

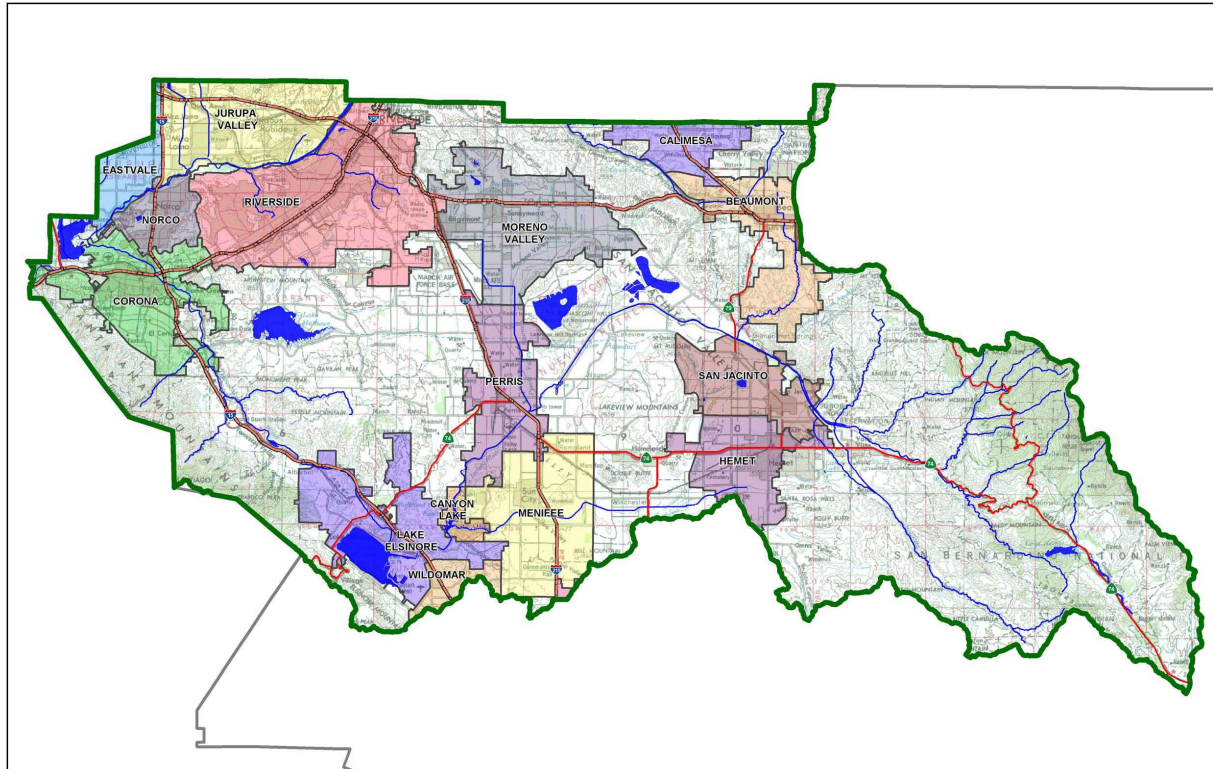
Project Specific Water Quality Management Plan

*A Template for Projects located within the **Santa Ana Watershed** Region of Riverside County*

Project Title: Tract 37858

Development No: PEN20-0172/0173

Design Review/Case No: LWQ24-0033



- ☒ Preliminary
- ☐ Final

Original Date Prepared: August 2024

Revision Date(s): September 2025

*Prepared for Compliance with
Regional Board Order No. **R8-2010-0033***

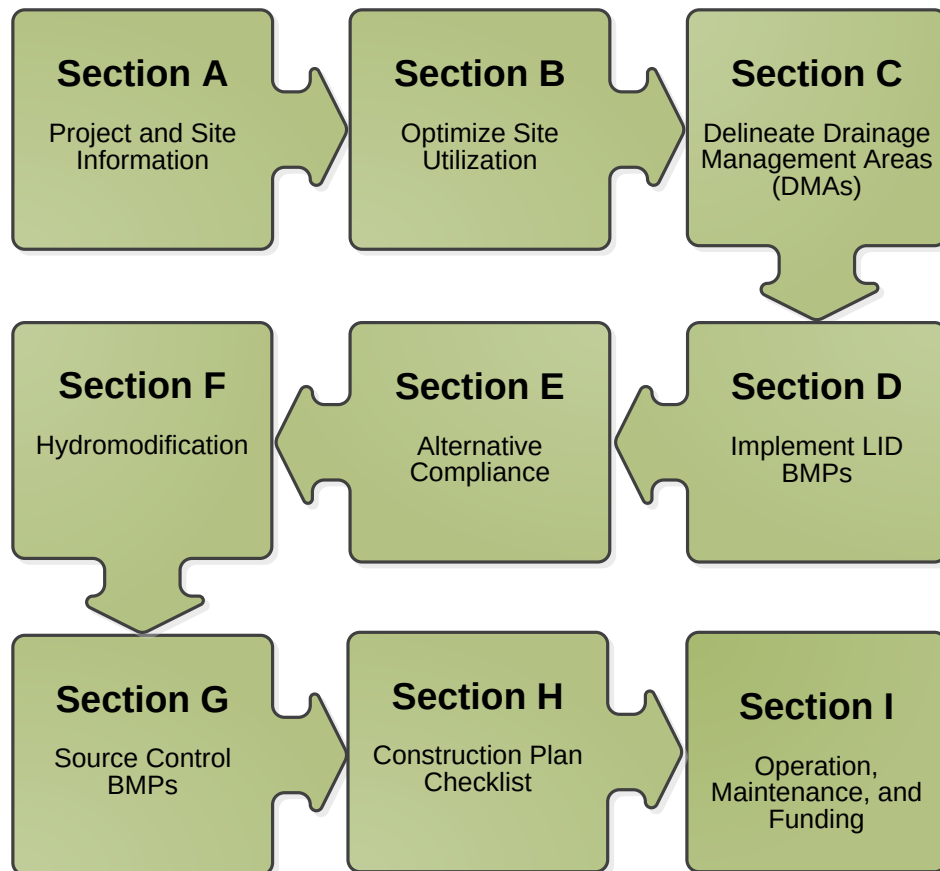
Template revised June 30, 2016

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A Brief Introduction

This Project-Specific WQMP Template for the **Santa Ana Region** has been prepared to help guide you in documenting compliance for your project. Because this document has been designed to specifically document compliance, you will need to utilize the WQMP Guidance Document as your “how-to” manual to help guide you through this process. Both the Template and Guidance Document go hand-in-hand, and will help facilitate a well prepared Project-Specific WQMP. Below is a flowchart for the layout of this Template that will provide the steps required to document compliance.



OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for RC Hobbs Companies by Adkan Engineers for Tract 37858 project.

This WQMP is intended to comply with the requirements of City of Moreno Valley for Ordinance 827 which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. In addition, the property owner accepts responsibility for interim operation and maintenance of Stormwater BMPs until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under City of Moreno Valley Water Quality Ordinance (Municipal Code Chapter 8.10).

"I, the undersigned, certify under penalty of law that the provisions of this WQMP have been reviewed and accepted and that the WQMP will be transferred to future successors in interest."

Owner's Signature

Roger Hobbs
Owner's Printed Name

Date

9/2/25
President
Owner's Title/Position

PREPARER'S CERTIFICATION

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan meet the requirements of Regional Water Quality Control Board Order No. **R8-2010-0033** and any subsequent amendments thereto."

Preparer's Signature

Michael Bredecke
Preparer's Printed Name

Date

09/02/2025
Project Manager
Preparer's Title/Position

Preparer's Licensure:



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Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	Residential
Planning Area:	Residential
Community Name:	Moreno Valley
Development Name:	Tract 37858
PROJECT LOCATION	
Latitude & Longitude (DMS): 33.911114, -117.170367	
Project Watershed and Sub-Watershed: Santa Ana River	
Gross Acres: 6.28+/-	
APN(s): 478-090-018, 024 & 025	
Map Book and Page No.: Parcel Map Book 38 Page 28 & Parcel Map Book 96 Page 16	
PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	R10 Residential
Proposed or Potential SIC Code(s)	N/A
Area of Impervious Project Footprint (entire disturbed area)	273,370 SF
Total Area of <u>proposed</u> Impervious Surfaces within the Project Footprint (SF)/or Replacement	198,612 SF
Does the project consist of offsite road improvements?	☒ Y ☐ N
Does the project propose to construct unpaved roads?	☐ Y ☒ N
Is the project part of a larger common plan of development (phased project)?	☐ Y ☒ N
EXISTING SITE CHARACTERISTICS	
Total area of <u>existing</u> Impervious Surfaces within the Project limits Footprint (SF)	64,144 sf
Is the project located within any MSHCP Criteria Cell?	☐ Y ☒ N
If so, identify the Cell number:	N/A
Are there any natural hydrologic features on the project site?	☐ Y ☒ N
Is a Geotechnical Report attached?	☒ Y ☐ N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)	A
What is the Water Quality Design Storm Depth for the project?	0.70

The planned development is 4.56 acres and will consist of 41 lot single-family residences, street improvements, onsite stormwater treatment areas (infiltration Basins) in the southwest corner at Bradshaw Circle and Cactus Avenue and the west of the site and Bradshaw Circle. Existing site is located in the City of Moreno Valley near the intersection of Cactus and Moreno Beach Drive. The site has been plowed and cleared of native vegetation. All onsite runoff will flow to the southwest as per the existing drainage path. Offsite improvements and runoff will be mitigated by Filterra catch basins.

A.1 Maps and Site Plans

When completing your Project-Specific WQMP, include a map of the local vicinity and existing site. In addition, include all grading, drainage, landscape/plant palette and other pertinent construction plans in Appendix 2. At a **minimum**, your WQMP Site Plan should include the following:

- Drainage Management Areas
- Proposed Structural BMPs
- Drainage Path
- Drainage Infrastructure, Inlets, Overflows
- Source Control BMPs
- Buildings, Roof Lines, Downspouts
- Impervious Surfaces
- Standard Labeling
- BMP Locations (Lat/Long)

Use your discretion on whether or not you may need to create multiple sheets or can appropriately accommodate these features on one or two sheets. Keep in mind that the Co-Permittee plan reviewer must be able to easily analyze your project utilizing this template and its associated site plans and maps.

A.1 Identify Receiving Waters

Using Table A.1 below, list in order of upstream to downstream, the receiving waters that the project site is tributary to. Continue to fill each row with the Receiving Water's 303(d) listed impairments (if any), designated beneficial uses, and proximity, if any, to a RARE beneficial use. Include a map of the receiving waters in Appendix 1.

Table A.1 Identification of Receiving Waters

Receiving Waters	EPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
Moreno Valley Storm Drain Line F	N/A	N/A	N/A
Perris Valley Channel	N/A	N/A	N/A
San Jacinto River Reach 3	N/A	Intermittent (AGR, GWR, REC1, REC2, WILD), RARE	10.8 miles
Canyon Lake (Railroad Canyon Reservoir)	Nutrients	MUN, AGR, GWR, REC1, REC2, COMM, WARM, WILD	Not a RARE water body
San Jacinto River Reach 1	N/A	Intermittent (AGR, GWR, REC1, REC2, WILD), RARE	20.0 miles
Lake Elsinore	DDT, Nutrients, Organic Enrichment/Low Dissolved Oxygen, PCBs, Toxicity	REC1, REC2, COMM, WARM, WILD, RARE	24.7 miles
Temescal Creek Channel Reach 6	N/A	Intermittent (GWR, REC1, REC2, WARM, WILD)	Not a RARE water body
Temescal Creek Channel Reach 4-5	N/A	GWR, REC1, REC2, WARM, WILD, RARE	29.4 miles
Lee Lake (Temescal Creek Reach 3)	N/A	MUN, AGR, IND, PROC	Not a RARE water body
Temescal Creek Channel Reach 2	N/A	REC2, WARM, WILD, RARE	35.5 miles
Temescal Canyon Lake	N/A	N/A	N/A
Temescal Creek Channel Reach 1	N/A	REC2, WARM, WILD	N/A
Santa Ana River Reach 3	Copper, Indicator Bacteria, Lead	AGR, GWR, REC1, REC2, WARM, WILD, RARE, SPWN	52.2 miles
Prado Basin	pH	REC1, REC2, WARM, WILD, RARE	53.8miles
Santa Ana River Reach 2	N/A	AGR, GWR, REC1, REC2, WARM, WILD, RARE, SPWN	55.3 miles
Santa Ana River Reach 1	N/A	REC1, REC2, Intermittent (WARM, WILD)	Not a RARE water body
Pacific Ocean (Nearshore Zone)	N/A	NAV, REC1, REC2, COMM, WILD, RARE, SPWN, MAR, SHEL	85.2 miles

A.2 Additional Permits/Approvals required for the Project:

Table A.2 Other Applicable Permits

Agency	Permit Required	
State Department of Fish and Game, 1602 Streambed Alteration Agreement	☐ Y	☒ N
State Water Resources Control Board, Clean Water Act (CWA) Section 401 Water Quality Cert.	☐ Y	☒ N
US Army Corps of Engineers, CWA Section 404 Permit	☐ Y	☒ N
US Fish and Wildlife, Endangered Species Act Section 7 Biological Opinion	☐ Y	☒ N
Statewide Construction General Permit Coverage	☒ Y	☐ N
Statewide Industrial General Permit Coverage	☐ Y	☒ N
Western Riverside MSHCP Consistency Approval (e.g., JPR, DBESP)	☐ Y	☒ N
Other <i>(please list in the space below as required)</i> City of Moreno Valley Grading permits, encroachment permits	☒ Y	☐ N

If yes is answered to any of the questions above, the Co-Permittee may require proof of approval/coverage from those agencies as applicable including documentation of any associated requirements that may affect this Project-Specific WQMP.

Section B: Optimize Site Utilization (LID Principles)

Review of the information collected in Section 'A' will aid in identifying the principal constraints on site design and selection of LID BMPs as well as opportunities to reduce imperviousness and incorporate LID Principles into the site and landscape design. For example, **constraints** might include impermeable soils, high groundwater, groundwater pollution or contaminated soils, steep slopes, geotechnical instability, high-intensity land use, heavy pedestrian or vehicular traffic, utility locations or safety concerns. **Opportunities** might include existing natural areas, low areas, oddly configured or otherwise unbuildable parcels, easements and landscape amenities including open space and buffers (which can double as locations for bioretention BMPs), and differences in elevation (which can provide hydraulic head). Prepare a brief narrative for each of the site optimization strategies described below. This narrative will help you as you proceed with your LID design and explain your design decisions to others.

The 2010 Santa Ana MS4 Permit further requires that LID Retention BMPs (Infiltration Only or Harvest and Use) be used unless it can be shown that those BMPs are infeasible. Therefore, it is important that your narrative identify and justify if there are any constraints that would prevent the use of those categories of LID BMPs. Similarly, you should also note opportunities that exist which will be utilized during project design. Upon completion of identifying Constraints and Opportunities, include these on your WQMP Site plan in Appendix 1.

Consideration of "highest and best use" of the discharge should also be considered. For example, Lake Elsinore is evaporating faster than runoff from natural precipitation can recharge it. Requiring infiltration of 85% of runoff events for projects tributary to Lake Elsinore would only exacerbate current water quality problems associated with Pollutant concentration due to lake water evaporation. In cases where rainfall events have low potential to recharge Lake Elsinore (i.e. no hydraulic connection between groundwater to Lake Elsinore, or other factors), requiring infiltration of Urban Runoff from projects is counterproductive to the overall watershed goals. Project proponents, in these cases, would be allowed to discharge Urban Runoff, provided they used equally effective filtration-based BMPs.

Site Optimization

The following questions are based upon Section 3.2 of the WQMP Guidance Document. Review of the WQMP Guidance Document will help you determine how best to optimize your site and subsequently identify opportunities and/or constraints, and document compliance.

Did you identify and preserve existing drainage patterns? If so, how? If not, why?

Yes, existing drainage patterns on site drain all water from the Northeast to the Southwest at Bradshaw Circle and the intersection of Bradshaw Circle and Cactus Avenue. The proposed design uses catch basins to direct the flow into the proposed infiltration basins for treatment prior to draining into the existing storm drain line on Cactus Avenue.

Did you identify and protect existing vegetation? If so, how? If not, why?

No, existing natural vegetation will not be protected. All vegetation has been previously removed, there is no existing vegetation to protect.

Did you identify and preserve natural infiltration capacity? If so, how? If not, why?

Yes, natural infiltration will be used at each infiltration basin.

Did you identify and minimize impervious area? If so, how? If not, why?

No, site design will be typical for this type of development.

Did you identify and disperse runoff to adjacent pervious areas? If so, how? If not, why?

Yes, roof runoff from proposed homes will flow through landscape all other flows will drain to the proposed infiltration basins before draining into the existing storm drain line on Cactus Avenue.

Section C: Delineate Drainage Management Areas (DMAs)

Utilizing the procedure in Section 3.3 of the WQMP Guidance Document which discusses the methods of delineating and mapping your project site into individual DMAs, complete Table C.1 below to appropriately categorize the types of classification (e.g., Type A, Type B, etc.) per DMA for your project site. Upon completion of this table, this information will then be used to populate and tabulate the corresponding tables for their respective DMA classifications.

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s) ¹²	Area (Sq. Ft.)	DMA Type
D.1.1	Asphalt/Concrete	27,397	D
D.1.2	Roof	47,763	D
D.1.3	Landscaping (Pads)	25,718	D
D.1.4	Landscaping (Basin)	4,744	D
D.2.1	Asphalt/Concrete	24,414	D
D.2.2	Street	36,509	D
D.2.3	Landscaping (Pads)	19,669	D
D.2.4	Landscaping (Basin)	12,398	D
D.3.1	Concrete/Asphalt	21,099	D
D.3.2	Natural Soil	4,789	D
D.4.1	Concrete/Asphalt	27,356	D
D.4.2	Natural Soil	4,593	D
D.5.1	Concrete/Asphalt	8,808	D
D.5.2	Natural Soil	1,284	D
D.6.1	Concrete/Asphalt	5,658	D
D.6.2	Natural Soil	1,172	D

¹Reference Table 2-1 in the WQMP Guidance Document to populate this column

²If multi-surface provide back-up

Table C.2 Type 'A', Self-Treating Areas

DMA Name or ID	Area (Sq. Ft.)	Stabilization Type	Irrigation Type (if any)

Table C.3 Type 'B', Self-Retaining Areas

Self-Retaining Area				Type 'C' DMAs that are draining to the Self-Retaining Area		
DMA Name/ ID	Post-project surface type	Area (square feet) [A]	Storm Depth (inches) [B]	DMA Name / ID	[C] from Table C.4 = [C]	Required Retention Depth (inches) [D]

$$[D] = [B] + \frac{[B] \cdot [C]}{[A]}$$

Table C.4 Type 'C', Areas that Drain to Self-Retaining Areas

DMA					Receiving Self-Retaining DMA		
DMA Name/ ID	Area (square feet)	Post-project surface type	Impervious fraction	Product	DMA name /ID	Area (square feet)	Ratio
	[A]		[B]	[C] = [A] x [B]		[D]	[C]/[D]

Table C.5 Type 'D', Areas Draining to BMPs

DMA Name or ID	BMP Name or ID
D.1.1	Infiltration Basin 1
D.1.2	Infiltration Basin 1
D.1.3	Infiltration Basin 1
D.1.4	Infiltration Basin 1
D.2.1	Infiltration Basin 2
D.2.2	Infiltration Basin 2
D.2.3	Infiltration Basin 2
D.2.4	Infiltration Basin 2
D.3.1	Filtterra 1
D.3.2	Filtterra 1
D.4.1	Filtterra 2
D.4.2	Filtterra 2
D.5.1	Filtterra 3
D.5.2	Filtterra 3
D.6.1	Filtterra 4
D.6.2	Filtterra 4

Note: More than one drainage management area can drain to a single LID BMP, however, one drainage management area may not drain to more than one BMP.

Section D: Implement LID BMPs

D.1 Infiltration Applicability

Is there an approved downstream 'Highest and Best Use' for stormwater runoff (see discussion in Chapter 2.4.4 of the WQMP Guidance Document for further details)? ☐ Y ☒ N

If yes has been checked, Infiltration BMPs shall not be used for the site; proceed to section D.3

If no, continue working through this section to implement your LID BMPs. It is recommended that you contact your Co-Permittee to verify whether or not your project discharges to an approved downstream 'Highest and Best Use' feature.

Geotechnical Report

A Geotechnical Report or Phase I Environmental Site Assessment may be required by the Copermitttee to confirm present and past site characteristics that may affect the use of Infiltration BMPs. In addition, the Co-Permittee, at their discretion, may not require a geotechnical report for small projects as described in Chapter 2 of the WQMP Guidance Document. If a geotechnical report has been prepared, include it in Appendix 3. In addition, if a Phase I Environmental Site Assessment has been prepared, include it in Appendix 4.

Is this project classified as a small project consistent with the requirements of Chapter 2 of the WQMP Guidance Document? ☐ Y ☒ N

Infiltration Feasibility

Table D.1 below is meant to provide a simple means of assessing which DMAs on your site support Infiltration BMPs and is discussed in the WQMP Guidance Document in Chapter 2.4.5. Check the appropriate box for each question and then list affected DMAs as applicable. If additional space is needed, add a row below the corresponding answer.

Table D.1 Infiltration Feasibility

Does the project site...	YES	NO
...have any DMAs with a seasonal high groundwater mark shallower than 10 feet?		X
If Yes, list affected DMAs:		
...have any DMAs located within 100 feet of a water supply well?		X
If Yes, list affected DMAs:		
...have any areas identified by the geotechnical report as posing a public safety risk where infiltration of stormwater could have a negative impact?		X
If Yes, list affected DMAs:		
...have measured in-situ infiltration rates of less than 1.6 inches / hour?		X
If Yes, list affected DMAs:		
...have significant cut and/or fill conditions that would preclude in-situ testing of infiltration rates at the final infiltration surface?		X
If Yes, list affected DMAs:		
...geotechnical report identify other site-specific factors that would preclude effective and safe infiltration?		X
Describe here:		

If you answered "Yes" to any of the questions above for any DMA, Infiltration BMPs should not be used for those DMAs and you should proceed to the assessment for Harvest and Use below.

D.2 Harvest and Use Assessment

Please check what applies:

- ☐ Reclaimed water will be used for the non-potable water demands for the project.
- ☐ Downstream water rights may be impacted by Harvest and Use as approved by the Regional Board (verify with the Copermittee).
- ☒ The Design Capture Volume will be addressed using Infiltration Only BMPs. In such a case, Harvest and Use BMPs are still encouraged, but it would not be required if the Design Capture Volume will be infiltrated or evapotranspired.
- ☐ None of the above

If any of the above boxes have been checked, Harvest and Use BMPs need not be assessed for the site. If none of the above criteria applies, follow the steps below to assess the feasibility of irrigation use, toilet use and other non-potable uses (e.g., industrial use).

Irrigation Use Feasibility

Complete the following steps to determine the feasibility of harvesting stormwater runoff for Irrigation Use BMPs on your site:

Step 1: Identify the total area of irrigated landscape on the site, and the type of landscaping used.

Total Area of Irrigated Landscape: N/A

Type of Landscaping (Conservation Design or Active Turf): N/A

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for irrigation use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces: N/A

Step 3: Cross reference the Design Storm depth for the project site (see Exhibit A of the WQMP Guidance Document) with the left column of Table 2-3 in Chapter 2 to determine the minimum area of Effective Irrigated Area per Tributary Impervious Area (EIATIA).

Enter your EIATIA factor: N/A

Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum irrigated area that would be required.

Minimum required irrigated area: N/A

Step 5: Determine if harvesting stormwater runoff for irrigation use is feasible for the project by comparing the total area of irrigated landscape (Step 1) to the minimum required irrigated area (Step 4).

Minimum required irrigated area (Step 4)	Available Irrigated Landscape (Step 1)
N/A	N/A

Toilet Use Feasibility

Complete the following steps to determine the feasibility of harvesting stormwater runoff for toilet flushing uses on your site:

- Step 1: Identify the projected total number of daily toilet users during the wet season, and account for any periodic shut downs or other lapses in occupancy:

Projected Number of Daily Toilet Users: N/A

Project Type: N/A

- Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for toilet use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces: N/A

- Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-2 in Chapter 2 to determine the minimum number of toilet users per tributary impervious acre (TUTIA).

Enter your TUTIA factor: N/A

- Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum number of toilet users that would be required.

Minimum number of toilet users: N/A

- Step 5: Determine if harvesting stormwater runoff for toilet flushing use is feasible for the project by comparing the Number of Daily Toilet Users (Step 1) to the minimum required number of toilet users (Step 4).

Minimum required Toilet Users (Step 4)	Projected number of toilet users (Step 1)
N/A	N/A

Other Non-Potable Use Feasibility

Are there other non-potable uses for stormwater runoff on the site (e.g. industrial use)? See Chapter 2 of the Guidance for further information. If yes, describe below. If no, write N/A.

N/A

- Step 1: Identify the projected average daily non-potable demand, in gallons per day, during the wet season and accounting for any periodic shut downs or other lapses in occupancy or operation.

Average Daily Demand: N/A

- Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for the identified non-potable use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces: N/A

- Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-4 in Chapter 2 to determine the minimum demand for non-potable uses per tributary impervious acre.

Enter the factor from Table 2-4: N/A

- Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum number of gallons per day of non-potable use that would be required.

Minimum required use: N/A

- Step 5: Determine if harvesting stormwater runoff for other non-potable use is feasible for the project by comparing the projected average daily use (Step 1) to the minimum required non-potable use (Step 4).

Minimum required non-potable use (Step 4)	Projected average daily use (Step 1)
N/A	N/A

If Irrigation, Toilet and Other Use feasibility anticipated demands are less than the applicable minimum values, Harvest and Use BMPs are not required and you should proceed to utilize LID Bioretention and Biotreatment per Section 3.4.2 of the WQMP Guidance Document.

