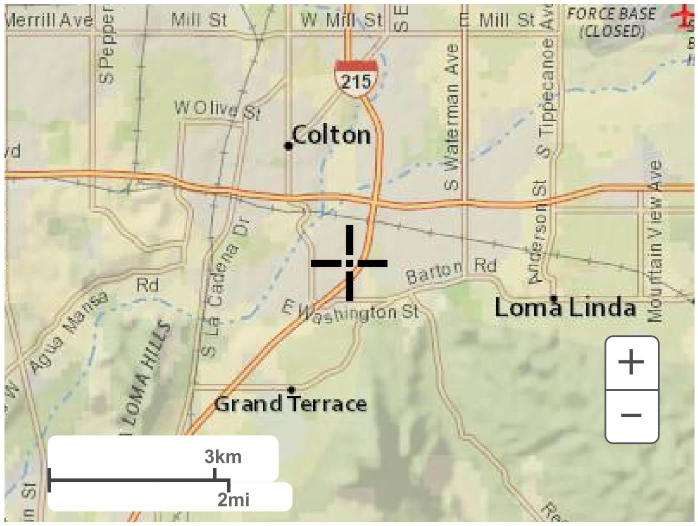
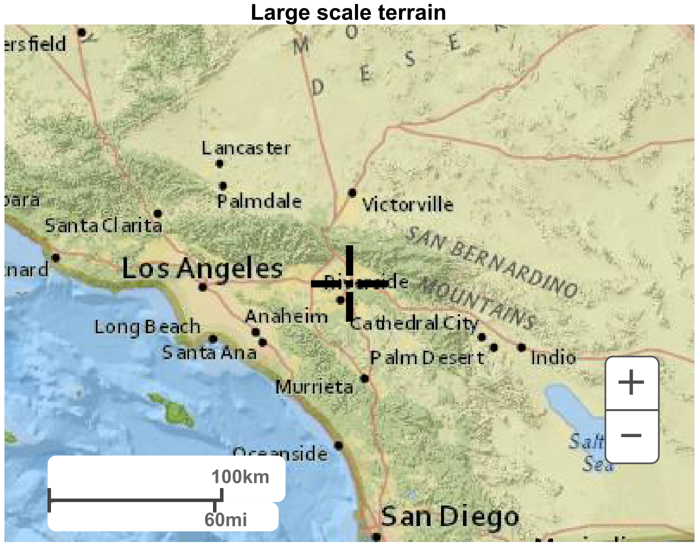
Maps & aerials