D.3 Bioretention and Biotreatment Assessment

Other LID Bioretention and Biotreatment BMPs as described in Chapter 2.4.7 of the WQMP Guidance Document are feasible on nearly all development sites with sufficient advance planning.

Select one of the following:

- ☐ LID Bioretention/Biotreatment BMPs will be used for some or all DMAs of the project as noted below in Section D.4 (note the requirements of Section 3.4.2 in the WQMP Guidance Document).
- ☐ A site-specific analysis demonstrating the technical infeasibility of all LID BMPs has been performed and is included in Appendix 5. If you plan to submit an analysis demonstrating the technical infeasibility of LID BMPs, request a pre-submittal meeting with the Copermittee to discuss this option. Proceed to Section E to document your alternative compliance measures.

D.4 Feasibility Assessment Summaries

From the Infiltration, Harvest and Use, Bioretention and Biotreatment Sections above, complete Table D.2 below to summarize which LID BMPs are technically feasible, and which are not, based upon the established hierarchy.

Table D.2 LID Prioritization Summary Matrix

DMA Name/ID	LID BMP Hierarchy				No LID (Alternative Compliance)
	1. Infiltration	2. Harvest and use	3. Bioretention	4. Biotreatment	
D.1.1	☒	☐	☐	☐	☐
D.1.2	☒	☐	☐	☐	☐
D.1.3	☒	☐	☐	☐	☐
D.1.4	☒	☐	☐	☐	☐
D.2.1	☒	☐	☐	☐	☐
D.2.2	☒	☐	☐	☐	☐
D.2.3	☒	☐	☐	☐	☐
D.2.4	☒	☐	☐	☐	☐
D.3.1	☐	☐	☐	☒	☐
D.3.2	☐	☐	☐	☒	☐
D.4.1	☐	☐	☐	☒	☐
D.4.2	☐	☐	☐	☒	☐
D.5.1	☐	☐	☐	☒	☐
D.5.2	☐	☐	☐	☒	☐
D.6.1	☐	☐	☐	☒	☐
D.6.2	☐	☐	☐	☒	☐

For those DMAs where LID BMPs are not feasible, provide a brief narrative below summarizing why they are not feasible, include your technical infeasibility criteria in Appendix 5, and proceed to Section E below to document Alternative Compliance measures for those DMAs. Recall that each proposed DMA must pass through the LID BMP hierarchy before alternative compliance measures may be considered.

Per geotechnical report by Soil Exploration Co., Inc. Project No. 19251-01.

Infiltration Results in Appendix F suggest positive infiltration rates greater than 1.6 in/hr. at the location where the infiltration basins are being proposed.

D.5 LID BMP Sizing

Each LID BMP must be designed to ensure that the Design Capture Volume will be addressed by the selected BMPs. First, calculate the Design Capture Volume for each LID BMP using the V_{BMP} worksheet in Appendix F of the LID BMP Design Handbook. Second, design the LID BMP to meet the required V_{BMP} using a method approved by the Copermittee. Utilize the worksheets found in the LID BMP Design Handbook or consult with your Copermittee to assist you in correctly sizing your LID BMPs. Complete Table D.3 below to document the Design Capture Volume and the Proposed Volume for each LID BMP. Provide the completed design procedure sheets for each LID BMP in Appendix 6. You may add additional rows to the table below as needed.

Table D.3 DCV Calculations for LID BMPs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	Infiltration Basin 1		
	[A]		[B]	[C]	[A] x [C]			
D.1.1	27,397	Concrete/Asphalt	1.0	0.89	24,438.10	Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)
D.1.2	47,763	Roof	1.0	0.89	42,604.60			
D.1.3	25,718	Lot Landscaping	0.1	0.11	2,840.80			
D.1.4	4,744	Infiltration Basin	0.1	0.11	524			
	105,622				70,407.50	0.70	4,107.1	4,642.5

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	Infiltration Basin 2		
	[A]		[B]	[C]	[A] x [C]			
D.2.1	24,414	Concrete/Asphalt	1.0	0.89	21,777.30	Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)
D.2.2	36,509	Roof	1.0	0.89	32,566.00			
D.2.3	19,669	Lot Landscaping	0.1	0.11	2,172.60			
D.2.4	12,398	Infiltration Basin	0.1	0.11	1,369.50			
	92,990				57,885.40	0.70	3,376.60	3,376.60

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I _f	DMA Runoff Factor	DMA Areas x Runoff Factor	Filterra 1		
	[A]		[B]	[C]	[A] x [C]			
D.3.1	21,099	Concrete/Asphalt	1.0	0.89	18,820.3	Design Rainfall Intensity (in/hr)	Design Flow Rate, Q _{BMP} (cfs)	Proposed Flow Rate on Plans (cfs)
D.3.2	4,789	Natural Soil	0.3	0.225	1,078.3			
	25,888				19,989.6	0.2	0.091	1.42
DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I _f	DMA Runoff Factor	DMA Areas x Runoff Factor	Filterra 2		
	[A]		[B]	[C]	[A] x [C]			
D.4.1	27,356	Concrete/Asphalt	1.0	0.89	24,401.6	Design Rainfall Intensity (in/hr)	Design Flow Rate, Q _{BMP} (cfs)	Proposed Flow Rate on Plans (cfs)
D.4.2	4,593	Natural Soil	0.3	0.225	1,034.2			
	31,949				25,435.8	0.20	0.117	1.42
DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I _f	DMA Runoff Factor	DMA Areas x Runoff Factor	Filterra 3		
	[A]		[B]	[C]	[A] x [C]			
D.5.1	8,808	Concrete/Asphalt	1.0	0.89	7,856.7	Design Rainfall Intensity (in/hr)	Design Flow Rate, Q _{BMP} (cfs)	Proposed Flow Rate on Plans (cfs)
D.5.2	1,284	Natural Soil	0.3	0.225	289.1			
	10,092				8145.8	0.20	0.037	1.42
DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I _f	DMA Runoff Factor	DMA Areas x Runoff Factor	Filterra 4		
	[A]		[B]	[C]	[A] x [C]			
D.6.1	5,658	Concrete/Asphalt	1.0	0.89	5,046.9	Design Rainfall Intensity (in/hr)	Design Flow Rate, Q _{BMP} (cfs)	Proposed Flow Rate on Plans (cfs)
D.6.2	1,172	Natural Soil	0.3	0.225	263.9			
	6,830				5,310.8	0.20	0.024	1.42

[B], [C] is obtained as described in Section 2.3.1 of the WQMP Guidance Document

[E] is obtained from Exhibit A in the WQMP Guidance Document

[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6

Section E: Alternative Compliance (LID Waiver Program)

LID BMPs are expected to be feasible on virtually all projects. Where LID BMPs have been demonstrated to be infeasible as documented in Section D, other Treatment Control BMPs must be used (subject to LID waiver approval by the Copermittee). Check one of the following Boxes:

☒ LID Principles and LID BMPs have been incorporated into the site design to fully address all Drainage Management Areas. No alternative compliance measures are required for this project and thus this Section is not required to be completed.

- Or -

☐ The following Drainage Management Areas are unable to be addressed using LID BMPs. A site-specific analysis demonstrating technical infeasibility of LID BMPs has been approved by the Co-Permittee and included in Appendix 5. Additionally, no downstream regional and/or sub-regional LID BMPs exist or are available for use by the project. The following alternative compliance measures on the following pages are being implemented to ensure that any pollutant loads expected to be discharged by not incorporating LID BMPs, are fully mitigated.

E.1 Identify Pollutants of Concern

Utilizing Table A.1 from Section A above which noted your project's receiving waters and their associated EPA approved 303(d) listed impairments, cross reference this information with that of your selected Priority Development Project Category in Table E.1 below. If the identified General Pollutant Categories are the same as those listed for your receiving waters, then these will be your Pollutants of Concern and the appropriate box or boxes will be checked on the last row. The purpose of this is to document compliance and to help you appropriately plan for mitigating your Pollutants of Concern in lieu of implementing LID BMPs.

Table E.1 Potential Pollutants by Land Use Type

Priority Project Categories and/or Project Features (check those that apply)	General Pollutant Categories							
	Bacterial Indicators	Metals	Nutrients	Pesticides	Toxic Organic Compounds	Sediments	Trash & Debris	Oil & Grease
☒ Detached Residential Development	P	N	P	P	N	P	P	P
☐ Attached Residential Development	P	N	P	P	N	P	P	P ⁽²⁾
☐ Commercial/Industrial Development	P ⁽³⁾	P	P ⁽¹⁾	P ⁽¹⁾	P ⁽⁵⁾	P ⁽¹⁾	P	P
☐ Automotive Repair Shops	N	P	N	N	P ^(4, 5)	N	P	P
☐ Restaurants (>5,000 ft ²)	P	N	N	N	N	N	P	P
☐ Hillside Development (>5,000 ft ²)	P	N	P	P	N	P	P	P

☐ Parking Lots (>5,000 ft ²)	P ⁽⁶⁾	P	P ⁽¹⁾	P ⁽¹⁾	P ⁽⁴⁾	P ⁽¹⁾	P	P
☐ Retail Gasoline Outlets	N	P	N	N	P	N	P	P
Project Priority Pollutant(s) of Concern	☒	☐	☒	☒	☐	☒	☒	☒

P = Potential

N = Not Potential

⁽¹⁾ A potential Pollutant if non-native landscaping exists or is proposed onsite; otherwise not expected

⁽²⁾ A potential Pollutant if the project includes uncovered parking areas; otherwise not expected

⁽³⁾ A potential Pollutant is land use involving animal waste

⁽⁴⁾ Specifically petroleum hydrocarbons

⁽⁵⁾ Specifically solvents

⁽⁶⁾ Bacterial indicators are routinely detected in pavement runoff

E.2 Stormwater Credits

Projects that cannot implement LID BMPs but nevertheless implement smart growth principles are potentially eligible for Stormwater Credits. Utilize Table 3-8 within the WQMP Guidance Document to identify your Project Category and its associated Water Quality Credit. If not applicable, write N/A.

Table E.2 Water Quality Credits

Qualifying Project Categories	Credit Percentage ²
<i>Total Credit Percentage¹</i>	

¹Cannot Exceed 50%

²Obtain corresponding data from Table 3-8 in the WQMP Guidance Document

E.3 Sizing Criteria

After you appropriately considered Stormwater Credits for your project, utilize Table E.3 below to appropriately size them to the DCV, or Design Flow Rate, as applicable. Please reference Chapter 3.5.2 of the WQMP Guidance Document for further information.

Table E.3 Treatment Control BMP Sizing

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I _f	DMA Runoff Factor	DMA Area x Runoff Factor	Enter BMP Name / Identifier Here			
	[A]		[B]	[C]	[A] x [C]				
						Design Storm Depth (in)	Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs)	Total Storm Water Credit % Reduction	Proposed Volume or Flow on Plans (cubic feet or cfs)
	$A_T = \sum[A]$				$\sum = [D]$	[E]	$[F] = \frac{[D] \times [E]}{[G]}$	$[F] \times (1-[H])$	[I]

[B], [C] is obtained as described in Section 2.3.1 from the WQMP Guidance Document

[E] is for Flow-Based Treatment Control BMPs [E] = .2, for Volume-Based Control Treatment BMPs, [E] obtained from Exhibit A in the WQMP Guidance Document

[G] is for Flow-Based Treatment Control BMPs [G] = 43,560, for Volume-Based Control Treatment BMPs, [G] = 12

[H] is from the Total Credit Percentage as Calculated from Table E.2 above

[I] as obtained from a design procedure sheet from the BMP manufacturer and should be included in Appendix 6

E.4 Treatment Control BMP Selection

Treatment Control BMPs typically provide proprietary treatment mechanisms to treat potential pollutants in runoff, but do not sustain significant biological processes. Treatment Control BMPs must have a removal efficiency of a medium or high effectiveness as quantified below:

- **High:** equal to or greater than 80% removal efficiency
- **Medium:** between 40% and 80% removal efficiency

Such removal efficiency documentation (e.g., studies, reports, etc.) as further discussed in Chapter 3.5.2 of the WQMP Guidance Document, must be included in Appendix 6. In addition, ensure that proposed Treatment Control BMPs are properly identified on the WQMP Site Plan in Appendix 1.

Table E.4 Treatment Control BMP Selection

Selected Treatment Control BMP Name or ID ¹	Priority Pollutant(s) of Concern to Mitigate ²	Removal Efficiency Percentage ³

¹ Treatment Control BMPs must not be constructed within Receiving Waters. In addition, a proposed Treatment Control BMP may be listed more than once if they possess more than one qualifying pollutant removal efficiency.

² Cross Reference Table E.1 above to populate this column.

³ As documented in a Co-Permittee Approved Study and provided in Appendix 6.

Section F: Hydromodification

F.1 Hydrologic Conditions of Concern (HCOC) Analysis

Once you have determined that the LID design is adequate to address water quality requirements, you will need to assess if the proposed LID Design may still create a HCOC. Review Chapters 2 and 3 (including Figure 3-7) of the WQMP Guidance Document to determine if your project must mitigate for Hydromodification impacts. If your project meets one of the following criteria which will be indicated by the check boxes below, you do not need to address Hydromodification at this time. However, if the project does not qualify for Exemptions 1, 2 or 3, then additional measures must be added to the design to comply with HCOC criteria. This is discussed in further detail below in Section F.2.

HCOC EXEMPTION 1: The Priority Development Project disturbs less than one acre. The Copermittee has the discretion to require a Project-Specific WQMP to address HCOCs on projects less than one acre on a case by case basis. The disturbed area calculation should include all disturbances associated with larger common plans of development.

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, HCOC criteria do not apply.

HCOC EXEMPTION 2: The volume and time of concentration¹ of storm water runoff for the post-development condition is not significantly different from the pre-development condition for a 2-year return frequency storm (a difference of 5% or less is considered insignificant) using one of the following methods to calculate:

- Riverside County Hydrology Manual
- Technical Release 55 (TR-55): Urban Hydrology for Small Watersheds (NRCS 1986), or derivatives thereof, such as the Santa Barbara Urban Hydrograph Method
- Other methods acceptable to the Co-Permittee

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, report results in Table F.1 below and provide your substantiated hydrologic analysis in Appendix 7.

Table F.1 Hydrologic Conditions of Concern Summary

	2 year – 24 hour		
	Pre-condition	Post-condition	% Difference
Flow (cubic feet per second)			
Volume (Cubic Feet)			

¹ Time of concentration is defined as the time after the beginning of the rainfall when all portions of the drainage basin are contributing to flow at the outlet.

HCOC EXEMPTION 3: All downstream conveyance channels to an adequate sump (for example, Prado Dam, Lake Elsinore, Canyon Lake, Santa Ana River, or other lake, reservoir or naturally erosion resistant feature) that will receive runoff from the project are engineered and regularly maintained to ensure design flow capacity; no sensitive stream habitat areas will be adversely affected; or are not identified on the Co-Permittees Hydromodification Susceptibility Maps.

Does the project qualify for this HCOC Exemption? ☒ Y ☐ N

If Yes, HCOC criteria do not apply and note below which adequate sump applies to this HCOC qualifier:

See receiving waters exhibit in Appendix 1 for downstream conveyance to Lake Elsinore.

See Appendix 7 for HCOC Exemption Map.

F.2 HCOC Mitigation

If none of the above HCOC Exemption Criteria are applicable, HCOC criteria is considered mitigated if they meet one of the following conditions:

- ☐ a. Additional LID BMPS are implemented onsite or offsite to mitigate potential erosion or habitat impacts as a result of HCOCs. This can be conducted by an evaluation of site-specific conditions utilizing accepted professional methodologies published by entities such as the California Stormwater Quality Association (CASQA), the Southern California Coastal Water Research Project (SCCRWP), or other Co-Permittee approved methodologies for site-specific HCOC analysis.
- ☐ b. The project is developed consistent with an approved Watershed Action Plan that addresses HCOC in Receiving Waters.
- ☐ c. Mimicking the pre-development hydrograph with the post-development hydrograph, for a 2-year return frequency storm. Generally, the hydrologic conditions of concern are not significant, if the post-development hydrograph is no more than 10% greater than pre-development hydrograph. In cases where excess volume cannot be infiltrated or captured and reused, discharge from the site must be limited to a flow rate no greater than 110% of the pre-development 2-year peak flow.

Be sure to include all pertinent documentation used in your analysis of the items a, b or c in Appendix 7.

Section G: Source Control BMPs

Source control BMPs include permanent, structural features that may be required in your project plans — such as roofs over and berms around trash and recycling areas — and Operational BMPs, such as regular sweeping and “housekeeping”, that must be implemented by the site’s occupant or user. The MEP standard typically requires both types of BMPs. In general, Operational BMPs cannot be substituted for a feasible and effective permanent BMP. Using the Pollutant Sources/Source Control Checklist in Appendix 8, review the following procedure to specify Source Control BMPs for your site:

1. **Identify Pollutant Sources:** Review Column 1 in the Pollutant Sources/Source Control Checklist. Check off the potential sources of Pollutants that apply to your site.
2. **Note Locations on Project-Specific WQMP Exhibit:** Note the corresponding requirements listed in Column 2 of the Pollutant Sources/Source Control Checklist. Show the location of each Pollutant source and each permanent Source Control BMP in your Project-Specific WQMP Exhibit located in Appendix 1.
3. **Prepare a Table and Narrative:** Check off the corresponding requirements listed in Column 3 in the Pollutant Sources/Source Control Checklist. In the left column of Table G.1 below, list each potential source of runoff Pollutants on your site (from those that you checked in the Pollutant Sources/Source Control Checklist). In the middle column, list the corresponding permanent, Structural Source Control BMPs (from Columns 2 and 3 of the Pollutant Sources/Source Control Checklist) used to prevent Pollutants from entering runoff. **Add additional narrative** in this column that explains any special features, materials or methods of construction that will be used to implement these permanent, Structural Source Control BMPs.
4. **Identify Operational Source Control BMPs:** To complete your table, refer once again to the Pollutant Sources/Source Control Checklist. List in the right column of your table the Operational BMPs that should be implemented as long as the anticipated activities continue at the site. Copermittee stormwater ordinances require that applicable Source Control BMPs be implemented; the same BMPs may also be required as a condition of a use permit or other revocable Discretionary Approval for use of the site.

Table G.1 Permanent and Operational Source Control Measures

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
On-site storm drain inlets	Mark all inlets with the words “Only Rain Down the Storm Drain” or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify.	Maintain and periodically repaint or replace inlet markings. Provide stormwater pollution prevention information to new site owners, lessees, or operators. See applicable operational BMPs in Fact Sheet SC-44, “Drainage System Maintenance,” in the CASQA Stormwater Quantity Handbooks. Include the following in lease agreements:” Tennant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains.”
Landscape / Outdoor Pesticide Use	Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution. Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions. Consider using pest-resistant plants, especially adjacent to hardscape. To ensure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	Maintain landscaping using minimum or no pesticides. See applicable operational BMPs in Appendix 10. Provide IPM information to new owners, lessees, and operators.
Roofing, gutters, and trim	Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.	
Plaza, sidewalks, and parking lots		Sweep plazas, sidewalks, and parking lot regularly to prevent accumulation of litter and debris.

		Collect debris from pressure washing to prevent entry into the storm drain system. Collect wash water containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.
--	--	--

Section H: Construction Plan Checklist

Populate Table H.1 below to assist the plan checker in an expeditious review of your project. The first two columns will contain information that was prepared in previous steps, while the last column will be populated with the corresponding plan sheets. This table is to be completed with the submittal of your final Project-Specific WQMP.

Table 0.1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)	BMP Location (Lat/Long)
D.1.4	Infiltration Basin 1	Tentative Tract Map Sheet 1	33.911136, -117.170744
D.2.4	Infiltration Basin 2	Tentative Tract Map Sheet 1	33.910293, -117.170705
BMP 3	Biotreatment Device 1	Tentative Tract Map Sheet 2	33.910345, -117.172876
BMP 4	Biotreatment Device 2	Tentative Tract Map Sheet 2	33.910337, -117.172998
BMP 5	Biotreatment Device 3	Tentative Tract Map Sheet 2	33.910312, -117.170779
BMP 6	Biotreatment Device 4	Tentative Tract Map Sheet 2	33.910314, -117.170920

Note that the updated table — or Construction Plan WQMP Checklist — is **only a reference tool** to facilitate an easy comparison of the construction plans to your Project-Specific WQMP. Co-Permittee staff can advise you regarding the process required to propose changes to the approved Project-Specific WQMP.

Section I: Operation, Maintenance and Funding

The Copermittee will periodically verify that Stormwater BMPs on your site are maintained and continue to operate as designed. To make this possible, your Copermittee will require that you include in Appendix 9 of this Project-Specific WQMP:

1. A means to finance and implement facility maintenance in perpetuity, including replacement cost.
2. Acceptance of responsibility for maintenance from the time the BMPs are constructed until responsibility for operation and maintenance is legally transferred. A warranty covering a period following construction may also be required.
3. An outline of general maintenance requirements for the Stormwater BMPs you have selected.
4. Figures delineating and designating pervious and impervious areas, location, and type of Stormwater BMP, and tables of pervious and impervious areas served by each facility. Geo-locating the BMPs using a coordinate system of latitude and longitude is recommended to help facilitate a future statewide database system.
5. A separate list and location of self-retaining areas or areas addressed by LID Principles that do not require specialized O&M or inspections but will require typical landscape maintenance as noted in Chapter 5, pages 85-86, in the WQMP Guidance. Include a brief description of typical landscape maintenance for these areas.

Your local Co-Permittee will also require that you prepare and submit a detailed Stormwater BMP Operation and Maintenance Plan that sets forth a maintenance schedule for each of the Stormwater BMPs built on your site. An agreement assigning responsibility for maintenance and providing for inspections and certification may also be required.

Details of these requirements and instructions for preparing a Stormwater BMP Operation and Maintenance Plan are in Chapter 5 of the WQMP Guidance Document.

Maintenance Mechanism: RC Hobbs Companies

Will the proposed BMPs be maintained by a Home Owners' Association (HOA) or Property Owners Association (POA)?