Small scale terrain

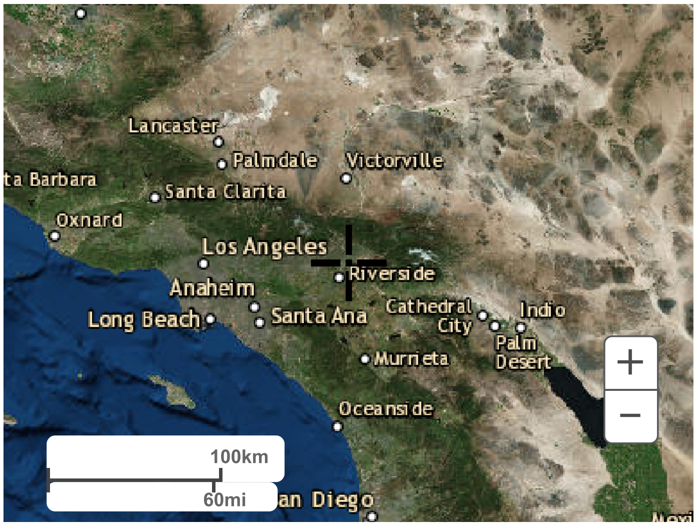


Large scale terrain



Large scale map

Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

WQMP Project Report

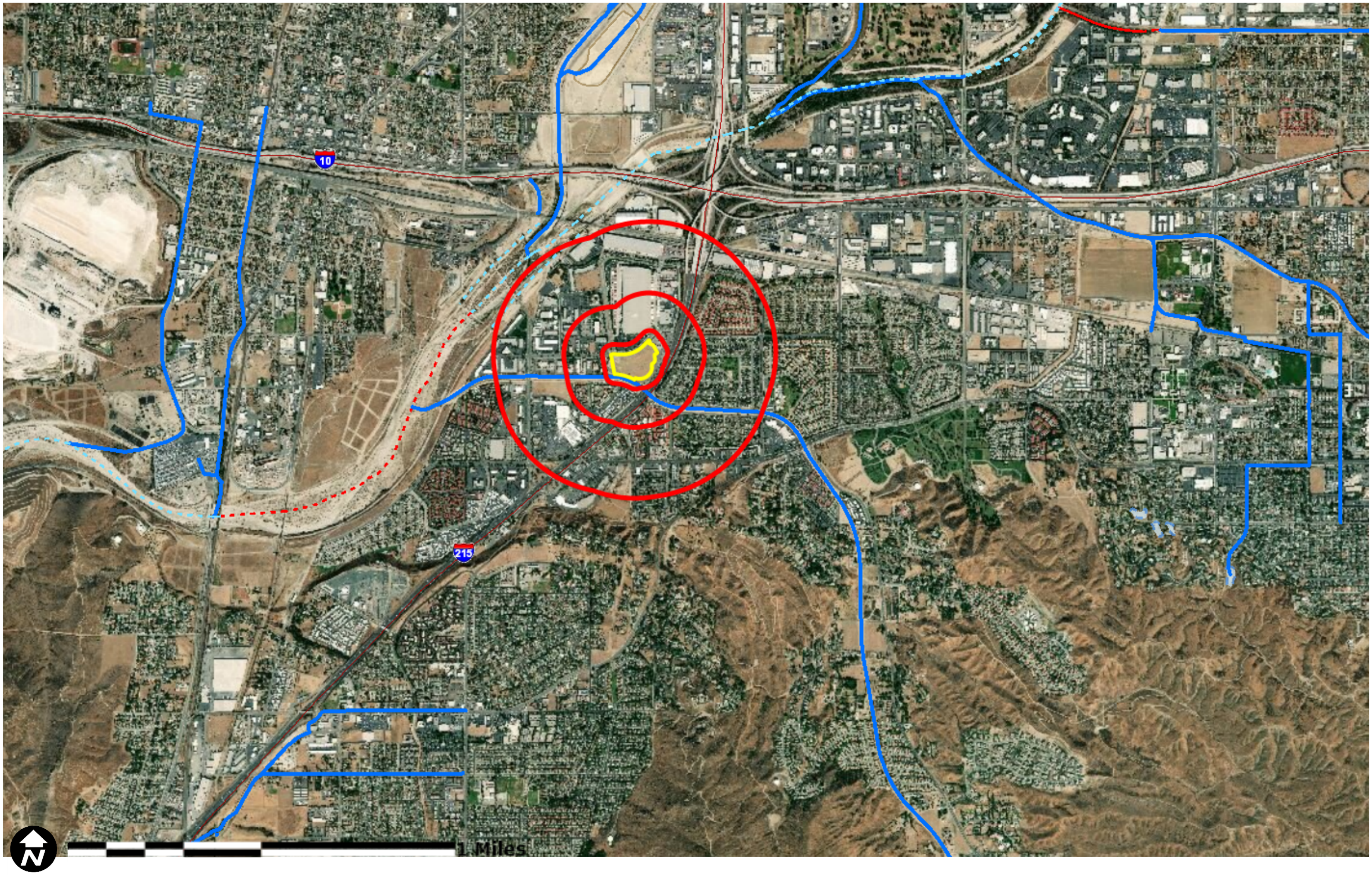
County of San Bernardino Stormwater Program

Santa Ana River Watershed Geodatabase

Monday, July 23, 2018

Note: The information provided in this report and on the Stormwater Geodatabase for the County of San Bernardino Stormwater Program is intended to provide basic guidance in the preparation of the applicant's Water Quality Management Plan (WQMP) and should not be relied upon without independent verification.