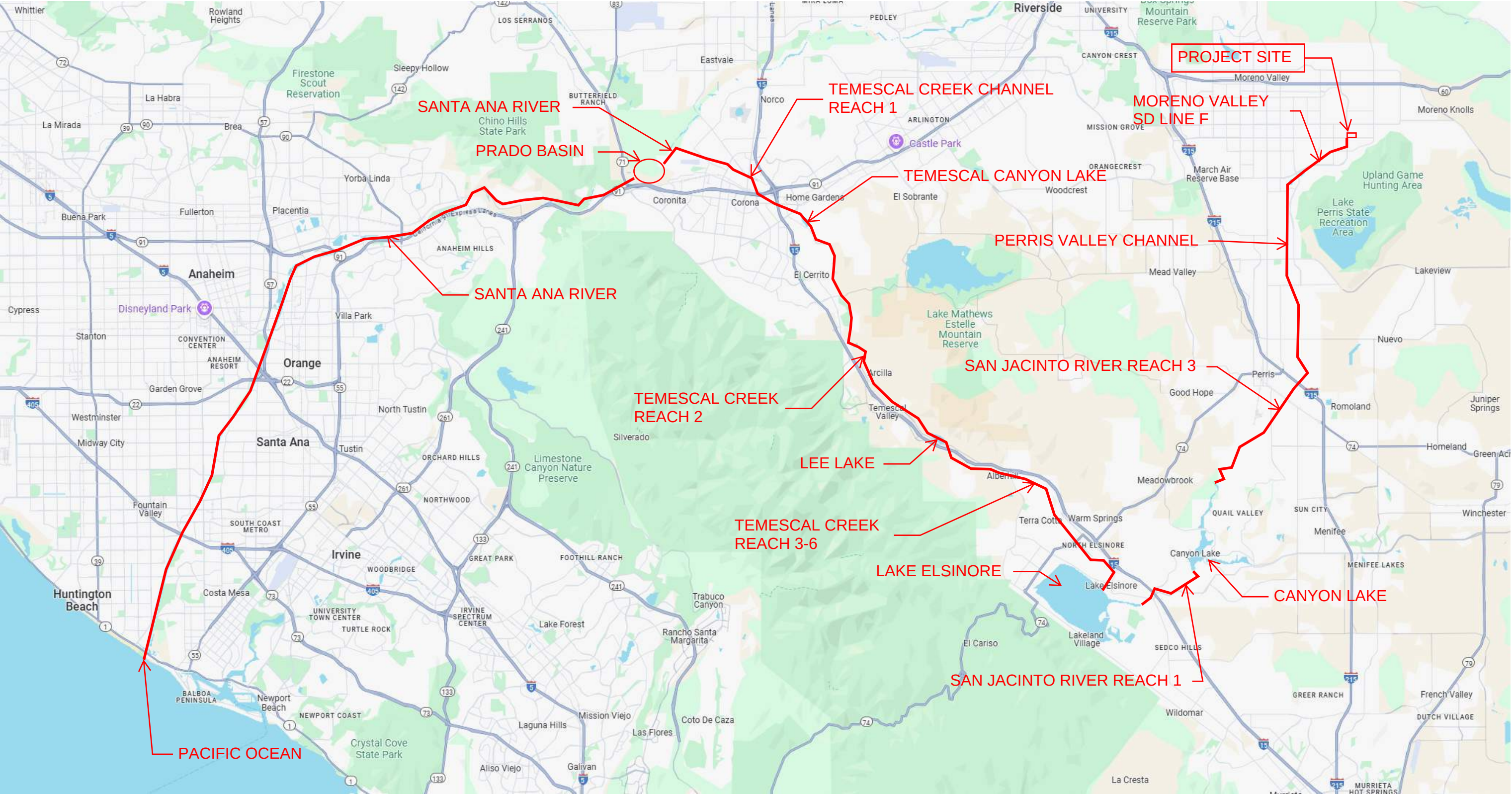
☒ Y ☐ N

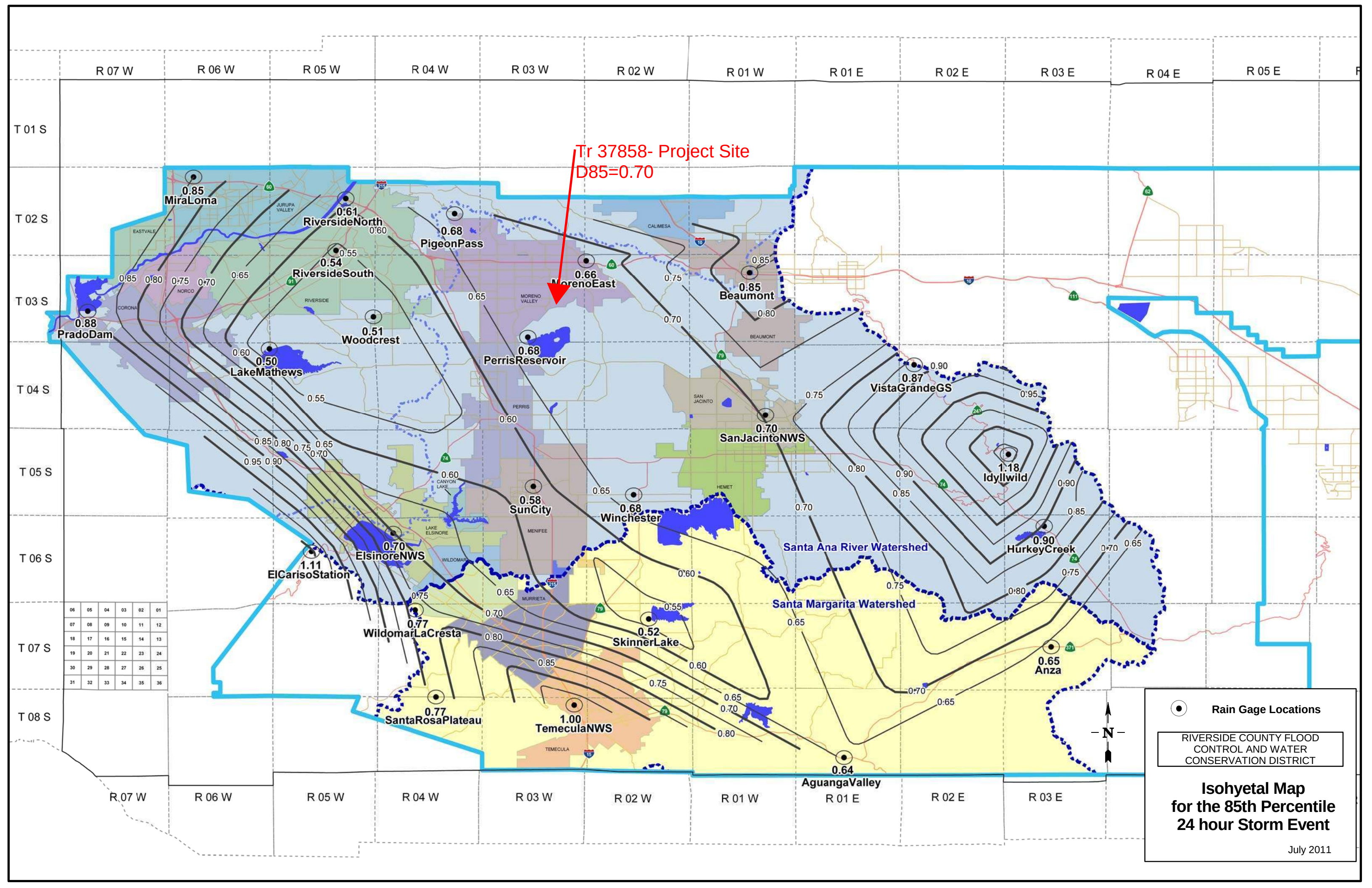
Include your Operation and Maintenance Plan and Maintenance Mechanism in Appendix 9. Additionally, include all pertinent forms of educational materials for those personnel that will be maintaining the proposed BMPs within this Project-Specific WQMP in Appendix 10.

Appendix 1: Maps and Site Plans

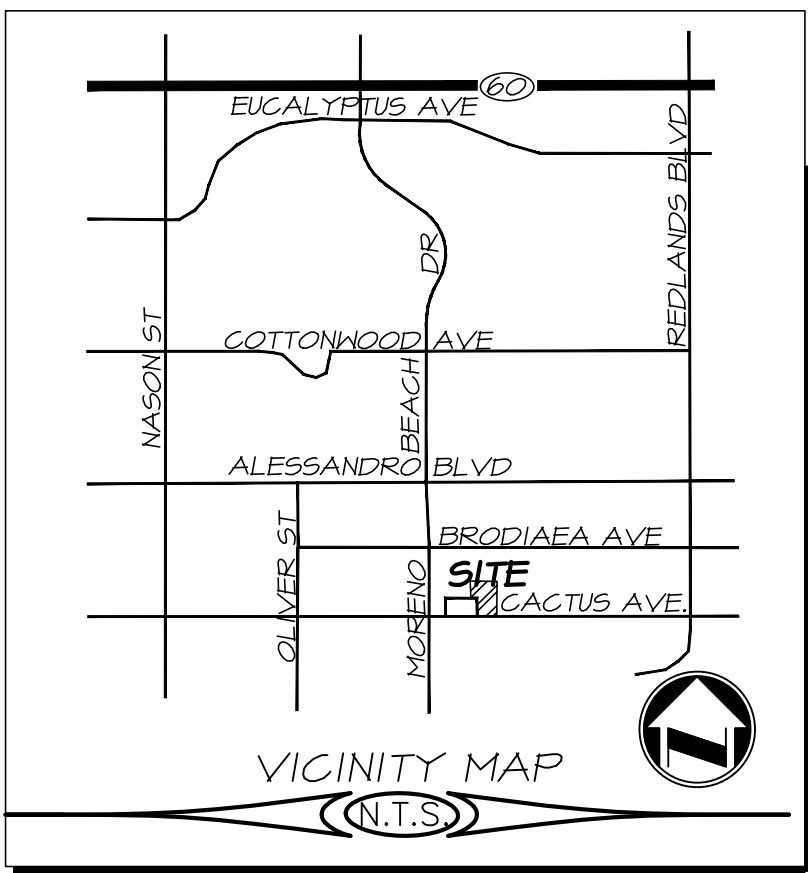
Location Map, WQMP Site Plan and Receiving Waters Map

RECEIVING WATERS EXHIBIT





BMP MAP
TRACT 37858



LEGEND

- DMA AREA SINGLE FAMILY RESIDENTIAL (65% IMPERVIOUS)
- STREETS (100% IMPERVIOUS)
- LANDSCAPING (10% IMPERVIOUS)
- DMA BOUNDARY
- DRAINAGE PATH

BMP DATA DMA 1				
DMA	DMA CLASSIFICATION	NAME	SURFACE TYPE	AREA (SF)
1.1	D	STREETS	ASPHALT/CONCRETE	27,397
1.2	D	ROOF	ROOF	47,163
1.3	D	PAD LANDSCAPING	ORNAMENTAL LANDSCAPING	25,718
1.4	D	LANDSCAPING	ORNAMENTAL LANDSCAPING	5,360
TOTAL				105,622

BMP DATA DMA 2				
DMA	DMA CLASSIFICATION	NAME	SURFACE TYPE	AREA (SF)
2.1	D	STREETS	ASPHALT/CONCRETE	24,414
2.2	D	ROOF	ROOF	36,509
2.3	D	PAD LANDSCAPING	ORNAMENTAL LANDSCAPING	19,669
2.4	D	LANDSCAPING	ORNAMENTAL LANDSCAPING	12,348
TOTAL				92,940

SOURCE CONTROL BMPs

①	ON-SITE STORM DRAIN INLETS
②	LANDSCAPE/ OUTDOOR PESTICIDE USE

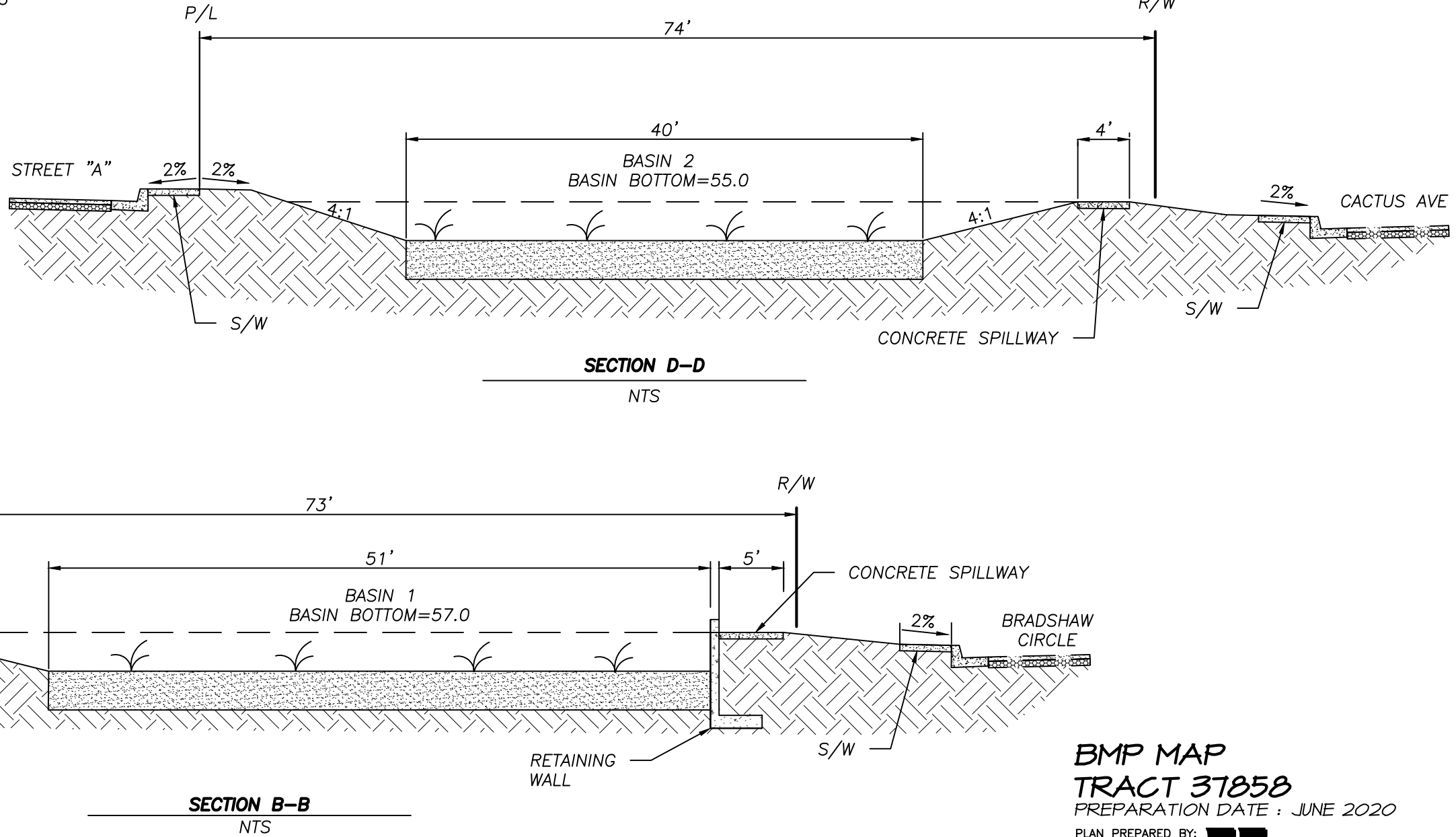
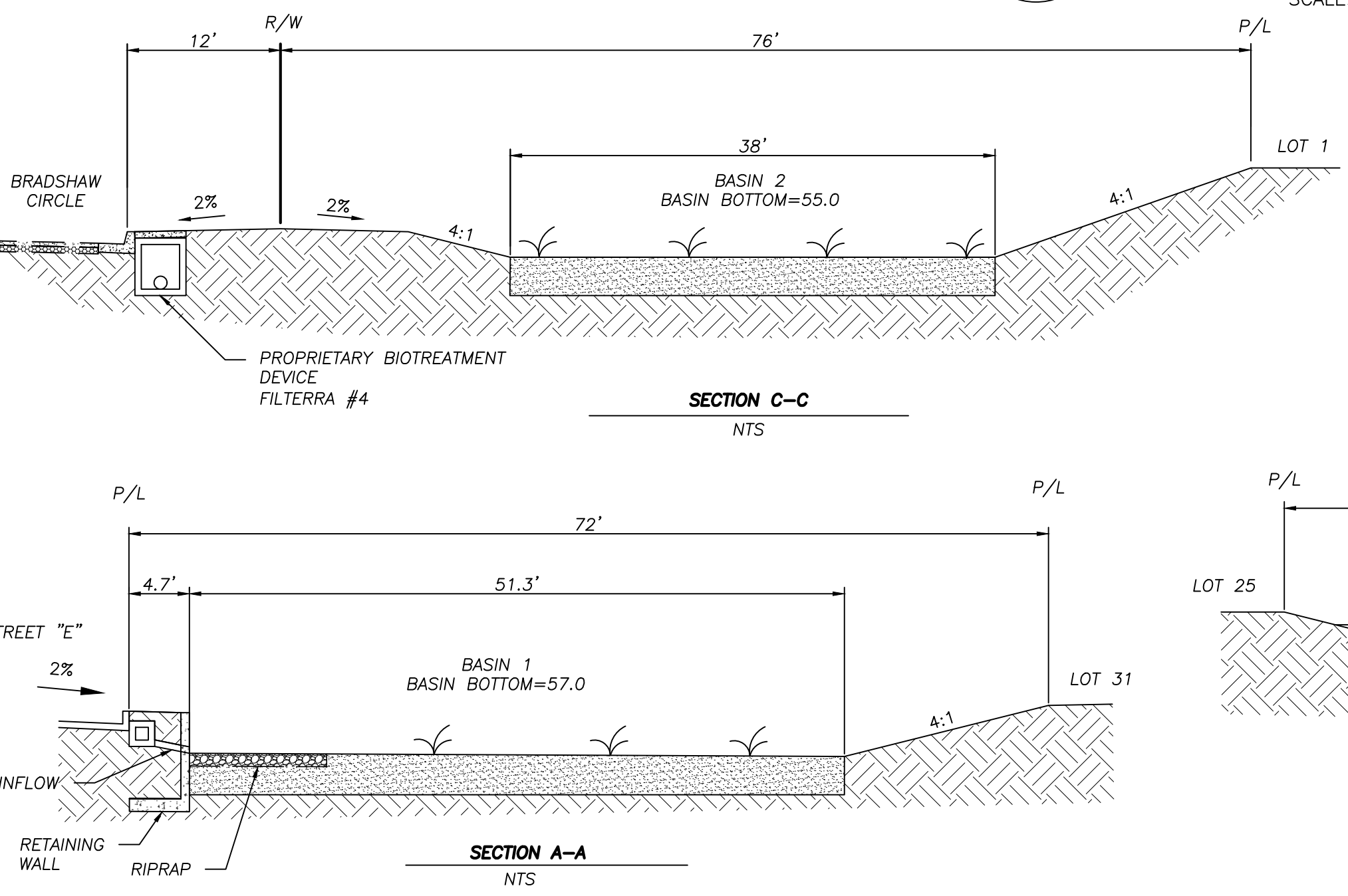
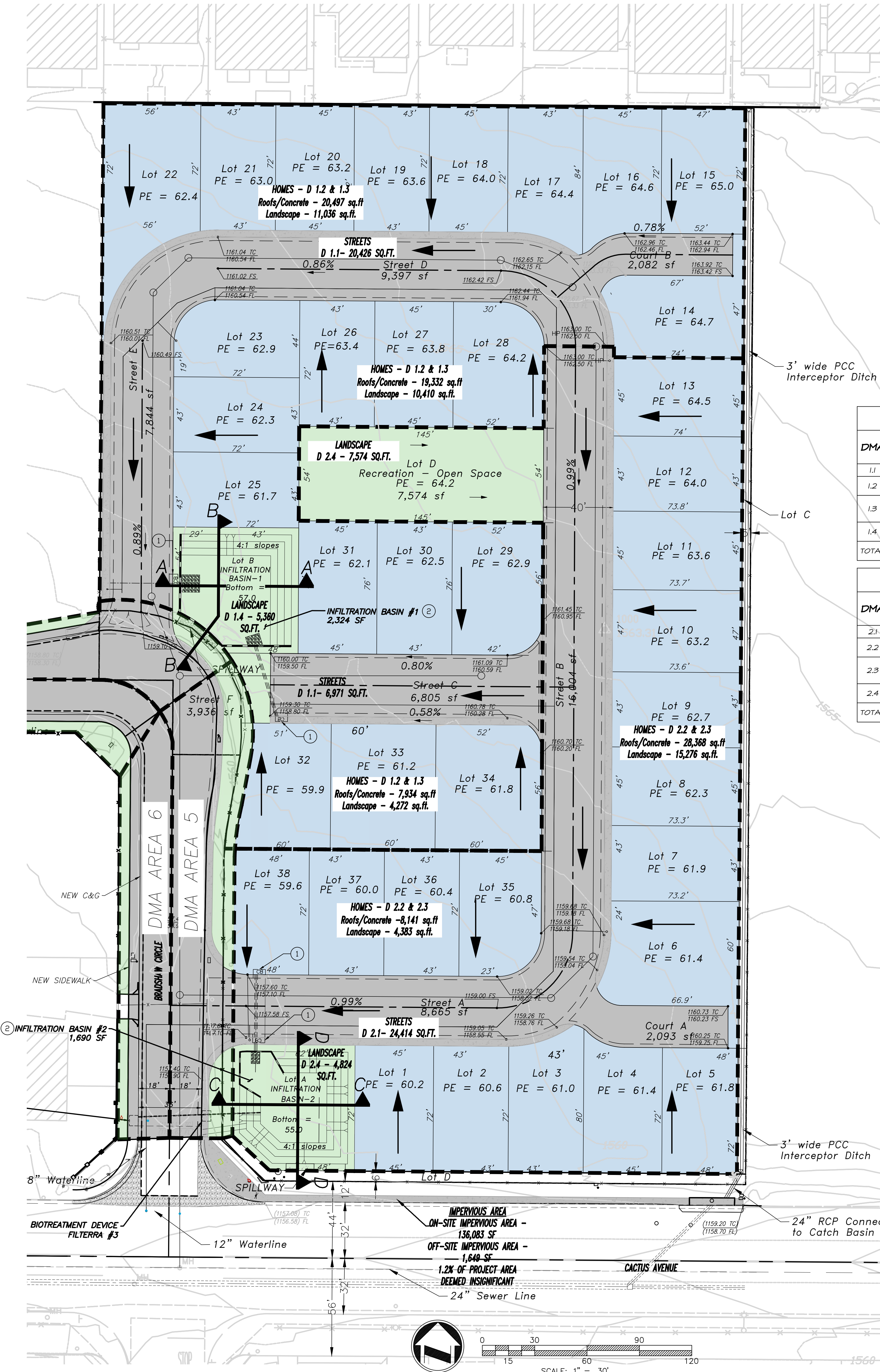
* NO OPEN TRASH RECEPTACLES NOR TRASH ENCLOSURES ARE TO BE PROPOSED ONSITE



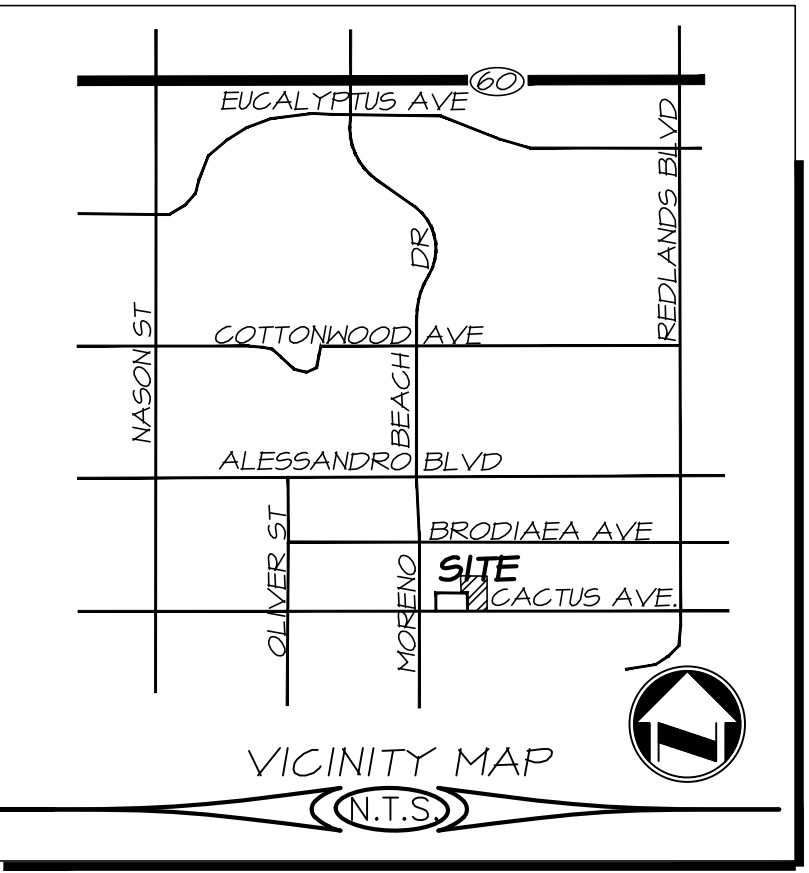
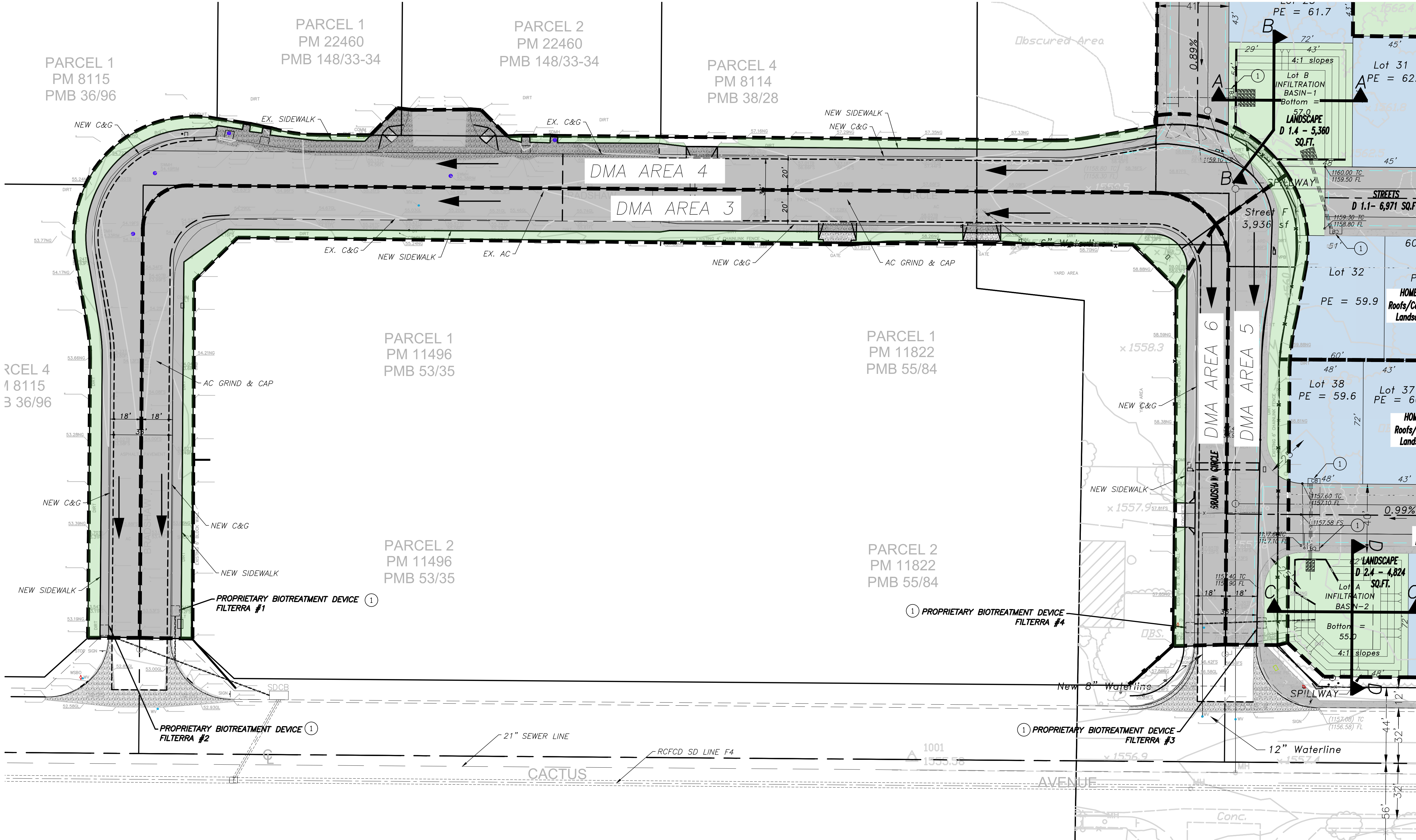
STORM DRAIN STENCIL

STORM DRAIN NOTE

PER CITY OF MORENO VALLEY STD NO. MVFE-300B-0 NOTE 13: STENCIL INLET STRUCTURE WITH "ONLY RAIN IN THE STORM DRAIN" METAL STORM DRAIN MARKET RECOMMENDED TO BE INSTALL ON ALL INLETS. SEE CALTRANS STD. D71



BMP MAP
TRACT 37858



BMP DATA DMA 3

DMA	DMA CLASSIFICATION	NAME	SURFACE TYPE	AREA (SF)
3.1	D	STREETS	ASPHALT/CONCRETE	21,091
3.2	D	NATURAL SOIL	ORNAMENTAL LANDSCAPING	4,184
TOTAL				25,275

BMP DATA DMA 4

DMA	DMA CLASSIFICATION	NAME	SURFACE TYPE	AREA (SF)
4.1	D	STREETS	ASPHALT/CONCRETE	21,356
4.2	D	NATURAL SOIL	NATURAL SOIL	4,593
TOTAL				31,949

BMP DATA DMA 5

DMA	DMA CLASSIFICATION	NAME	SURFACE TYPE	AREA (SF)
5.1	D	STREETS	ASPHALT/CONCRETE	8,808
5.2	D	NATURAL SOIL	NATURAL SOIL	1,284
TOTAL				10,092

BMP DATA DMA 6

DMA	DMA CLASSIFICATION	NAME	SURFACE TYPE	AREA (SF)
6.1	D	STREETS	ASPHALT/CONCRETE	5,658
6.2	D	NATURAL SOIL	NATURAL SOIL	1,172
TOTAL				6,830

SOURCE CONTROL BMPS

①	ON-SITE STORM DRAIN INLETS
②	LANDSCAPE/ OUTDOOR PESTICIDE USE

LEGEND

- DMA AREA SINGLE FAMILY RESIDENTIAL (65% IMPERVIOUS)
- STREETS (100% IMPERVIOUS)
- LANDSCAPING (10% IMPERVIOUS)
- DMA BOUNDARY
- DRAINAGE PATH

STORM DRAIN NOTE

PER CITY OF MORENO VALLEY STD. NO. MVE-300B-D NOTE 13:
STENCIL INLET STRUCTURE WITH
"ONLY RAIN IN THE STORM DRAIN"
METAL STORM DRAIN MARKET
RECOMMENDED TO BE INSTALL ON
ALL INLETS.
SEE CALTRANS STD. D71



STORM DRAIN STENCIL

BMP MAP

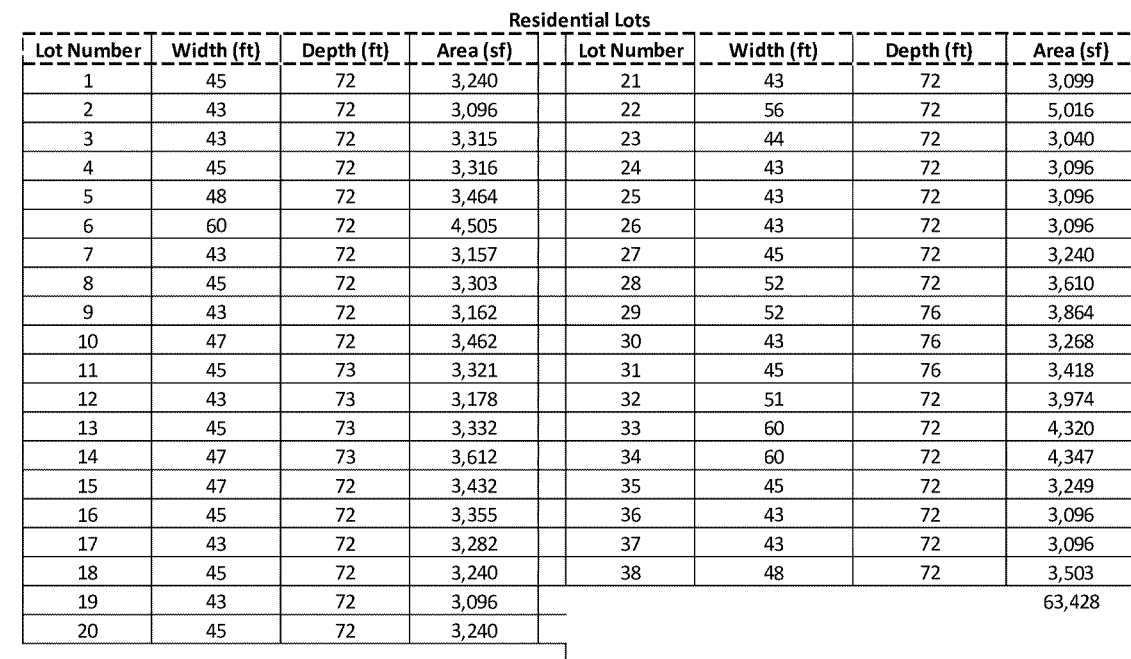
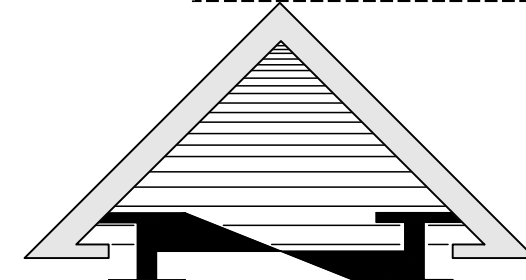
PREPARATION DATE : JULY 2024

PLAN PREPARED BY:

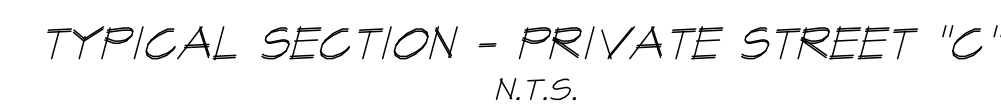
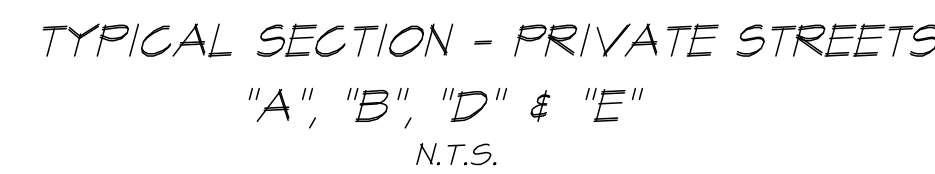
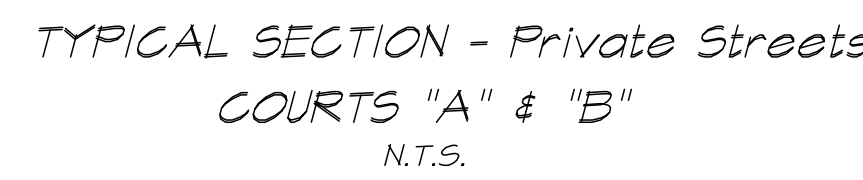
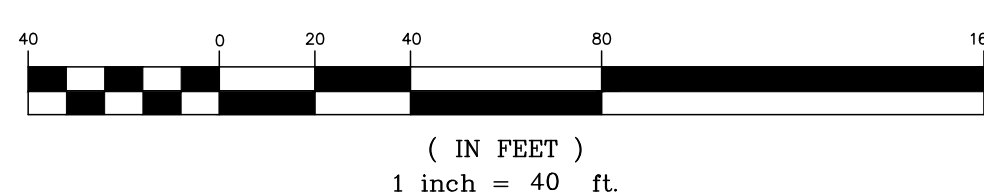
adkan ENGINEERS
Civil Engineering • Surveying • Planning
6879 Airport Drive, Riverside, CA 92504
Tel:(951) 688-0241-Fax:(951) 688-0399

Appendix 2: Construction Plans

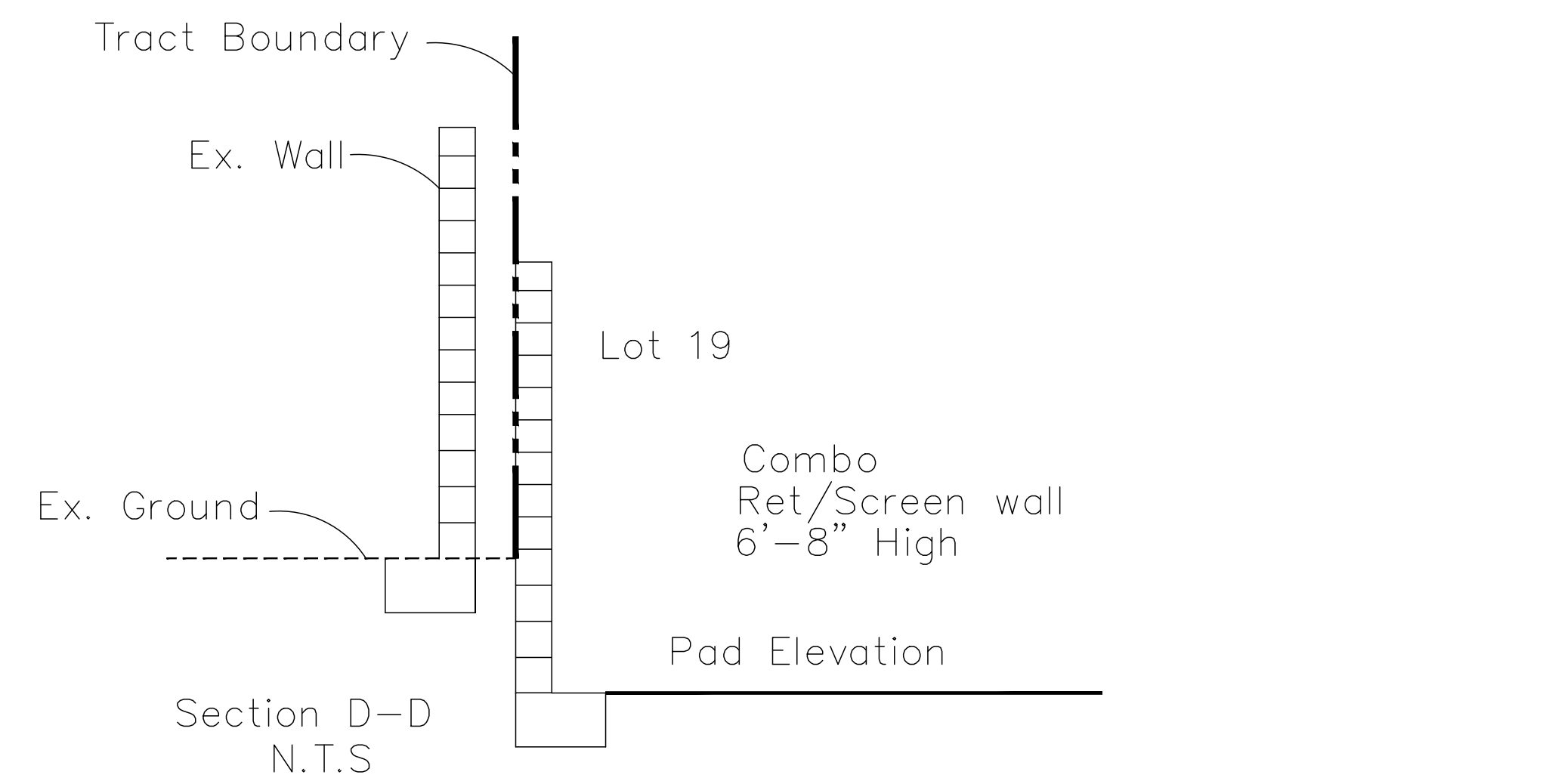
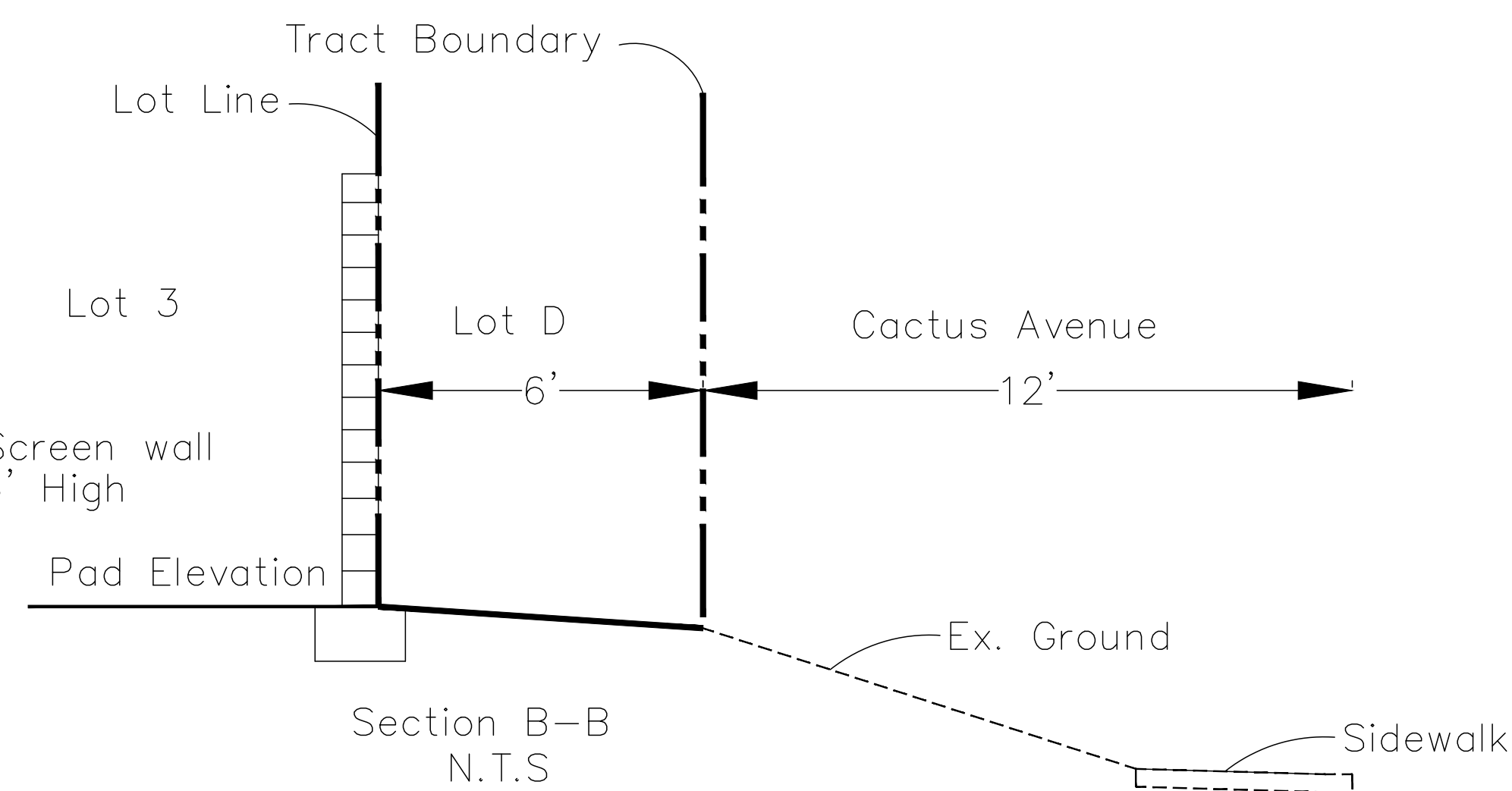
Grading and Drainage Plans

[illegible]

GRAPHIC SCALE



APN'S: 478-090-024-2 AND 478-0909-25-3

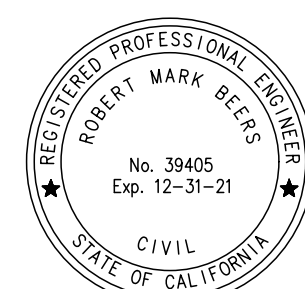


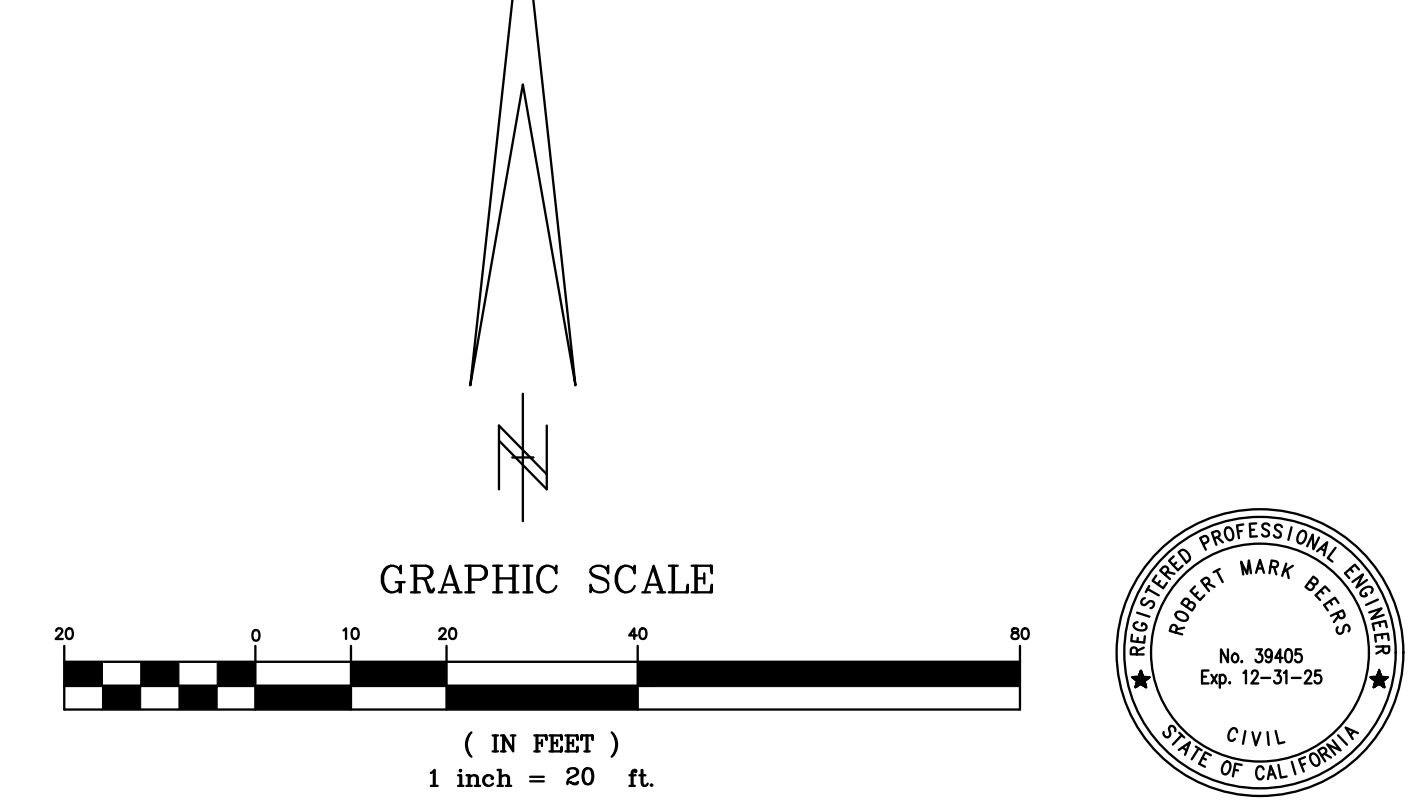
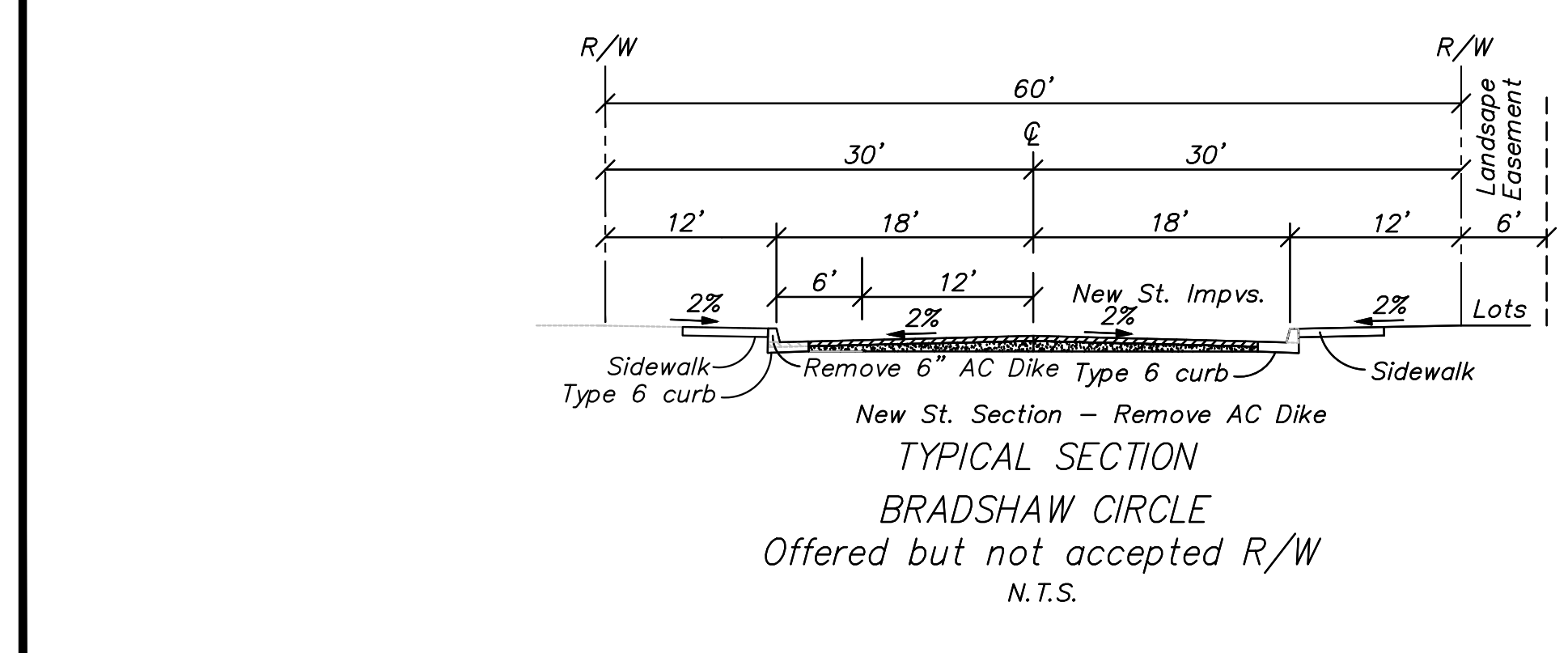
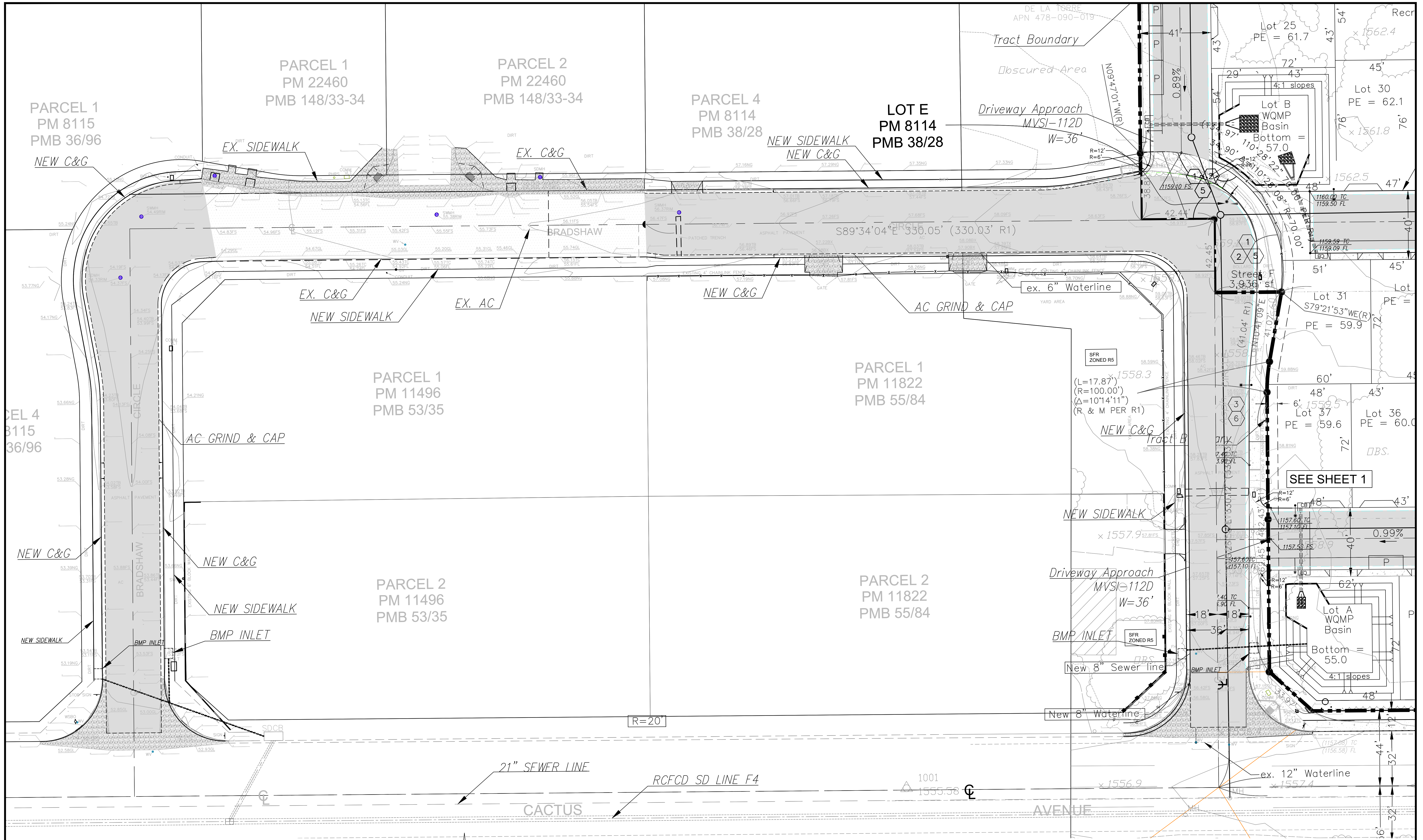
CATV: SPECTRUM