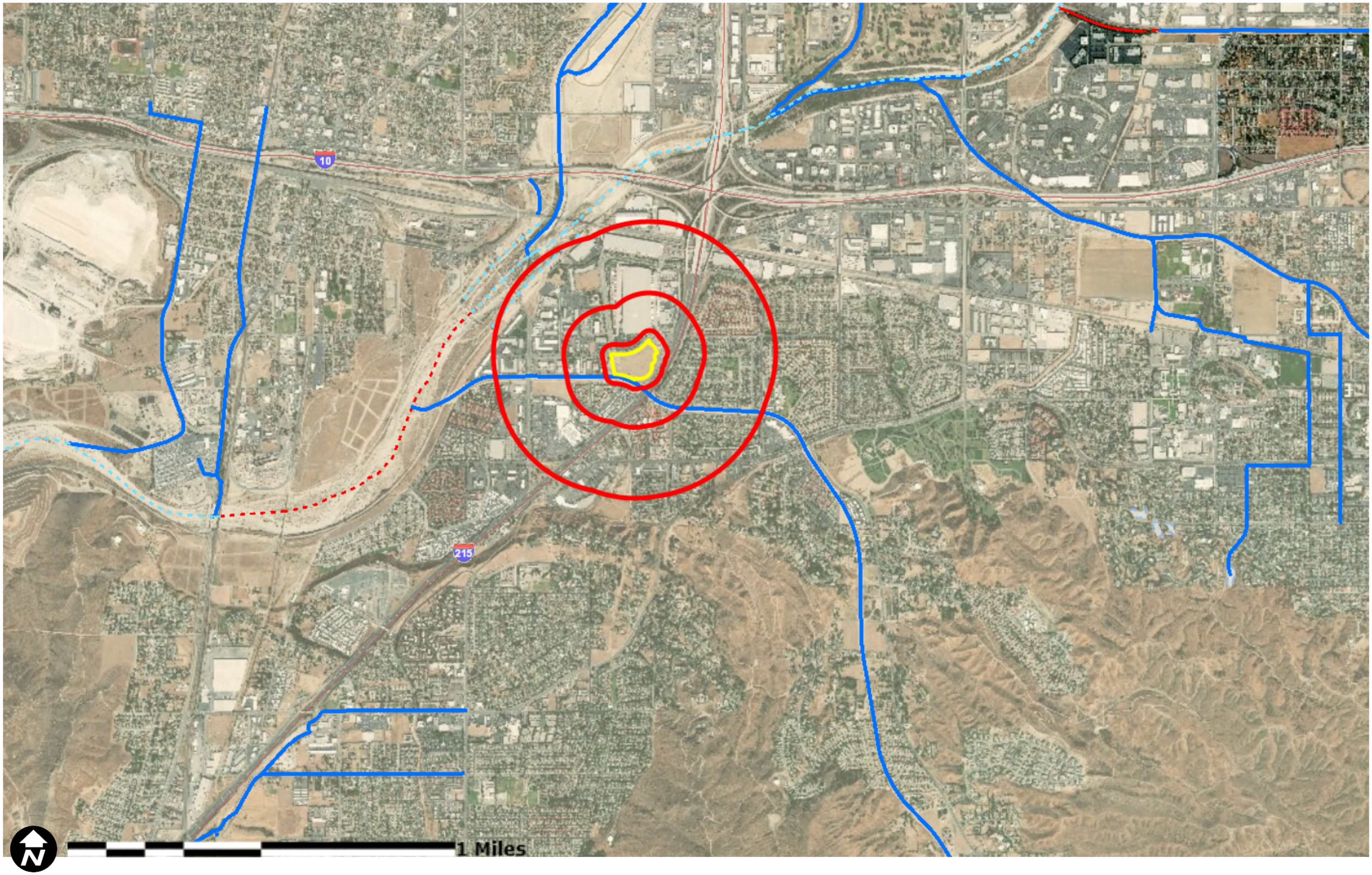
Project Site Parcel Number(s):	027614453, 027614452, 027614448, 027614449
Project Site Acreage:	11.018
HCOC Exempt Area:	Yes. Verify that the project is completely with the HCOC exemption area.
Closest Receiving Waters: (Applicant to verify based on local drainage facilities and topography.)	**System Number** - 702 **Facility Name** - Reche Canyon Creek **Owner** - SBCFCD
Closest channel segment's susceptibility to Hydromodification:	EHM
Highest downstream hydromodification susceptibility:	High
Is this drainage segment subject to TMDLs?	No
Are there downstream drainage segments subject to TMDLs?	No
Is this drainage segment a 303d listed stream?	No
Are there 303d listed streams downstream?	Yes
Are there unlined downstream waterbodies?	No
Project Site Onsite Soil Group(s):	B
Environmentally Sensitive Areas within 200':	None
Groundwater Depth (FT):	-117
Parcels with potential septic tanks within 1000':	No
Known Groundwater Contamination Plumes within 1000':	No
Studies and Reports Related to Project Site:	CSDP No. 7 Storm Drain Systems CSDP No. 7 Storm Drain Systems CSDP No. 7 Storm Drain Systems CSDP No. 7 Storm Drain Hydraulic Design Data SBVMWD High Groundwater / Pressure Zone Area



Site Address: permitrack.sbcounty.gov/wap

County of San Bernardino
Stormwater Facility Mapping

Ashley Stormwater



County of San Bernardino
Stormwater Facility Mapping

Ashley Stormwater

Site Address: permitrack.sbcounty.gov/wap

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