Date _____ Robert M. Beers _____

PHONE: (714) 833-8100

SHEET 1 OF 1





BRADSHAW CIRCLE - R/W
NOTE: OFFERS OF DEDICATION FOR PUBLIC STREET PURPOSES FOR BRADSHAW CIRCLE RIGHT-OF-WAY MADE BY:
PM 8114 PMB 38 PAGE 28
PM 8115 PMB 36 PAGE 96
PM 11496 PMB 53 PAGE 35
PM 11822 PMB 55 PAGE 64
TIM 37855 WILL IMPROVE BRADSHAW CIRCLE WITH NEW AC PAVING AND CURB & GUTTER & STREET LIGHTS

PROJECT ENTRANCES
PROJECT ENTRANCES OFF BRADSHAW CIRCLE SHALL BE DESIGNED AND CONSTRUCTED PER CITY OF MORENO VALLEY STD. PLAN MVSI - 112D-0

ROBERT BEERS
8175 Limonite Avenue, Suite E
Jurupa Valley, CA 92509
Ph. (951) 317-2041 Fax (909) 360-2070
Robert M. Beers RCE 38405 Expires 12-31-25 Date

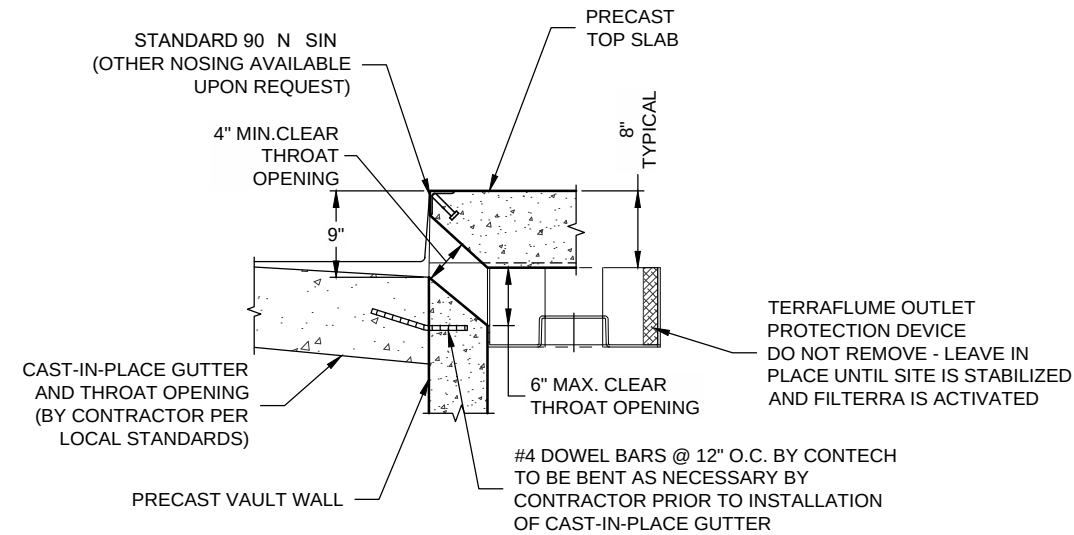
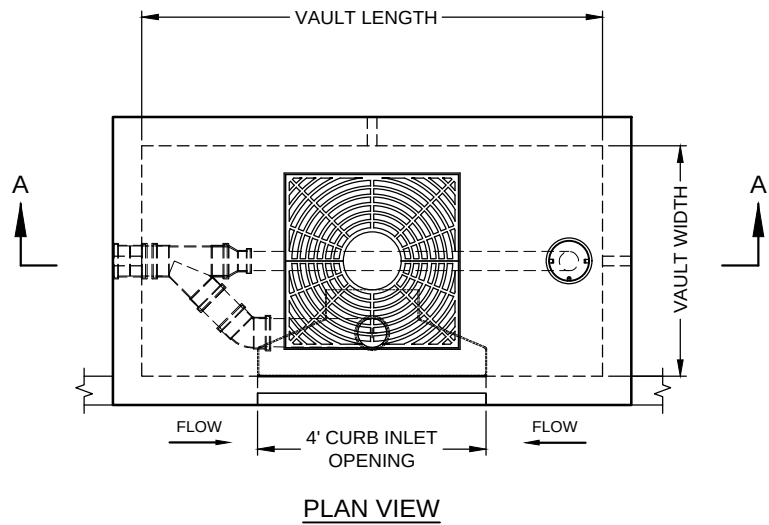
MARK	REVISIONS	APPR.	DATE

PREPARED FOR:
RC Hobbs Company, Inc.
1428 E. Chapman Avenue
Orange, CA 92666
PHONE: (714) 633-8100

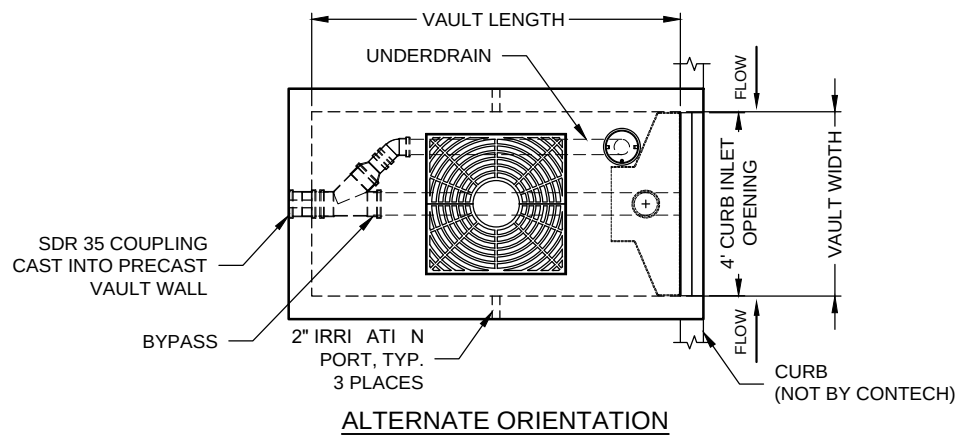
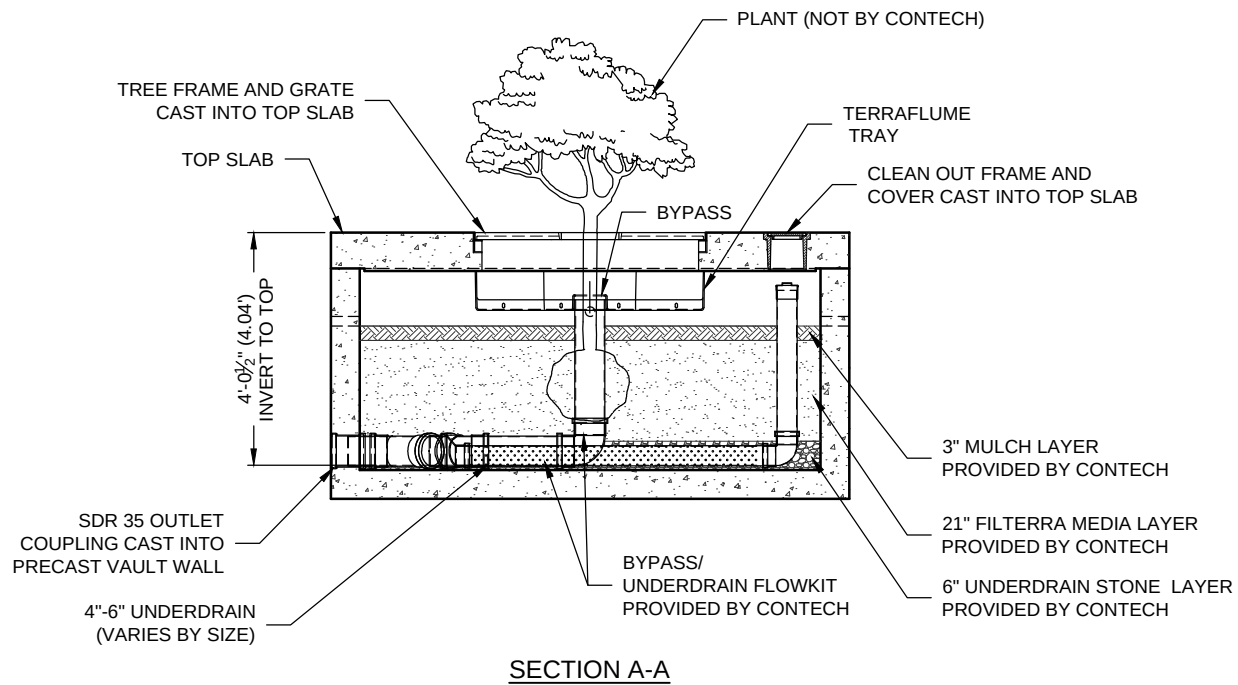
PEN24-0021 / TTM 37858
OFFSITE
Bradshaw Circle Improvements
City of Moreno Valley
CALIFORNIA

DATE July 30, 2024
JOB NO. _____
DRAWN BY R.A.H.
CHECKED BY R.M.B.
SHEET 2 OF 2

I:\COMMON\CAD\TREATMENT\64 FILTERRA\40 STANDARD DRAWINGS\FTIBC - INTERNAL BYPASS CURB INLET\DETAILS\DWG\FTIBC - FILTERRA INTERNAL BYPASS CURB INLET CONFIG DTL.DWG 3/23/2023 3:32 PM



STANDARD CURB INLET WITH TERRAFLUME
NOT TO SCALE



FTIBC CONFIGURATION

VAULT SIZE (L x W)	MEDIA AREA (SF)	LONG SIDE INLET DESIG. / PART NO.	SHORT SIDE INLET DESIG. / PART NO.	AVAILABILITY	MAX. OUTLET/ BYPASS PIPE DIA.	MAX. BYPASS FLOW (CFS)	UNDER- DRAIN PIPE DIA. (PERF)	TREE GRATE QTY. & SIZE
4 x 4	16	FTIBC0404	FTIBC0404	ALL	6" SDR 35	1.42	4" SDR 35	(1) 3' x 3'
6 x 4	24	FTIBC0604	FTIBC0406	ALL	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
8 x 4	32	FTIBC0804	FTIBC0408	ALL (EXCEPT DE, MD, NJ, PA, VA, WV)	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
7.83 x 4.5	35	FTIBC078045	FTIBC045078	DE, MD, NJ, PA, VA, WV ONLY	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
6 x 6	36	FTIBC0606	FTIBC0606	ALL (EXCEPT CA, TX)	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
8 x 6	48	FTIBC0806	FTIBC0608	ALL	10" SDR 35	2.37	4" SDR 35	(1) 4' x 4'
10 x 6	60	FTIBC1006	FTIBC0610	ALL (EXCEPT CA, TX)	10" SDR 35	2.37	6" SDR 35	(1) 4' x 4'
8 x 8	64	FTIBC0808	FTIBC0808	CA, TX ONLY	10" SDR 35	2.37	6" SDR 35	(1) 4' x 4'
12 x 6	72	FTIBC1206	FTIBC0612	ALL (EXCEPT TX)	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'
10 x 8	80	FTIBC1008	FTIBC0810	CA, TX ONLY	10" SDR 35	2.37	6" SDR 35	(1) 4' x 4'
13 x 7	91	FTIBC1307	FTIBC0713	ALL (EXCEPT CA, TX)	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'
12 x 8	96	FTIBC1208	FTIBC0812	CA, TX ONLY	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'
14 x 8	112	FTIBC1408	N/A	ALL	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'

INTERNAL PIPE CONFIGURATION MAY VARY DEPENDING ON VAULT SIZE

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FILTERRA INTERNAL BYPASS CURB (FTIBC)
CONFIGURATION DETAIL



FOR PATENT INFORMATION, GO TO www.ContechES.com/IP

Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data



SOIL EXPLORATION COMPANY, INC.

Soil Engineering, Environmental Engineering, Materials Testing, Geology

January 21, 2020

Project No. 19251-01

TO: Roger Hobbs
1428 E. Chapman Ave.
Orange, CA 92866

SUBJECT: Preliminary Soil Investigation, Infiltration Tests and Liquefaction Evaluation Report,
Proposed Residential Development Site (41 Lots), Cactus Avenue and Bradshaw Circle
(APN 478-090-018, -024 and -025), City of Moreno Valley, California

Introduction

In accordance with your authorization, Soil Exploration Co., Inc. has performed a preliminary soil investigation, infiltration tests and liquefaction evaluation for the subject site. The accompanying report presents a summary of our findings, conclusions, recommendations, and limitations of our work for proposed 41 lot, two-story wood frame residential development.

Scope of Work

- Review soils, geologic, seismic, groundwater data and maps in our files.
- Perform exploration of the site by means of five 8" diameter borings, 16.5 to 50 feet deep, at readily accessible locations.
- Field engineer (California Registered RCE) for logging of the excavations, sampling of select soils, observation of excavation resistance, record SPT blow counts and water seepage (if any).
- Perform basic laboratory testing of select soil samples, including moisture, density, expansion potential, sieve analysis and corrosion potential (pH, chlorides, resistivity and water soluble sulfates).
- Perform digitized search of known faults within a 50-mile radius of the site.
- Determine CBC (2019) seismic parameters.
- Consult with civil/structural design consultants.
- Perform two shallow infiltration tests at locations suggested by civil design engineer for WQMP design purposes.
- Prepare a report of our findings, conclusions and recommendations for site preparation, including overexcavation/removal depth, allowable bearing value, foundation/slab-on-grade depth/thickness/reinforcement recommendations, excavation characteristics of earth materials, lateral earth pressures for retaining walls design, pavement thickness estimates, suitability of onsite soils for compacted fills, liquefaction/dynamic settlement evaluation, general earthwork and grading specifications, California Building Code (2019) seismic design coefficients, Cal/OSHA classification of soils and infiltration rate (inches/hour).

Site Conditions

The rectangular shaped, relatively flat site is located on the north side of Cactus Avenue, east of Bradshaw Circle, in the City of Moreno Valley, Riverside County, California. Cactus Avenue is a paved road with curbs and no sidewalks. Bradshaw Circle is a paved road with no curbs, gutters or sidewalks. A chain link fence borders the site on the east side and a block wall on the north side. Existing houses are located on adjacent property to the north. Adjacent property to the east is vacant. Vegetation consists of very dense weeds and dense tumbleweeds.

The approximate locations of the above and other features are shown on Exploratory Boring and Infiltration Test Location Map, Plate 1. The base map is Site Plan prepared by Robert Beers of Jurupa Valley, California.

Proposed Development

We understand that the site is proposed for a single family, 41 lot residential development and associated improvements. The structures will be light, two-story wood frame construction with concrete floor slabs supported on prepared subgrade. Grading plans are not available for review at this time, however based on the relatively flat topography of the site, modest cut or fill grading and no significant cut or fill slopes are proposed.

Field Work

Five exploratory borings were drilled on January 8, 2020, to a maximum depth of 50 feet below existing ground surface utilizing a B-53 mobile drill rig equipped with 8-inch diameter hollow stem augers. Refer to Plate 1 for boring locations. The borings were logged by a California Registered Civil Engineer. Standard Penetration Tests (SPT) blow counts were recorded for the earth materials. Relatively undisturbed samples of the soils were also obtained by utilizing California Ring Sampler.

In general, these borings revealed that the site surface soils consist of sandy silt, silty sand and sand with silt (USCS "ML", "SM" and "SP-SM"). The granular earth materials are generally medium dense to very dense, however loose soils were noted to depths of 2 to 7 feet. Detailed descriptions of the earth materials encountered are presented in the form of Geotechnical Boring Logs in Appendix B.

USGS Geologic Map of the Sunnymead Quadrangle shows the site area is underlain with young alluvial-fan deposits (see Figure 2).

Laboratory Testing

Basic laboratory tests were performed for select soil samples. The tests consisted primarily of natural moisture contents, dry densities, sieve analysis and corrosion potential (pH, chlorides, resistivity and water soluble sulfates). Laboratory test results are presented in Appendix C and with Geotechnical Boring Logs in Appendix B.

Groundwater

Groundwater, seepage or wet soils were not encountered in our exploratory borings, drilled to a maximum depth of 50 feet, at the time this work was performed. Groundwater study is not within the scope of this work. Groundwater data from well in the vicinity of the site is tabulated below (see Figure 1, Site Location Map, for location of well):

Well No.	WSE* (ft)	Date Measured	Distance/Location Relative to Site	Estimated Depth of Water Below Site (ft)
EMWD 10141	1471.31	11/3/2011	SW/0.27 miles	74.5
	1483.11	11/27/2018		62.7

* WSE = Water Surface Elevation

Liquefaction Evaluation

Soil liquefaction is a process by which loose, saturated, fine granular deposits, such as fine sands, lose a significant portion of their shear strength due to pore water pressure buildup resulting from cyclic loading, such as that caused by an earthquake. In general, liquefaction potential is higher when the groundwater table is less than 30 feet below ground surface. Soil liquefaction can lead to foundation bearing failures and excessive settlements.

Based on Riverside County GIS map, the site is located within an area of moderate liquefaction potential (see Figure 3).

Summary of conditions for the deep boring B-1 are as follows:

Depth (ft)	Class (USCS)	SPT Count (blows/foot)	Moisture (%)	Passing 200 Sieve (%)	Compactness/Consistency
2	ML-SM	5	14.6	55	Loose
5	SM	8	-	-	Loose
10	SM	50	11.9	39	Dense
15	SM	36	-	-	Dense
20	SM	36	9.1	41	Dense
25	SM	36	-	-	Dense
30	SP-SM	70	2.7	12	Very dense
35	SP-SM	-	-	-	-
40	SP-SM	77	-	-	Very dense
45	SP-SM	-	-	-	-
50	SP-SM	86	-	-	Very dense

Liquefaction Analysis/Dynamic Settlement: LiquefyPro

Liquefaction susceptibility using Standard Penetration Test data and laboratory grain size test results were analyzed using LiquefyPro software (Version 5.5g). Liquefaction analysis performed for this evaluation included: [1] evaluation of soil consistency and compactness influencing liquefaction, [2] correction of penetration resistance data to convert measured SPT N-values to standard N_{60} -values, [3] calculating the earthquake induced stress ratio (CSR), [4] calculating cyclic resistance ratio (CRR), [5] assume water table at 60 feet below the ground surface, and [6] evaluation of liquefaction potential by calculating a factor of safety against liquefaction (FS), by dividing CRR by CSR. The software output is presented in Appendix G.

The main observations of the results are as follows:

- Onsite soils at the site in general have a Safety Factor of 5.0 against liquefaction. Subsequent to compaction of upper 5 feet of soils, indicated settlement of saturated and unsaturated sands is 0.00 in. and 1.14 in., respectively, with total settlement of saturated and unsaturated sands of 1.14 in., with differential settlement of 0.570 to 0.753 in. in 30 feet.
- Liquefaction also involves lateral or horizontal displacement (lateral spreading) of essentially intact blocks of surficial soils on slopes or toward a free-face slope such as river or canal bank. The potential for and magnitude of lateral spreading is dependent upon many conditions, including the presence of a relatively thick, continuous, potentially liquefiable sand layer and high slopes. Subsurface information obtained for this study indicates that high slopes are not anticipated. Based on currently available procedures, the site does not appear to be susceptible to (lateral spread) ground surface disruption during a moderate seismic event.

Seismicity/Faulting

The site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone or County of Riverside Fault zone.

A computer search of all known Quaternary major faults within 50 miles of the site from USGS Earthquake Hazards Program is presented in Appendix D. Please note that it is probable that not all active or potentially active faults in the region have been identified. Furthermore, seismic potential of the smaller and less notable faults is not sufficiently developed for assignment of maximum magnitudes and associated levels of ground shaking that might occur at the site due to these faults.

Conclusions and Recommendations

Conclusions

- All vegetable matter, old fills, buried utilities/irrigation lines, etc. and deleterious materials would require removal from the proposed building/grading areas.
- Overexcavation and recompaction of the loose surficial soils should be anticipated to provide adequate and uniform support for the proposed structures. All surficial earth materials encountered during our investigation can be excavated with normal grading equipment in good working condition.
- Onsite earth materials, cleansed of oversize cobbles and boulders (over 6 inches, if any), should be suitable for engineered/compacted fills.
- Based on observation and soil classification, the expansion potential of onsite near surface silty sands is expected to be very low ($EI < 20$).
- Subsequent to site preparation, the use of shallow spread footing foundations appears feasible for the proposed construction.
- Flooding potential of the site should be determined by the design civil engineer and considered in planning and construction.
- Site is located approximately 2.78 miles from the San Jacinto fault. The site is located in a region of generally high seismicity, as is all of Southern California. During its design life, the site is expected to experience moderate to strong ground motions from earthquakes on regional and/or nearby causative faults.
- There is a 2 percent probability in 50 years (2475 year return period) that site modified peak ground acceleration at the site (PGA_m) will exceed 0.909g (see Appendix D).
- Groundwater was not encountered during subsurface investigation. Our experience indicates that surface or near-surface groundwater conditions can develop in areas where groundwater conditions did not exist prior to site development, especially in areas where a substantial increase in surface water infiltration results from landscape irrigation.

Recommendations

Site Preparation/Overexcavation

Grading and backfills should be performed in accordance with the City of Moreno Valley Grading Ordinance and attached General Earthwork and Grading Specifications (Appendix E), except as modified in the text of this report.

Structures should be provided with a compacted fill mat that extends to at least 5 feet beyond the structure lines in plan and to a depth of at least 5 feet below existing or proposed grade, whichever is deeper. The excavated bottom should be cleaned from roots, soft spots, wet spots, porous soils, old foundations, seepage pits and deleterious materials, etc. As a result, deeper excavations should not be precluded and this should be determined by observations and testing of excavated bottoms during grading.

After cleaning of the excavated bottom, the exposed surfaces should be further scarified to a depth of at least 12-inches, moisture conditioned/thoroughly watered and recompact by utilizing heavy vibratory rollers to at least 90 percent of the maximum dry density, as determined by ASTM D1557-12 Test Method, prior to placement of fill. Oversize material (larger than 6-inch size, if any) should not be utilized for structural fills. All fills should be placed on underlying medium dense native soils and compacted to at least 90 percent of the maximum dry density.

The purposed of the above recommendations is to provide at least 3.5 feet of compacted fill mat below the foundation bottoms.

Compacted Fills/Imported Soils

Any soil to be placed as fill, whether presently onsite or import, should be approved by the soil engineer or his representative prior to its placement. All onsite soils to be used as fill should be cleansed of any roots or other deleterious materials. Cobbles larger than 3 inches in diameter should not be placed in the vicinity of foundations and utility lines. All fills should be placed in 6 to 8 inch loose lifts, thoroughly watered, mixed and compacted to at least 90 percent relative compaction. This is relative to the maximum dry density determined by ASTM 1557-12 Test Method.

Foundation Design/Footings

Following site preparation, the use of shallow spread footings is feasible. An allowable bearing value of 1800 psf is recommended. This bearing pressure has been established based on the assumption that the footings will be embedded into compacted fill mat. Isolated column footings should be at least 24 inches wide and embedded at least 24 inches below lowest adjacent firm grade.

The above bearing value may be increased by one third for temporary (wind or seismic) loads. We recommend footings reinforcement should be at least two No. 5 bars at top and two at the bottom of footings. Conventional foundation should be in accordance with current California Building Code (CBC) 2019, with design by a qualified structural engineer. Additional recommendations for conventional foundations of one and two-story residential structures are presented on Plate 2. Please note that foundation design is under the purview of the structural engineer and structural engineer may have more restrictive requirements which will govern.

Conventional Residential Slabs-On-Grade

Residential slabs-on-grade should be at least 4 inches thick and should be reinforced with at least No. 3 bars at 18-inches on-center both ways, properly centered in mid-thickness of slabs (structural recommendations govern). Slabs-on-grade should be underlain with 10-mil Visqueen moisture barrier. The moisture barrier should be underlain by two inches of clean rolled sand.

Tentative Pavement Design

Based on the granular nature of the onsite soils, we have assigned an R-value of 45. The recommended sections are outlined as follows:

Street Type	Traffic Index (TI)	Asphalt Concrete (inches)	Aggregate Base (CAB) (inches)
Interior Street	5.5 to 6	3	6

The upper at least 12 inches of the subgrade soils below new pavements should be compacted to at least 90 percent relative compaction. Minimum relative compaction requirements for aggregated base should be 95 percent of the maximum laboratory dry density as determined by ASTM D1557-12.

Final pavement design shall be based on R-value testing of the subgrade soils at the completion of grading.

Hardscape Areas/Compaction/Concrete Joints

The upper at least 12 inches of subgrade soils for hardscape areas should be scarified and compacted to at least 90 percent.

The joints spacing for concrete slabs should be determined by the project architect. Joints should be laid out to form approximately square panels (equal transverse and longitudinal joint spacing). Rectangular panels, with the long dimension no more than one-and-one-half times the short, may be used when square panels are not feasible. The depth of longitudinal and transverse joints should be one-fourth the depth of the slab thickness.

Joint layout should be adjusted so that the joints will line up with the corners of structures, small foundations and other built-in structures. Acute angles or small pieces of slab curves as a result of joints layout should not be permitted.

Concrete Curing

Fresh concrete should be cured by protecting it against loss of moisture, rapid temperature change and mechanical injury for at least 3 days after placement. Moist curing, waterproof paper, white polyethylene sheeting, white liquid membrane compound, or a combination thereof may be used. After finishing operations have been completed, the entire surface of the newly place concrete should be covered by whatever curing medium is applicable to local conditions and approved by the engineer. The edges of concrete slabs exposed by the removal of forms should be protected immediately to provide these surfaces with continuous curing treatment equal to the method selected for curing the slab surfaces. The contractor should have at hand, and ready to install before actual placement begins, the equipment needed for adequate curing of the concrete.

In hot or windy weather (80°F or 15 mph), the contractor must take appropriate curing precautions after the placement of concrete. The use of mechanically compacted low slump concrete (not exceeding 4 inches at the time of placement) is recommended. We recommend that a slipsheet (or equivalent) be utilized if grouted tiles or other crack sensitive flooring is planned directly on concrete slabs.

Special Considerations/Excess Soils from Foundation Excavations

Excess soils generated from foundation excavations should not be placed on slabs and driveways subgrade without proper moisture and compaction. Slab subgrade should be verified to contain 1.2 times the soil optimum moisture content to a depth of 6 inches prior to placement of slab building materials. Moisture content should be tested in the field by the soil engineer. The addition of fiber mesh in the concrete and careful control of water/cement ratios may lessen the potential for slab cracking.

Lateral Earth Pressures/Retaining Walls

The following lateral earth pressures and soil parameters, in conjunction with the above-recommended bearing value (1800 psf), may be used for design of retaining walls with free draining compacted backfills. If passive earth pressure and friction are combined to provide required resistance to lateral forces, the value of the passive pressure should be reduced to two-thirds the following recommendations:

Active Earth Pressure with level backfill (P_a)	35 pcf (EFP), drained, yielding
At Rest Pressure (P_0)	55 pcf (EFP), drained, non-yielding (part of building wall)
Passive Earth Pressure (P_p)	250 pcf (EFP), drained, maximum of 2500 psf
Horizontal Coefficient of Friction (μ)	0.30
Unit Soil Weight (γ)	120 pcf

We recommend drainage for retaining walls to be provided in accordance with Plate 3 of this report. Maximum precautions should be taken when placing drainage materials and during backfilling. All wall backfills should be properly compacted to at least 90 percent relative compaction.

Seismic Considerations

The site is located approximately 2.78 miles from the San Jacinto fault. Moderate to strong ground shaking can be expected at the site and there is a 2 percent probability in 50 years (2475 year return period) that site modified peak ground acceleration at the site (PGA_m) will exceed 0.909g. The site soil profile is Class D. The structural engineer must consider City/County local codes, California Building Code (CBC) 2019 seismic data presented in this report (Appendix D), the latest requirements of the Structural Engineers Association, and any other pertinent data in selecting design parameters.

Expansion Index and Corrosion/Soluble Sulfates

Based on observation and soil classification, the expansion potential of the near surface sandy soils is anticipated to be very low ($EI < 20$).

Results of tests performed by Cal Land Engineering, Inc. of Brea, California on a select soil sample indicate negligible soluble sulfate exposure (less than 0.1 percent water soluble sulfates by weight), pH of 9.20, chlorides of 214 ppm and resistivity of 1,700 ohm-cm (see Appendix C). Based on pH, the soils are alkaline. Based on resistivity test results, soil is highly corrosive and ferrous metals/pipes/reinforcement should be protected. Concrete, mix, placement and curing for concrete should comply with ACI guidelines. Tentatively we recommend Type II cement and concrete slump not exceeding 4 inches at the time of placement. If critical, these should be further verified by your structural or a corrosion engineer.

Drainage

Positive drainage must be provided and maintained for the life of the project around the perimeter of the structures and all foundations toward streets or approved drainage devices to minimize water infiltration into the underlying soils. In addition, finish subgrade adjacent to exterior footings should be sloped down and away to facilitate surface drainage. Roof drainage should be collected and directed away from foundations and slopes via nonerosive devices. Water, either natural or by irrigation, should not be permitted to pond or saturate the foundation soils.

Cal/OSHA Classification/Trench Excavations/Backfills

In general Cal/OSHA classification of onsite soils appears to be Type B.

Temporary trench excavations deeper than 5 feet should be shored or sloped at 1:1 or flatter in compliance with Cal/OSHA requirements:

- a.) The shoring should be designed by a qualified engineer experienced in the shoring design.
- b.) The tops of any temporary unshored excavations should be barricaded to prevent vehicle and storage loads within a 1:1 line projected upward from the bottom of the excavation or a minimum of 5 feet, whichever is greater. If the temporary construction embankments, including shored excavations, are to be maintained during the rainy season, berms are suggested along the tops of the excavations where necessary to prevent runoff from entering the excavation and eroding the slope faces.
- c.) The soils exposed in the excavations should be inspected during excavation by the soils engineer so that modifications can be made if variations in the soil conditions occur.
- d.) All unshored excavations should be stabilized within 30 days of initial excavation.

Foundation Plan Review/Additional Observations and/or Testing

The recommendations provided in this report are based on preliminary design information and subsurface conditions as interpreted from limited exploratory work. Our conclusions and recommendations should be reviewed and verified during construction and revised if necessary.

Soil Exploration Co., Inc. should review the foundation plans and observe and/or test at the following stages of construction:

- During all overexcavations and fill placement.
- Following footing excavations and prior to placement of footing materials.
- During wetting of slab subgrade (1.2X optimum to a depth of at least 6") and prior to placement of slab materials.
- During all trench and retaining wall backfills.
- During subgrade preparation/compaction, prior to paving.
- When any unusual conditions are encountered.

Final Compaction Report

A final report of compaction control should be prepared subsequent to the completion of rough grading. The report should include a summary of work performed, laboratory test results, and the results, locations and elevations of field density tests performed during grading.

Limitation of Investigation

Our investigation was performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable Geotechnical Engineers practicing in this or similar locations. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

The field and laboratory test data are believed representative of the project site; however, soil conditions can vary significantly. As in most projects, conditions revealed during grading may be at variance with preliminary findings. If this condition occurs, the possible variations must be evaluated by the Project Geotechnical Engineer and adjusted as required or alternate design recommended.

This report is issued with the understanding that it is the responsibility of the owner, or his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractor carry out such recommendations in the field.

This firm does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and we cannot be responsible for other than our own personnel on the site; therefore, the safety of others is the responsibility of the contractor. The contractor should notify the owner if he considers any of the recommended actions presented herein to be unsafe.

The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they are due to natural processes or the works of man on this or adjacent properties. In additions, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge.

This report was prepared for the client based on client's needs, directions and requirements at the time. This report is not authorized for use by and is not to be relied upon by any party except the client with whom Soil Exploration Co., Inc. contracted for the work. Use of, or reliance on, this report by any other party is at that party's risk. Unauthorized use of or reliance on this report constitutes an agreement to defend and indemnify Soil Exploration Co., Inc. from and against any liability which may arise as a result of such use or reliance, regardless of any fault, negligence, or strict liability of Soil Exploration Co., Inc.

Closure

If you should have any questions or concerns regarding this report, please do not hesitate to call our office. We appreciate this opportunity to be of service.

Very truly yours,
Soil Exploration Co., Inc.

Gene K. Luu, PE 53417
Project Engineer

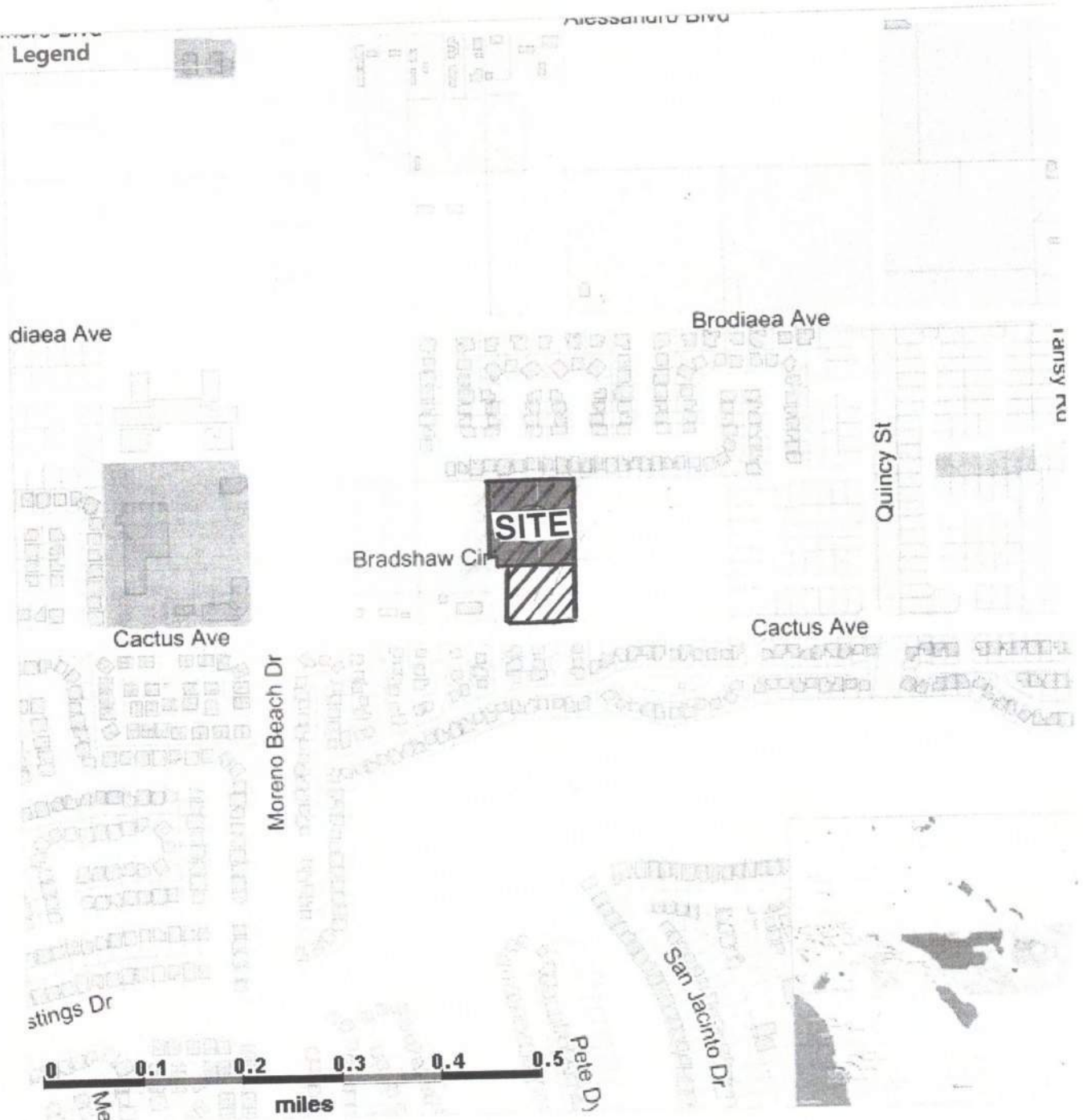
Distribution: [1] Addressee (rch@rchobbs.com)
[1] Robert Beers (rmbeers777@hotmail.com)

Attachments: Figure 1 Site Location Map
Figure 2 USGS Geologic Map
Figure 3 Riverside County GIS Map
Figure 4 U.S. Geological Survey Faults Map

Plate 1 Exploratory Boring and Infiltration Test Location Map
Plate 2 Minimum Foundation and Slab Recommendations for Expansive Soils
Plate 3 Retaining Wall Backfill and Subdrain Backfill

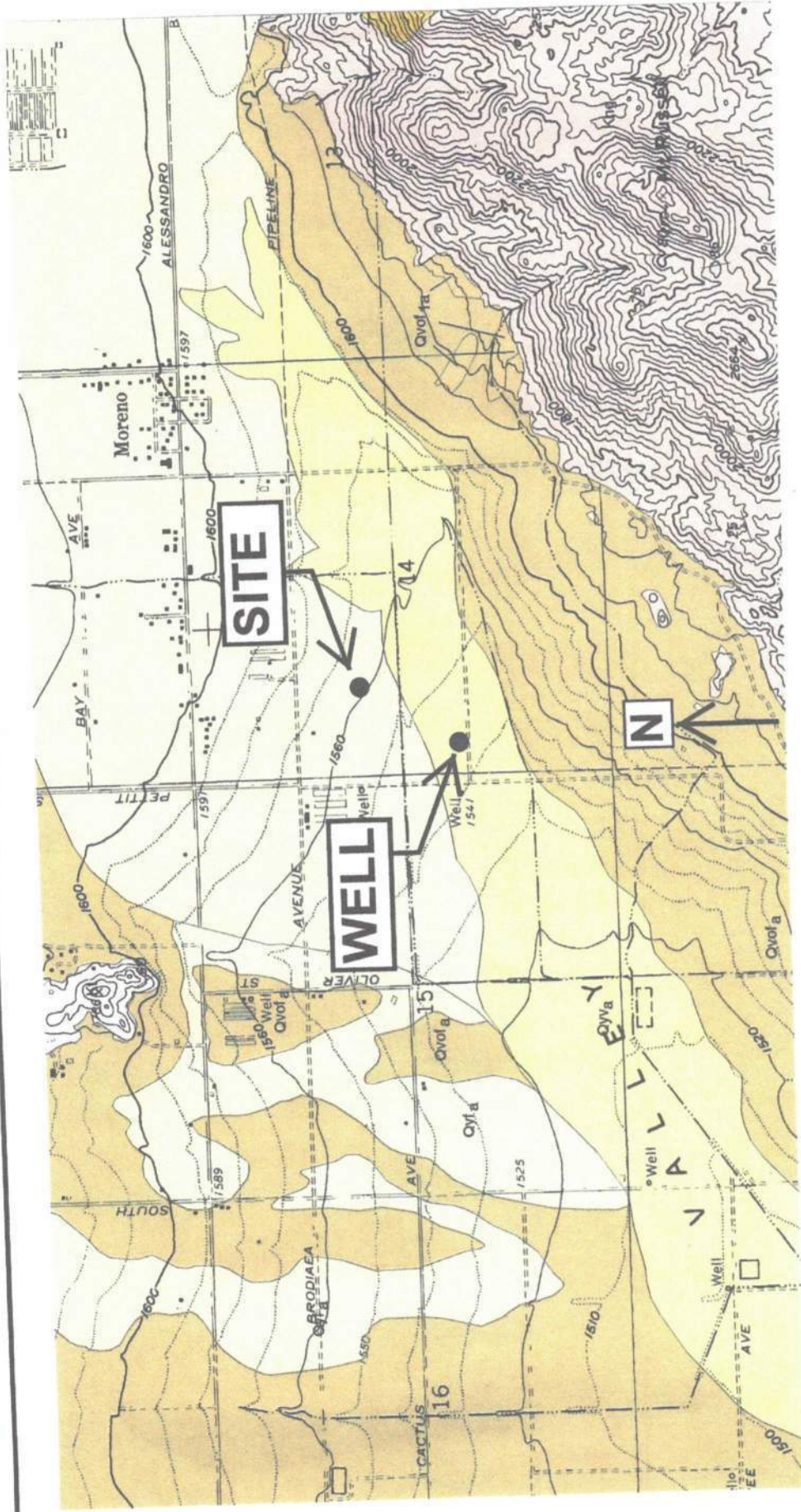
Appendix A References
Appendix B Geotechnical Boring Logs
Appendix C Laboratory Test Results
Appendix D USGS National Seismic Hazard Maps-Source Parameters
and CBC (2019) Seismic Parameters

Appendix E General Earthwork and Grading Specifications
Appendix F Infiltration Test Procedures and Test Results
Appendix G Liquefaction Analysis Summary



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Figure 1



Base Map: USGS Geologic Map of the Sunnymead 7.5' Quadrangle, Riverside County, California.

LEGEND:

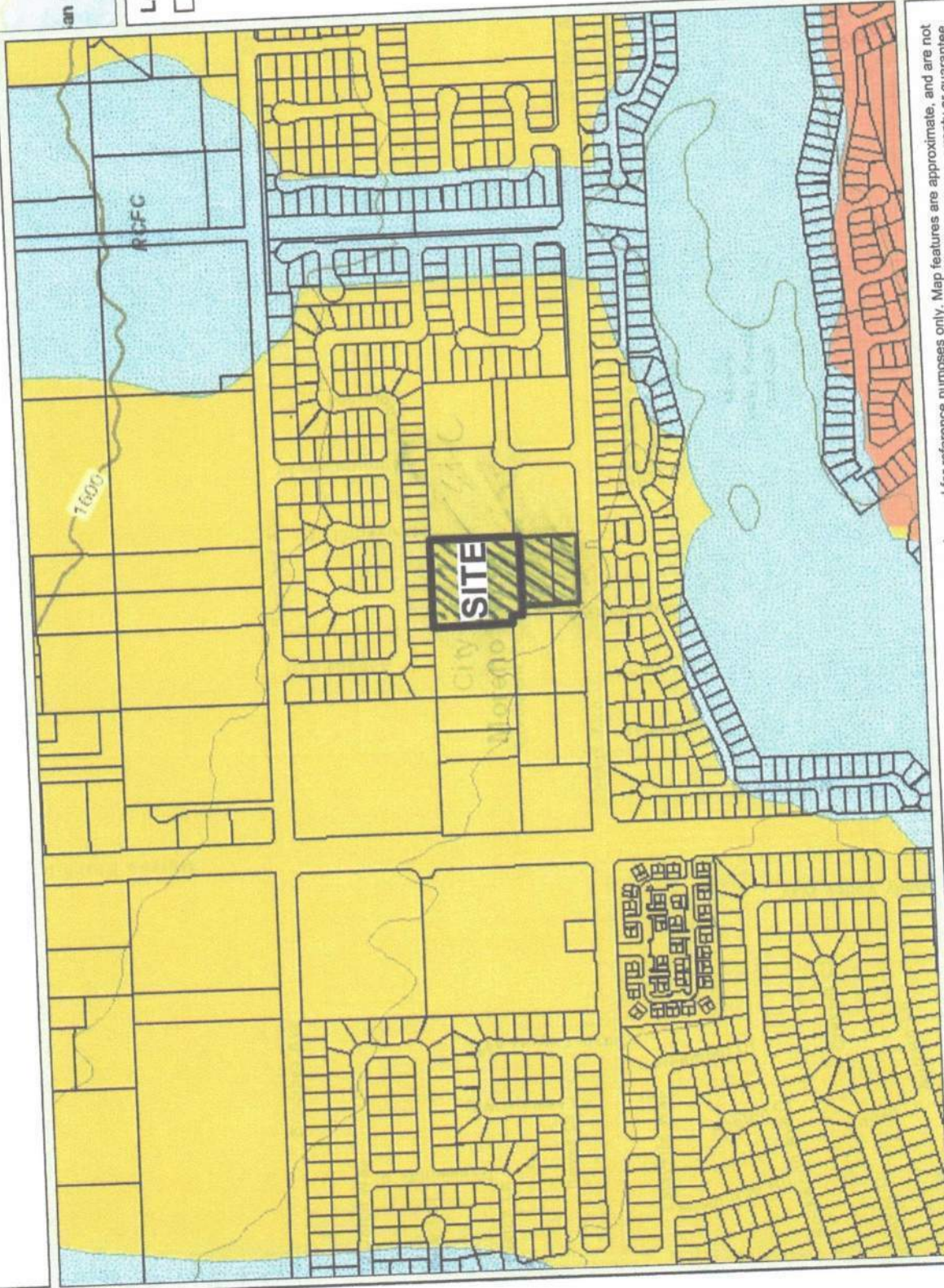
Qyf: Young alluvial-fan deposits (Holocene and late Pleistocene) – Gray-hued sand and cobble- and gravel-sand deposits from lithically diverse sedimentary units.

- a: Arenaceous (very coarse sand through very fine sand).
- g: Gravel.

Soil Exploration Co., Inc. 19251-01
 Project No.: 19251-01
 Date: January 21, 2020
 Figure: 2

Cactus Avenue and Bradshaw Circle
 (APN 478-090-018, -024 and -025)
 City of Moreno Valley, California

Map My County Map



Legend

- ☐ Parcels
- Contours 20 ft interval (with 10
- 20' CONTOUR
- 100' INDEX CONTOUR
- Faults**
- OTHER AUTHORITY
- ALQUIST-PRIOLO
- RIVERSIDE COUNTY
- Fault Zones**
- OTHER FAULT ZONE
- COUNTY FAULT ZONE
- ELSINORE FAULT ZONE
- SAN ANDREAS FAULT ZONE
- SAN JACINTO FAULT ZONE
- Flood**
- Liquefaction**
- Other Susceptibility
- High
- Low
- Moderate
- Very High
- Very Low
- Blue-line Streams
- City Areas
- World Street Map

Notes

APN 478-090-018, 024, 025

Figure 3

"IMPORTANT" Maps and data are to be used for reference purposes only. Map features are approximate, and are not necessarily accurate to surveying or engineering standards. The County of Riverside makes no warranty or guarantee as to the content (the source is often third party), accuracy, timeliness, or completeness of any of the data provided, and assumes no legal responsibility for the information contained on this map. Any use of this product with respect to accuracy and precision shall be the sole responsibility of the user.

© Riverside County GIS

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0 752 1,505 Feet

U.S. Geological Survey 2014 Faults



1/9/2020, 3:38:49 PM

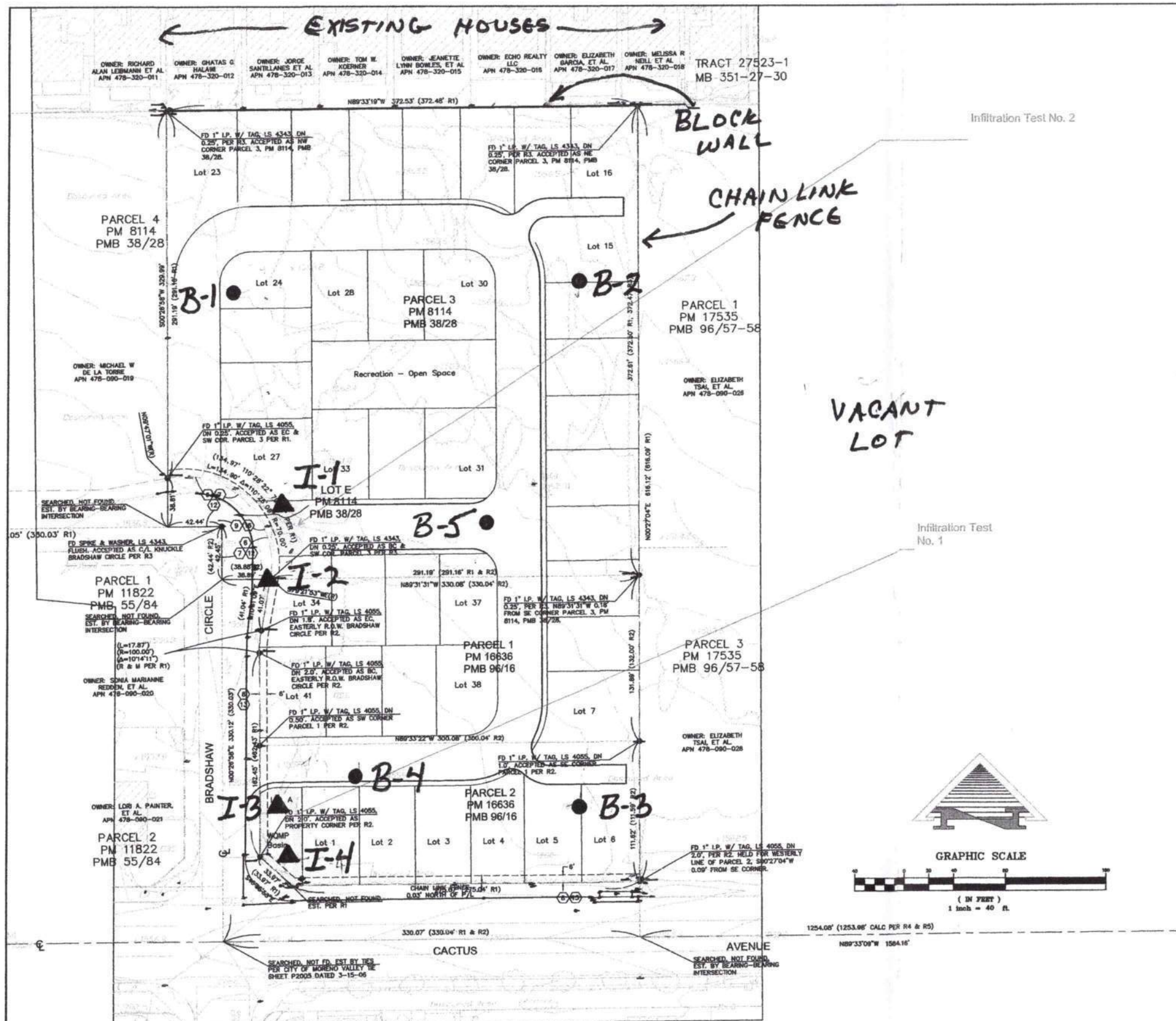
NSHM 2014 Fault Sources

- Normal
- Strike Slip
- Thrust
- Unassigned



USGS, National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Figure 4



Nominal Lot Size: 43' by 72' and 45' by 72'

ROBERT BEERS
8175 Limonite Avenue, Suite E
Jurupa Valley, CA 92509
Ph. (951) 317-2041 Fax (909) 360-2070

Date _____ Robert M. Beers R.C.E. 39405 Expires 12-31-21

FIELD BOOK REF.

MARK REVISIONS APPR. DATE

PREPARED FOR:

RC Hobbs Companies
1428 E. Chapman Avenue
Orange, CA 92666
PHONE: (714) 633-8100

TTM 37858
Base Lotting Layout
City of Moreno Valley
CALIFORNIA

DATE Dec 9, 2019

JOB NO. _____

DRAWN BY R.A.M.

CHECKED BY R.M.B.

SHEET 1 OF 1

Base Layout: 41 Lots

**EXPLORATORY BORING
& INFILTRATION TEST LOCATION MAP
PLATE 1**

LEGEND

B-5 • Approximate Location of Boring
I-4 ▲ Approximate Location of Infiltration Test

Soil Exploration Co., Inc.

Project No. 19251-01

January 21, 2020

EXPANSION INDEX (ASTM D 4829)	
0-20	
VERY LOW EXPANSION	
1-Story Footings (See Note 1)	All footings at least 18" deep. Reinforcement for continuous footings: Two No. 5 bars top and two No. 5 bars bottom
2-Story Footings (See Note 1)	All footings at least 18" deep. Reinforcement for continuous footings: Two No. 5 bars top and two No. 5 bars bottom
Minimum Footing Width	Continuous: 15" for 1-story Continuous: 15" for 2-story
Pad Footings	Isolated column: 24" wide and 24" deep, tied to continuous footings in two directions
Garage Door Grade Beam (See Note 2)	A grade beam 18" deep by 15" wide for 1- and 2-story should be provided across the garage entrance and other large openings
Living Area Floor Slabs* (See Notes 3, 4 and 5)	4" thick slab. No. 3 rebar at 18 inches on-center reinforcement at mid-height with 10-mil Visqueen moisture barrier above 2" sand base
Garage Floor Slabs* (See Notes 4 and 6)	4" thick slab. No. 3 rebar at 18 inches on-center reinforcement at mid-height with 10-mil Visqueen moisture barrier above 2" sand base. Garage slabs should be quarter-sawn.
Presoaking of Living Areas & Garage Slabs Subgrade**	(1.2) times optimum moisture to a depth of at least 6"

The Above Are Minimum Recommendations.

All Work Should Comply with Applicable/Governing Agency Codes and Requirements

* Based on California Green Code, a 4" thick base of $\frac{1}{2}$ inch or larger clean aggregate shall be used below the Visqueen.

**Presoaking of living areas and garage slabs should be observed and tested by the project geotechnical engineer.

NOTES:

1. Depth of interior or exterior footings to be measured from lowest adjacent finish grade.
2. The base of the grade beam should be at the same elevation as that of the adjoining footings.
3. Living areas slabs may be tied to the footings as directed by the structural engineer.
4. We recommend the use of at least No. 3 bars at 18 inches on-center, each way, for all slabs.
5. 10-mil Visqueen sheeting welded at laps has proved successful. Equivalents are acceptable.
6. Garage slabs should be isolated from stem wall footings with a minimum 3/8" felt expansion joint.
7. Sand base should have a Sand Equivalent (SE) of 30 or greater (e.g., washed concrete sand).

Post-Tensioned Slabs

As an alternative to conventional foundations, building may be supported on post-tensioned slabs, to be designed by a structural engineer in consultation with the geotechnical consultant. In addition, a post-tensioned slab is also recommended for VERY HIGH expansion potential (Expansion Index greater than 130), if encountered. Post-tensioned slabs should have perimeter footings embedded a minimum of 12 inches below the adjacent grade. The slabs should be designed such that they can be deformed approximately 1-inch vertically over a width of 30 feet without distress in the event of shrinkage or swelling of the supporting soils. Living area slabs should be underlain by a 10-mil Visqueen moisture barrier covered by a 2-inch layer of sand. Presoaking is recommended for post tensioned slabs: (1.2) x optimum to a depth of 12 inches, (1.3) x optimum to a depth of 18 inches, and (1.4) x optimum to a depth of 24 inches for LOW, MEDIUM, and HIGH expansion potential soils, respectively. LOW and MEDIUM expansive soil lots using conventional foundation should comply with 2019 CBC. For very high expansion potential (Expansion Index greater than 130), specific recommendations by the geotechnical consultant will be required. Placement of 4 inches of sand base is also suggested for post-tensioned slab systems. Unless stated in the attached report, for EI=21-50 use PI=25, and EI=51-90 use PI=35.

**Minimum Foundation and Slab Recommendations
For Expansive Soils**

ONE- AND TWO-STORY RESIDENTIAL BUILDINGS

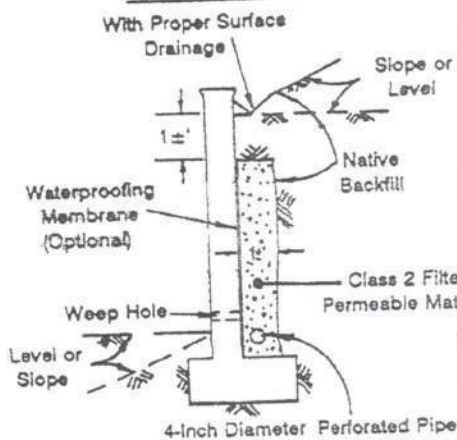


Soil Exploration Co. Inc.

Plate: 2

SUBDRAIN OPTIONS FOR NATIVE MATERIAL BACKFILL

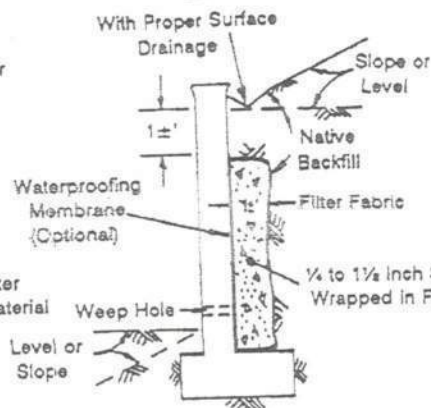
OPTION N2: Pipe Surrounded with Class 2 Material



Class 2 Filter Permeable Material Grading Per Catrans Specifications

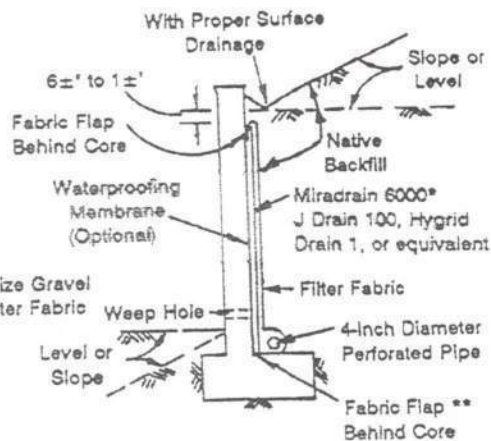
Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

OPTION N1: Gravel Wrapped in Filter Fabric



Proper Outlet Should be Provided for Gravel Subdrain (See Notes)

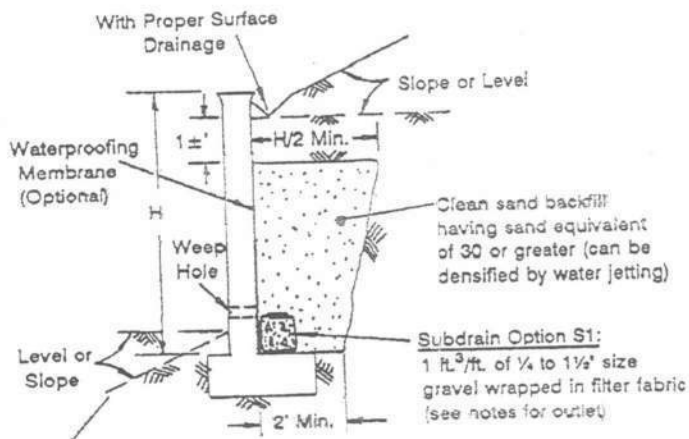
OPTION N3: Geotextile Drain



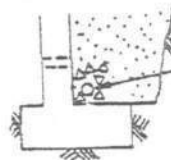
*Miradrain 6000 or J Drain 100 for non-waterproofed walls; Miradrain 6200 or J Drain 200 for completed waterproofed walls

**Peel back the bottom fabric flap, place pipe next to core, wrap fabric around pipe and tuck behind core.

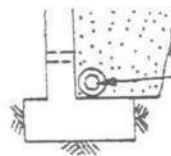
SUBDRAIN OPTIONS FOR CLEAN SAND BACKFILL



Subdrain Option S1:
1 ft³/ft of 1/4 to 1 1/2" size gravel wrapped in filter fabric (see notes for outlet)



Subdrain Option S2:
4" diameter perforated pipe surrounded with 1 ft³/ft of Class 2 filter material per Catrans specifications as above



Subdrain Option S3:
4" diameter perforated pipe wrapped in filter fabric

Notes:

- Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785 Polyvinyl Chloride plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down.
- Filter fabric should be Mirafi 140N, 140NS, Supac 4NP, Amoco 4545, Trevira 1114, or approved equivalent.
- All drains should have a gradient of 1 percent minimum.
- Outlet portion for gravel subdrain should have a 4"-diameter pipe with the perforated portion inserted into the gravel approximately 2' minimum and the nonperforated portion extending approximately 1' outside the gravel. Proper sealing should be provided at the pipe insertion enabling water to run from the gravel portion into rather than outside the pipe.
- Waterproofing membrane may be required for a specific retaining wall such as a stucco or basement wall.
- Weephole should be 2" minimum diameter and provided at 25' minimum in length of wall. If exposure is permitted, weephole should be located at 3" above finished grade. If exposure is not permitted such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk to discharge through the curb face or equivalent should be provided, or for a basement-type wall, a proper subdrain outlet system should be provided. Open vertical masonry joints (i.e., omit mortar from joints of first course above finished grade) at 32' maximum intervals may be substituted for weepholes. Screening such as with a filter fabric should be provided for weepholes/open joints to prevent earth materials from entering the holes/joints.

RETAINING WALL BACKFILL
AND SUBDRAIN DETAIL



Soil Exploration Co. Inc.

Plate: 3

APPENDIX A



REFERENCES

- USGS Geologic Map of the Sunnymead 7.5' Quadrangle, Riverside County, California.
- Riverside County GIS Liquefaction Map.
- U.S. Geological Survey – Earthquake Hazards Program, 2008 National Seismic Hazard Maps – Source Parameters.
- U.S. Geological Survey Faults, 2014.

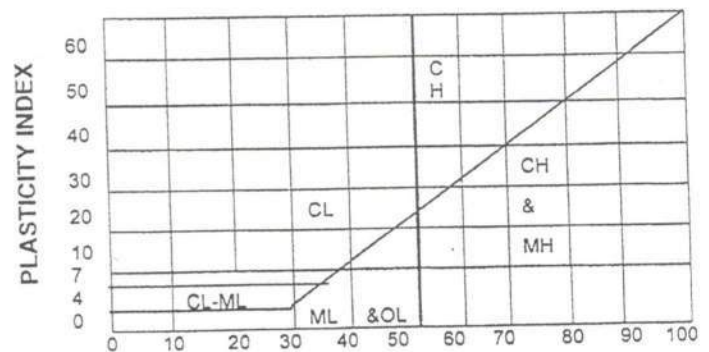
APPENDIX B



MAJOR DIVISIONS		SYMBOLS		TYPICAL NAMES
COARSE-GRAINED SOILS (More than 1/2 of soil < No. 200 sieve)	GRAVELS (More than 1/2 of coarse fraction > No. 4 sieve size)	GW		Well-graded gravels or gravel-sand mixtures, little or no fines
		GP		Poorly graded gravels or gravel-sand mixtures, little or no fines
		GM		Silty gravels, gravel-sand-silt mixtures
		GC		Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than 1/2 of coarse fraction < No. 4 sieve size)	SW		Well-graded sands or gravelly sands, little or no fines
		SP		Poorly graded sands or gravelly sands, little or no fines
		SM		Silty sands, sand-silt mixtures
		SC		Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (More than 1/2 of soil < No. 200 sieve)	SILTS & CLAYS LL < 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL		Organic silts and organic silty clays of low plasticity.
	SILTS & CLAYS LL > 50	MH		Inorganic silts, caceous or diatomaceous fine sandy or silty soils, elastic silts
		CH		Inorganic clays of medium to high plasticity, organic silty clays, organic silts
		OH		Organic clays of medium to high plasticity, organic silty clays, organic silts
	HIGHLY ORGANIC SOILS	Pt		Peat and other highly organic soils

CLASSIFICATION CHART
(UNIFIED SOIL CLASSIFICATION SYSTEM)

CLASSIFICATION	RANGE OF GRAIN SIZES	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDER	ABOVE 12"	ABOVE 305
COBBLES	3" to 12"	305 to 76.2
GRAVEL COARSE FINE	3" to No. 4	76.2 to 4.76
	3" TO 3/4"	76.2 to 19.1
	3/4" to No. 4	19.1 to 4.76
SAND COARSE MEDIUM FINE	No. 4 to 200	4.76 to 0.074
	No. 4 to 10	4.76 to 2.00
	No. 10 to 40	2.00 to 0.420
	No. 40 to 200	0.420 to 0.074
SILT & CLAY	BELOW No. 200	BELOW 0.074



GRAIN SIZE CHART

PLASTICITY CHART

	Ring Sample		Bag Sample	NR No Recovery	Classification in accordance with ASTM D2487 Description and visual observation in accordance with ASTM D2488 All Sieve Sizes shown are US Standard SPT Refusal is defined as one of the following: 10 blows for no apparent displacement 50 blows for less than 6 inches advancement 100 blows for 6 to 18 inches advancement
	SPT Sample		Seepage		

GEOTECHNICAL BORING LOGS

Drill Hole No. B-1

Date: January 8, 2020

Drilling Company: Larry Harklerode

Hole Diameter: 8" Drive Weight: 140 lbs. Drop: 30"

Project No. 19251-01

Type of Rig: B-53

Elevation: Existing Ground

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: <u>GL</u> SAMPLED BY: <u>GL</u>
1						ML	SANDY SILT: Olive/light brown, fine to medium grained, moist, <u>loose</u> Moist, <u>loose</u> % Passing No. 200 Sieve = 55
2							
3		X	4/2/3	-	14.6		
4							
5							
6		X	1/2/6	-	-	SM	SILTY SAND: Tan, fine to medium grained, slightly moist, <u>loose</u>
7							
8							
9							
10							
11		X	20/24/26	-	11.9		Light brown, moist, dense % Passing No. 200 Sieve = 39
12							
13							
14							
15							
16		X	12/15/21	-	-		Fine to coarse grained, dry, dense
17							
18							
19							
20							
21		X	9/16/20	-	9.1		Tan, fine to medium grained, dry, dense % Passing No. 200 Sieve = 41
22							
23							
24							
25							

GEOTECHNICAL BORING LOGS

Drill Hole No. B-1

Project No. 19251-01

Date: January 8, 2020

Drilling Company: Larry Harklerode

Type of Rig: B-53

Hole Diameter: 8" Drive Weight: 140 lbs. Drop: 30"

Elevation: Existing Ground

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: <u>GL</u> SAMPLED BY: <u>GL</u>
26		X	15/16/20			SM	Very pale brown, dry, dense
27							
28							
29							
30							
31		X	35/40/30	-	2.7	SP-SM	SAND WITH SILT: Very pale brown, fine to medium grained, dry, very dense, trace of gravel % Passing No. 200 Sieve = 12
32							
33							
34							
35							
36							
37							
38							
39							
40							
41		X	32/37/40	-	-		Dry, very dense
42							
43							
44							
45							
46							
47							
48							Dry, very dense
49							
50		X	38/41/45	-	-		

TOTAL DEPTH = 50 FEET
NO GROUNDWATER
NO CAVING
BORING BACKFILLED

GEOTECHNICAL BORING LOGS

Drill Hole No. B-2

Project No. 19251-01
Type of Rig: B-53
Elevation: Existing Ground

Date: January 8, 2020

Drilling Company: Larry Harklerode

Hole Diameter: 8" Drive Weight: 140 lbs. Drop: 30"

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: <u>GL</u> SAMPLED BY: <u>GL</u>
1						SM	<u>SILTY SAND</u> : Olive/light brown, fine to medium grained, slightly moist, dry, <u>loose</u>
2							
3			4/4/5	85.3	5.8		Dry, <u>loose</u>
4							
5							
6							
7							
8			9/11/16	91.2	15.6	ML	<u>SANDY SILT</u> : Pale yellow, slightly moist, medium dense
9							
10							
11			5/7/8	-	-	SM	<u>SILTY SAND</u> : Light brown, fine to medium grained, slightly moist, medium dense
12							
13							
14							
15							
16			17/20/30	-	-	ML	<u>SANDY SILT</u> : Very pale brown, dry, dense
17							
18							
19							
20							
21			13/14/20	-	-	SM	<u>SILTY SAND</u> : Yellow, fine to medium grained, dry, dense
22							
23							
24							
25							
							TOTAL DEPTH = 21.5 FEET NO GROUNDWATER NO CAVING BORING BACKFILLED

GEOTECHNICAL BORING LOGS

Drill Hole No. B-3

Date: January 8, 2020

Drilling Company: Larry Harklerode

Hole Diameter: 8" Drive Weight: 140 lbs. Drop: 30"

Project No. 19251-01

Type of Rig: B-53

Elevation: Existing Ground

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: <u>GL</u> SAMPLED BY: <u>GL</u>
1						SM	<u>SILTY SAND</u> : Light brown, fine to medium grained, slightly moist, <u>top 5 feet loose</u>
2							
3							
4							
5							
6			3/5/11	95.6	18.7		Slightly moist, medium dense
7						ML	<u>SANDY SILT</u> : Light brown, moist, medium dense
8							
9							
10							
11			13/23/23	-	-		Pale yellow, dry, dense
12							
13							
14							
15							
16			8/14/21	-	-		Light brown, slightly moist, dense
17							
18							
19							
20							
21							
22							
23							
24							
25							
							TOTAL DEPTH = 16.5 FEET NO GROUNDWATER NO CAVING BORING BACKFILLED

GEOTECHNICAL BORING LOGS

Drill Hole No. B-4

Date: January 8, 2020

Drilling Company: Larry Harklerode

Hole Diameter: 8" Drive Weight: 140 lbs. Drop: 30"

Project No. 19251-01

Type of Rig: B-53

Elevation: Existing Ground

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: <u>GL</u> SAMPLED BY: <u>GL</u>
1						SM	SILTY SAND: Brown, fine to medium grained, slightly moist, <u>top 2 feet loose</u>
2							
3		X	10/20/19	-	11.9		Light brown, dry, dense
4							
5							
6							
7		X	6/6/6	-	6.5		Pale brown, dry, medium dense
8							
9							
10							
11		X	12/24/28	-	-		Light brown, slightly moist, dense
12							
13							
14							
15							
16		X	19/20/20	-	-		Pale brown, dry, dense
17							
18							
19		X	17/22/24	-	-		Dry, dense
20							
21							TOTAL DEPTH = 20 FEET NO GROUNDWATER NO CAVING BORING BACKFILLED
22							
23							
24							
25							

GEOTECHNICAL BORING LOGS

Drill Hole No. B-5

Date: January 8, 2020

Drilling Company: Larry Harklerode

Hole Diameter: 8" Drive Weight: 140 lbs. Drop: 30"

Project No. 19251-01

Type of Rig: B-53

Elevation: Existing Ground

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: <u>GL</u> SAMPLED BY: <u>GL</u>
1						SM	SILTY SAND: Light brown, fine to medium grained, slightly moist, <u>top 4 feet loose</u>
2							
3							
4							
5							
6		X	7/8/10				Pale brown, dry, medium dense
7							
8							
9							
10							
11		X	14/22/26	-	-		Light brown, slightly moist, dense
12							
13							
14							
15							
16		X	13/16/21	-	-		Dry, dense
17							
18							
19							
20							
21		X	13/17/21	-	-		Dry, dense
22							
23							Dry, dense
24		X	14/15/22				TOTAL DEPTH = 25 FEET NO GROUNDWATER NO CAVING BORING BACKFILLED
25							

APPENDIX C



Proposed Residential Development
Cactus Avenue and Bradshaw Circle
City of Moreno Valley, California

LABORATORY TEST RESULTS

SIEVE SIZE	B-1 @ 2' % PASSING	B-1 @ 10' % PASSING	B-1 @ 20' % PASSING	B-1 @ 30' % PASSING
3/8"	100	100	100	100
No. 4	99	98	99.6	92
No. 8	98	97	98	88
No. 16	96	94	95	82
No. 30	93	89	90	67
No. 50	86	80	80	40
No. 100	74	62	64	21
No. 200	55	39	41	12
SIEVE ANALYSIS TEST DATA				

Cal Land Engineering, Inc.
dba Quartech Consultants
Geotechnical, Environmental & Civil Engineering

January 16, 2020

Soil Exploration Company Inc.
7535 Jurupa Avenue, Unit C
Riverside, California 92504

Attn: Mr. Gene Luu

RE: LABORATORY TEST RESULTS/REPORT

Client: Roger Hobbs
Project: Corrosion Potential
Project No.: 19251-01
QCI Job No.: 20-183-001h

Gentlemen:

We have completed the testing program conducted on sample for above project. The tests were performed in accordance with testing procedures as follows:

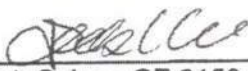
TEST	METHOD
Corrosion Potential	CT- 417, CT- 422, CT- 532 (643)

Enclosed is Summary of Laboratory Test Results.

We appreciate the opportunity to provide testing services to Soil Exploration Company Inc.
Should you have any questions, please call the undersigned.

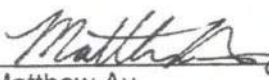
Sincerely yours,

Cal Land Engineering, Inc. (CLE)
dba Quartech Consultants (QCI)



Jack C. Lee, GE 2153
Principle Engineer





Matthew Au
Project Engineer

Enclosure

Cal Land Engineering, Inc.
dba Quartech Consultants
Geotechnical, Environmental, and Civil Engineering

Soil Exploration Company Inc.
7535 Jurupa Avenue, Suite C
Riverside, California 92504

QCI Project No.: 20-183-001h
Date: January 16, 2020
Summarized by: MA

Client: Roger Hobbs
Project: Corrosion Potential
Project No.: 19251-01

Corrosivity Test Results

Sample ID	Sample Depth (ft)	pH CT-532 (643)	Chloride CT-422 (ppm)	Sulfate CT-417 % By Weight	Resistivity CT-532 (643) (ohm-cm)
B-1	0-5'	9.20	214	0.0400	1,700

APPENDIX D



2008 National Seismic Hazard Maps - Source Parameters

[New Search](#)

Distance in Miles	Name	State	Pref Slip Rate (mm/yr)	Dip (degrees)	Dip Dir	Slip Sense	Rupture Top (km)	Rupture Bottom (km)
2.78	San Jacinto:SBV+SJV+A	CA	n/a	90	V	strike slip	0	16
2.78	San Jacinto:SBV+SJV+A+CC	CA	n/a	90	V	strike slip	0	16
2.78	San Jacinto:SJV+A+C	CA	n/a	90	V	strike slip	0	17
2.78	San Jacinto:SBV+SJV+A+C	CA	n/a	90	V	strike slip	0	17
2.78	San Jacinto:SJV+A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15
2.78	San Jacinto:SJV+A+CC+B	CA	n/a	90	V	strike slip	0.1	15
2.78	San Jacinto:SBV+SJV	CA	n/a	90	V	strike slip	0	16
2.78	San Jacinto:SJV+A+CC	CA	n/a	90	V	strike slip	0	16
2.78	San Jacinto:SJV	CA	18	90	V	strike slip	0	16
2.78	San Jacinto:SBV+SJV+A+CC+B	CA	n/a	90	V	strike slip	0.1	15
2.78	San Jacinto:SBV+SJV+A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15
2.78	San Jacinto:SJV+A	CA	n/a	90	V	strike slip	0	17
3.79	San Jacinto:A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15
3.79	San Jacinto:A+CC	CA	n/a	90	V	strike slip	0	16
3.79	San Jacinto:A	CA	9	90	V	strike slip	0	17
3.79	San Jacinto:A+C	CA	n/a	90	V	strike slip	0	17
3.79	San Jacinto:A+CC+B	CA	n/a	90	V	strike slip	0.1	15

8.27	<u>San Jacinto:SBV</u>	CA	6	90	V	strike slip	0	16
13.82	<u>S. San Andreas:CC+BB+NM+SM+NSB+SSB+BG+CO</u>	CA	n/a	86		strike slip	0.1	13
13.82	<u>S. San Andreas:CC+BB+NM+SM+NSB+SSB+BG</u>	CA	n/a	85		strike slip	0	14
13.82	<u>S. San Andreas:CC+BB+NM+SM+NSB+SSB</u>	CA	n/a	90	V	strike slip	0	14
13.82	<u>S. San Andreas:CH+CC+BB+NM+SM+NSB+SSB+BG+CO</u>	CA	n/a	86		strike slip	0.1	13
13.82	<u>S. San Andreas:SM+NSB+SSB+BG+CO</u>	CA	n/a	83		strike slip	0.1	13
13.82	<u>S. San Andreas:SSB+BG</u>	CA	n/a	71		strike slip	0	13
13.82	<u>S. San Andreas:NSB+SSB+BG+CO</u>	CA	n/a	79		strike slip	0.2	12
13.82	<u>S. San Andreas:SM+NSB+SSB+BG</u>	CA	n/a	81		strike slip	0	13
13.82	<u>S. San Andreas:SM+NSB+SSB</u>	CA	n/a	90	V	strike slip	0	13
13.82	<u>S. San Andreas:BB+NM+SM+NSB+SSB+BG+CO</u>	CA	n/a	85		strike slip	0.1	13
13.82	<u>S. San Andreas:BB+NM+SM+NSB+SSB+BG</u>	CA	n/a	84		strike slip	0	14
13.82	<u>S. San Andreas:PK+CH+CC+BB+NM+SM+NSB+SSB+BG+CO</u>	CA	n/a	86		strike slip	0.1	13
13.82	<u>S. San Andreas:PK+CH+CC+BB+NM+SM+NSB+SSB+BG</u>	CA	n/a	86		strike slip	0.1	13
13.82	<u>S. San Andreas:PK+CH+CC+BB+NM+SM+NSB+SSB</u>	CA	n/a	90	V	strike slip	0.1	13
13.82	<u>S. San Andreas:NSB+SSB+BG</u>	CA	n/a	75		strike slip	0	14
13.82	<u>S. San Andreas:NSB+SSB</u>	CA	n/a	90	V	strike slip	0	13
13.82	<u>S. San Andreas:BB+NM+SM+NSB+SSB</u>	CA	n/a	90	V	strike slip	0	14
13.82	<u>S. San Andreas:NM+SM+NSB+SSB+BG+CO</u>	CA	n/a	84		strike slip	0.1	13
13.82	<u>S. San Andreas:NM+SM+NSB+SSB+BG</u>	CA	n/a	83		strike slip	0	14
13.82	<u>S. San Andreas:NM+SM+NSB+SSB</u>	CA	n/a	90	V	strike slip	0	13

13.82	<u>S. San Andreas:SSB+BG+CO</u>	CA	n/a	77		strike slip	0.2	12
13.82	<u>S. San Andreas:CH+CC+BB+NM+SM+NSB+SSB+BG</u>	CA	n/a	86		strike slip	0	14
13.82	<u>S. San Andreas:CH+CC+BB+NM+SM+NSB+SSB</u>	CA	n/a	90	V	strike slip	0	14
13.82	<u>S. San Andreas:SSB</u>	CA	16	90	V	strike slip	0	13
16.74	<u>S. San Andreas:PK+CH+CC+BB+NM+SM+NSB</u>	CA	n/a	90	V	strike slip	0.1	13
16.74	<u>S. San Andreas:SM+NSB</u>	CA	n/a	90	V	strike slip	0	13
16.74	<u>S. San Andreas:BB+NM+SM+NSB</u>	CA	n/a	90	V	strike slip	0	14
16.74	<u>S. San Andreas:NSB</u>	CA	22	90	V	strike slip	0	13
16.74	<u>S. San Andreas:NM+SM+NSB</u>	CA	n/a	90	V	strike slip	0	13
16.74	<u>S. San Andreas:CH+CC+BB+NM+SM+NSB</u>	CA	n/a	90	V	strike slip	0	14
16.74	<u>S. San Andreas:CC+BB+NM+SM+NSB</u>	CA	n/a	90	V	strike slip	0	14
19.47	<u>Elsinore:W+G+T+J</u>	CA	n/a	84	NE	strike slip	0	16
19.47	<u>Elsinore:G+T+J</u>	CA	n/a	86	NE	strike slip	0	17
19.47	<u>Elsinore:G+T+J+CM</u>	CA	n/a	86	NE	strike slip	0	16
19.47	<u>Elsinore:W+G</u>	CA	n/a	81	NE	strike slip	0	14
19.47	<u>Elsinore:W+G+T</u>	CA	n/a	84	NE	strike slip	0	14
19.47	<u>Elsinore:G+T</u>	CA	5	90	V	strike slip	0	14
19.47	<u>Elsinore:G</u>	CA	5	90	V	strike slip	0	13
19.47	<u>Elsinore:W+G+T+J+CM</u>	CA	n/a	84	NE	strike slip	0	16
20.88	<u>Elsinore:T</u>	CA	5	90	V	strike slip	0	14
20.88	<u>Elsinore:T+J</u>	CA	n/a	86	NE	strike slip	0	17

20.88	<u>Elsinore;T+J+CM</u>	CA	n/a	85	NE	strike slip	0	16
21.34	<u>S. San Andreas;BG</u>	CA	n/a	58		strike slip	0	13
21.34	<u>S. San Andreas;BG+CO</u>	CA	n/a	72		strike slip	0.3	12
23.55	<u>Chino, alt 2</u>	CA	1	65	SW	strike slip	0	14
24.25	<u>Cucamonga</u>	CA	5	45	N	thrust	0	8
24.84	<u>Elsinore;W</u>	CA	2.5	75	NE	strike slip	0	14
24.92	<u>Chino, alt 1</u>	CA	1	50	SW	strike slip	0	9
25.54	<u>Cleghorn</u>	CA	3	90	V	strike slip	0	16
27.62	<u>Pinto Mtn</u>	CA	2.5	90	V	strike slip	0	16
28.55	<u>North Frontal (West)</u>	CA	1	49	S	reverse	0	16
32.99	<u>San Jose</u>	CA	0.5	74	NW	strike slip	0	15
35.01	<u>Helendale-So Lockhart</u>	CA	0.6	90	V	strike slip	0	13
35.40	<u>S. San Andreas;NM+SM</u>	CA	n/a	90	V	strike slip	0	14
35.40	<u>S. San Andreas;PK+CH+CC+BB+NM+SM</u>	CA	n/a	90	V	strike slip	0.1	13
35.40	<u>S. San Andreas;SM</u>	CA	29	90	V	strike slip	0	13
35.40	<u>S. San Andreas;CH+CC+BB+NM+SM</u>	CA	n/a	90	V	strike slip	0	14
35.40	<u>S. San Andreas;CC+BB+NM+SM</u>	CA	n/a	90	V	strike slip	0	14
35.40	<u>S. San Andreas;BB+NM+SM</u>	CA	n/a	90	V	strike slip	0	14
35.86	<u>Sierra Madre Connected</u>	CA	2	51		reverse	0	14
35.86	<u>Sierra Madre</u>	CA	2	53	N	reverse	0	14
36.19	<u>North Frontal (East)</u>	CA	0.5	41	S	thrust	0	16
36.23	<u>San Joaquin Hills</u>	CA	0.5	23	SW	thrust	2	13
40.12	<u>Puente Hills (Coyote Hills)</u>	CA	0.7	26	N	thrust	2.8	15
40.39	<u>Elsinore;J+CM</u>	CA	3	84	NE		0	17

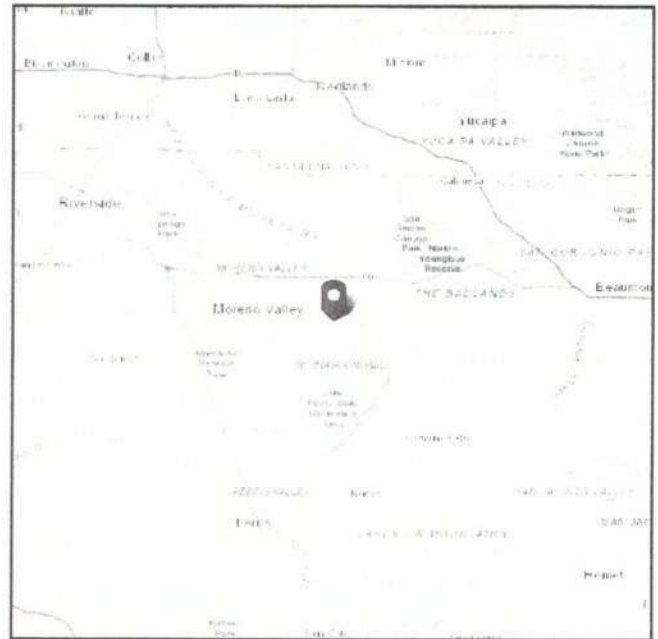
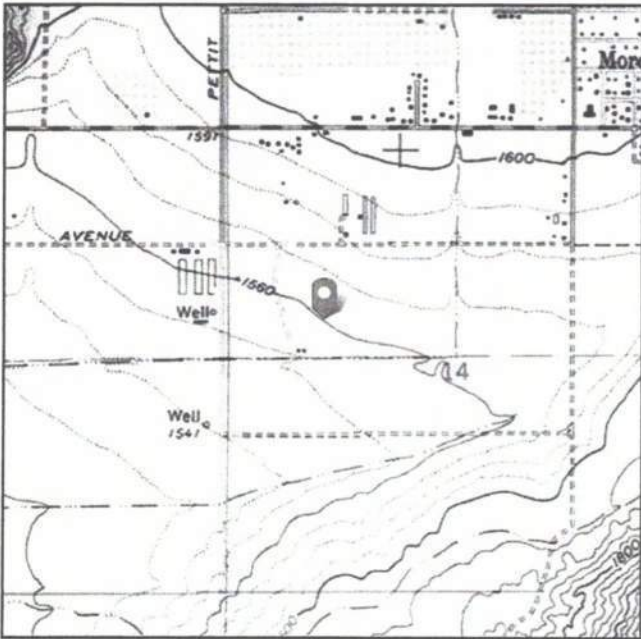
							strike slip		
40.39	<u>Elsinore;J</u>	CA	3	84	NE	strike slip	0		19
42.72	<u>Lenwood-Lockhart-Old Woman Springs</u>	CA	0.9	90	V	strike slip	0		13
44.65	<u>Burnt Mtn</u>	CA	0.6	67	W	strike slip	0		16
44.93	<u>Clamshell-Sawpit</u>	CA	0.5	50	NW	reverse	0		14
45.58	<u>Newport Inglewood Connected alt 1</u>	CA	1.3	89		strike slip	0		11
45.58	<u>Newport Inglewood Connected alt 2</u>	CA	1.3	90	V	strike slip	0		11
45.58	<u>Newport-Inglewood (Offshore)</u>	CA	1.5	90	V	strike slip	0		10
46.40	<u>Landers</u>	CA	0.6	90	V	strike slip	0		15
46.80	<u>Eureka Peak</u>	CA	0.6	90	V	strike slip	0		15
47.24	<u>San Jacinto;CC+B+SM</u>	CA	n/a	90	V	strike slip	0.2		14
47.24	<u>San Jacinto;CC</u>	CA	4	90	V	strike slip	0		16
47.24	<u>San Jacinto;CC+B</u>	CA	n/a	90	V	strike slip	0.2		14
47.67	<u>San Jacinto;C</u>	CA	14	90	V	strike slip	0		17
48.58	<u>Newport-Inglewood, alt 1</u>	CA	1	88		strike slip	0		15
48.77	<u>Puente Hills (Santa Fe Springs)</u>	CA	0.7	29	N	thrust	2.8		15
49.03	<u>Johnson Valley (No)</u>	CA	0.6	90	V	strike slip	0		16

ASCE 7 Hazards Report

Address:
No Address at This
Location

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: D - Stiff Soil

Elevation: 1562.21 ft (NAVD 88)
Latitude: 33.9112
Longitude: -117.1703



Site Soil Class:

D - Stiff Soil

Results:

S_s :	1.957	S_{D1} :	N/A
S_1 :	0.773	T_L :	8
F_a :	1	PGA :	0.826
F_v :	N/A	PGA _M :	0.909
S_{MS} :	1.957	F_{PGA} :	1.1
S_{M1} :	N/A	I_e :	1
S_{DS} :	1.305	C_v :	1.491

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed:

Thu Jan 09 2020

Date Source:

USGS Seismic Design Maps

APPENDIX E



GENERAL EARTHWORK AND GRADING SPECIFICATIONS

1.0 GENERAL INTENT

These specifications present general procedures and requirements for grading and earthwork as shown on the approved grading plans, including preparation of areas to be filled, placement of fill, installations of subdrains, and excavations. The recommendations contained in the geotechnical report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict. Evaluations performed by the consultant during the course of grading may result in new recommendations which could supersede these specifications or the recommendations of the geotechnical report.

2.0 EARTHWORK OBSERVATIONS AND TESTING

Prior to the commencement of grading, a qualified geotechnical consultant (soils engineer and engineering geologist, and their representatives) shall be employed for the purpose of observing earthwork procedures and testing the fills for conformance with the recommendations of the geotechnical report and these specifications. It will be necessary that the consultant provide adequate testing and observations so that he may determine that the work was accomplished as specified. It shall be the responsibility of the contractor to assist the consultant and keep him apprised of work schedules and changes so that he may schedule his personnel accordingly.

It shall be the sole responsibility of the contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and approved grading plans. If, in the opinion of the consultant, unsatisfactory conditions, such as questionable soil, poor moisture conditions, inadequate compaction, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the consultant will be empowered to reject the work and recommend that construction be stopped until the unsatisfactory conditions are rectified.

Maximum dry density tests used to determine the degree of compaction will be performed in accordance with the American Society of Testing and Materials, test method ASTM D1557-12.

3.0 PREPARATION OF AREAS TO BE FILLED

3.1 Clearing and Grubbing

All brush, vegetation, and debris shall be removed or piled and otherwise disposed of.

3.2 Processing

The existing ground which is determined to be satisfactory for support of fill shall be scarified to a minimum depth of 6 inches. Existing ground which is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until the soils are broken down and free of large clay lumps or clods and until the working surface is reasonably uniform and free of uneven features which would inhibit uniform compaction.

3.3 Overexcavation

Soft, dry, spongy, highly fractured or otherwise unsuitable ground, extending to such depth that surface processing cannot adequately improve the condition, shall be overexcavated down to firm ground, approved by the consultant.

3.4 Moisture Conditioning

Overexcavated and processed soils shall be watered, dried-back, blended, and/or mixed, as required to attain a uniform moisture content near optimum.

3.5 Recompaction

Overexcavation and processed soils which have been properly mixed and moisture-conditioned shall be recompacted to a minimum relative compaction of 90 percent.

3.6 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal : vertical), the ground shall be stepped or benched. The lowest bench shall be a minimum of 15 feet wide, shall be at least 2 feet deep, shall expose firm materials, and shall be approved by the consultant. Other benches shall be excavated in firm materials for a minimum width of 4 feet. Ground sloping flatter than 5:1 (horizontal : vertical) shall be benched or otherwise overexcavated when considered necessary by the consultant.

3.7 Approval

All areas to receive fill, including processed areas, removal areas and toe-of-fill benches shall be approved by the consultant prior to fill placement.

4.0 FILL MATERIAL

4.1 General

Material to be placed as fill shall be free of organic matter and other deleterious substances, and shall be approved by the consultant. Soils of poor gradation, expansion, or strength characteristics shall be placed in areas designated by consultant or shall be mixed with other soils to serve as satisfactory fill material.

4.2 Oversize

Oversize materials defined as rock, or other irreducible material with maximum dimension greater than 12 inches, shall not be buried or placed in fills, unless the location, materials, and disposal methods are specifically approved by the consultant. Oversize disposal operations shall be such that nesting of oversize material does not occur, and such that the oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 feet vertically of finish grade or within the range of future utilities or underground construction, unless specifically approved by the consultant.

4.3 Import

If importing of fill material is required for grading, the import material shall meet the requirements of Section 4.1.

5.0 FILL PLACEMENT and COMPACTION

5.1 Fill Lifts

Approved fill material shall be placed in areas prepared to receive fill in near-horizontal layers not exceeding 6 inches in compacted thickness. The consultant may approve thicker lifts if testing indicates the grading procedures are such that adequate compaction is being achieved with lifts of greater thickness. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to attain uniformity of material and moisture in each layer.

5.2 Fill Moisture

Fill layers at a moisture content less than optimum shall be watered and mixed, and wet fill layers shall be aerated by scarification or shall be blended with drier material. Moisture conditioning and mixing of fill layers shall continue until the fill material is at a uniform moisture content at or near optimum.

5.3 Compaction of Fill

After each layer has been evenly spread, moisture-conditioned, and mixed, it shall be uniformly compacted to not less than 90 percent of maximum dry density. Compaction equipment shall be adequately sized and shall be either specifically designed for soil compaction or of proven reliability, to efficiently achieve the specified degree of compaction.

5.4 Fill Slopes

Compacting of slopes shall be accomplished, in addition to normal compacting procedures, by backrolling of slopes with sheepfoot rollers at frequent increments of 2 to 3 feet in fill elevation gain, or by other methods producing satisfactory results. At the completion of grading, the relative compaction of the slope out to the slope face shall be at least 90 percent.

5.5 Compaction Testing

Field-tests to check the fill moisture and degree of compaction will be performed by the consultant. The location and frequency of tests shall be at the consultant's discretion. In general, the tests will be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of embankment.

6.0 SUBDRAIN INSTALLATION

Subdrain systems, if required, shall be installed in approved ground to conform to the approximate alignment and details shown on the plans or herein. The subdrain location or materials shall not be changed or modified without the approval of the consultant. The consultant, however, may recommend and upon approval, direct changes in subdrain line, grade or material. All subdrains should be surveyed for line and grade after installation and sufficient time shall be allowed for the surveys, prior to commencement of filling over the subdrain.

7.0 EXCAVATION

Excavations and cut slopes will be examined during grading. If directed by the consultant, further excavation or overexcavation and refilling of cut areas shall be performed, and/or remedial grading of cut slopes shall be performed. Where fill-over-cut slopes are to be graded, unless otherwise approved, the cut portion of the slope shall be made and approved by the consultant prior to placement of materials for construction of the fill portion of the slope.

8.0 TRENCH BACKFILLS

Trench excavations for utility pipes shall be backfilled under engineering supervision.

After the utility pipe has been laid, the space under and around the pipe shall be backfilled with clean sand or approved granular soil to a depth of at least one foot over the top of the pipe. The sand backfill shall be uniformly jetted into place before the controlled backfill is placed over the sand.

The onsite materials, or other soils approved by the soil engineer, shall be watered and mixed as necessary prior to placement in lifts over the sand backfill.

The controlled backfill shall be compacted to at least 90 percent of the maximum dry density as determined by the ASTM D1557-12 test method.

Field density tests and inspection of the backfill procedures shall be made by the soil engineer during backfilling to see that proper moisture content and uniform compaction is being maintained. The contractor shall provide test holes and exploratory pits as required by the soil engineer to enable sampling and testing.

APPENDIX F



Infiltration Test (Boring Percolation Test Procedure)

The tests were performed in accordance with Riverside County Stormwater Quality Best Management Practice Design Handbook for Low Impact Development, dated June 2014.

Two 8-inch diameter, 6-deep test holes (I-1 and I-2), were drilled at the suggested locations. The soil at the test locations was visually classified as silty sand. To mitigate any possible caving or sloughing of the test holes, a 6-inch diameter perforated pipe was placed in the hole. The bottom of the hole was covered with 2 inches of gravel.

The testing was conducted after presoaking. Two consecutive measurements showed that 6 inches of water seeped away in less than 25 minutes. The tests were therefore run an additional one hour with measurements taken at 10 minute intervals. Water level was adjusted to 20 inches above the bottom of the test hole after each measurement. The drop that occurred during the final reading was used for design rate purposes.

Infiltration Test/Tabulated Test Results

Test No.	Depth of Test (feet)	Earth Material	Infiltration Rate (in/hr)
I-1	6	Silty Sand (SM)	3.34
I-2	6	Silty Sand (SM)	3.52
I-3	6	Silty Sand (SM)	1.83
I-4	6	Silty Sand (SM)	1.99

INFILTRATION TEST DATA

(Boring Percolation Test Procedure)

Project: ROSE HOBBS Project No.: 19251-01
 Test Hole No.: I-1 Date Excavated: 1-8-70
 Depth of Test Hole, Dr: 6 FEET Diameter: 8" USCS Soil Classification: SM
 Diameter: 8" Presoak: yes
 Tested By: BR Date: 1/19/20

SANDY SOIL CRITERIA TEST

Trial No.	Time	Time Interval (min)	Initial Water Level (inches)	Final Water Level (inches)	Δ in Water Level (inches)	Greater Than or Equal to 6" (Y/N)
1	11:3805	25	52	61.125	9.125	Y
	12:0305					
2	12:1027	25	52	61	9	Y
	12:3527					

Use Normal Sandy (Circle One) Soil Criteria

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	Do Initial Depth to Water(in.)	Df Final Depth to Water(in.)	ΔD Change in Water Level (in.)	Infiltration Rate (in./hr.)
1	12:3910	12:4910	10	52	57.875	5.875	
2	12:5338	1:0338	10	"	57.625	5.625	
3	1:0459	1:1459	10	"	57.375	5.375	
4	1:1607	1:2607	10	"	"	"	
5	1:2810	1:3810	10	"	"	"	
6	1:4000	1:5000	10	"	"	"	3.34
7							
8							
9							
10							
11							
12							

COMMENTS:

$$\text{Infiltration Rate} = \frac{4 \times 60 \times 5.375}{10(4 + (20 + (20 - 5.375)))} = 3.34 \text{ in/hr}$$

INFILTRATION TEST DATA

(Boring Percolation Test Procedure)

Project: Roger Hobbs Project No.: 19251-01 Date: 1/8/20
 Test Hole No.: I-2 Tested By: ER Date: 1/19/20
 Depth of Test Hole, DT: 6' USCS Soil Classification: SM
 Diameter: 8" Presoak: yes

SANDY SOIL CRITERIA TEST

Trial No.	Time	Time Interval (min)	Initial Water Level (inches)	Final Water Level (inches)	Change in Water Level (inches)	Greater Than or Equal to 6" (Y/N)
1	11:40:01	25	52	61.25	9.25	Y
	12:05:01					
2	12:08:12	11	11	61.125	9.125	11
	12:23:12					

Use Normal Sandy (Circle One) Soil Criteria

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	Do Initial Depth to Water(in.)	Df Final Depth to Water(in.)	ΔD Change in Water Level (in.)	Infiltration Rate (in./hr.)
1	12:37:23	12:47:23	10	52	58.125	6.125	
2	12:51:34	1:01:34	11	11	57.875	5.875	
3	1:02:45	1:12:45	11	11	57.6875	5.6875	
4	1:14:56	1:24:56	11	11	57.625	5.625	
5	1:27:08	1:37:08	11	11	11	11	
6	1:39:20	1:49:20	11	11	11	11	3.52
7							
8							
9							
10							
11							
12							

COMMENTS:

Infiltration Rate: $\frac{4 \times 6.0 \times 5.625}{10(4 + (20 + (20 - 5.625)))} = 3.52 \text{ in./hr}$

INFILTRATION TEST DATA (Boring Percolation Test Procedure)

Project: ROSEN HOBBS Project No.: 19251-01
 Test Hole No.: T3 Date Excavated: 1-8-20
 Depth of Test Hole, D_T: 6'55" Diameter: 8" USCS Soil Classification: SM
 Diameter: 8" Presoak: yes
 Tested By: TR Date: 1/19/20

SANDY SOIL CRITERIA TEST

Trial No.	Time	Time Interval (min)	Initial Water Level (inches)	Final Water Level (inches)	Δ in Water Level (inches)	Greater Than or Equal to 6" (Y/N)
1	12:03:15	25	52	59.875	7.875	Y
	12:28:15					
2	12:33:10	25	"	59.125	7.125	Y
	12:58:10					

Use Normal Sandy (Circle One) Soil Criteria

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D _o Initial Depth to Water(in.)	D _f Final Depth to Water(in.)	ΔD Change in Water Level (in.)	Infiltration Rate (in./hr.)
1	1:00:20	1:10:20	10	52	55.5	3.5	
2	1:13:55	1:23:55	10	"	55.125	3.125	
3	1:24:37	1:34:37	10	"	"	"	
4	1:37:40	1:47:40	10	"	"	"	
5	1:49:06	1:59:06	10	"	"	"	
6	2:02:17	2:12:17	"	"	"	"	1.83
7							
8							
9							
10							
11							
12							

COMMENTS:

Infiltration Rate = $\frac{4 \times 60 \times 3.125}{10(4 + (20 + (20 - 3.125)))} = 1.83 \text{ in./hr.}$

INFILTRATION TEST DATA

(Boring Percolation Test Procedure)

Project: Roger Hobbs Project No.: 19257-01 Date: 1/8/20
 Test Hole No.: I-4 Tested By: BR Date: 1/19/20
 Depth of Test Hole, D_T: 6 USCS Soil Classification: SM
 Diameter: 8" Presoak: Yes

SANDY SOIL CRITERIA TEST

Trial No.	Time	Time Interval (min)	Initial Water Level (inches)	Final Water Level (inches)	Change in Water Level (inches)	Greater Than or Equal to 6" (Y/N)
1	12:05:03	25	52	60.125	8.125	Y
	12:30:03					
2	12:35:14	11	11	59.375	7.375	11
	1:00:14					

Use Normal Sandy (Circle One) Soil Criteria

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D _o Initial Depth to Water (in.)	D _f Final Depth to Water (in.)	ΔD Change in Water Level (in.)	Infiltration Rate (in./hr.)
1	1:02:25	1:12:25	10	52	55.8125	3.8125	
2	1:15:36	1:25:36	11	11	55.5625	3.5625	
3	1:26:47	1:36:47	11	11	55.4375	3.4375	
4	1:39:58	1:49:58	11	11	55.375	3.375	
5	1:52:00	2:02:00	11	11	11	3.375	
6	2:05:12	2:15:12	11	11	11	3.375	1.99
7							
8							
9							
10							
11							
12							

COMMENTS:

Infiltration Rate = $\frac{4 \times 60 \times 3.375}{10(4 + (20 + (20 - 3.375)))} = 1.99 \text{ in/hr}$

APPENDIX G



LIQUEFACTION ANALYSIS SUMMARY

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Font: Courier New, Regular, Size 8 is recommended for this report.
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Input File Name: UNTITLED
Title: PROJECT NAME: Roger Hobbs
Subtitle: Proj No. 19251-01

Surface Elev.=Existing Ground
Hole No.=B-1
Depth of Hole= 50.00 ft
Water Table during Earthquake= 60.00 ft
Water Table during In-Situ Testing= 60.00 ft
Max. Acceleration= 0.91 g
Earthquake Magnitude= 7.50

Input Data:

Surface Elev.=Existing Ground
Hole No.=B-1
Depth of Hole=50.00 ft
Water Table during Earthquake= 60.00 ft
Water Table during In-Situ Testing= 60.00 ft
Max. Acceleration=0.91 g
Earthquake Magnitude=7.50

1. SPT or BPT Calculation.
 2. Settlement Analysis Method: Ishihara / Yoshimine
 3. Fines Correction for Liquefaction: Idriss/Seed
 4. Fine Correction for Settlement: During Liquefaction*
 5. Settlement Calculation in: All zones*
 6. Hammer Energy Ratio,
 7. Borehole Diameter,
 8. Sampling Method,
 9. User request factor of safety (apply to CSR) , User= 1
Plot one CSR curve (fs1=1)
 10. Use Curve Smoothing: Yes*
- * Recommended Options

Ce = 0.89
Cb= 1
Cs= 1

In-Situ Test Data:

Depth ft	SPT	gamma pcf	Fines %
0.00	50.00	120.00	55.00
5.00	50.00	120.00	39.00
10.00	50.00	120.00	39.00
15.00	37.00	120.00	39.00
20.00	36.00	120.00	41.00
25.00	36.00	120.00	41.00
30.00	70.00	120.00	12.00
35.00	70.00	120.00	12.00
40.00	77.00	120.00	12.00
45.00	77.00	120.00	12.00
50.00	86.00	120.00	12.00

Output Results:

Settlement of Saturated Sands=0.00 in.
 Settlement of Unsaturated Sands=1.14 in.
 Total Settlement of Saturated and Unsaturated Sands=1.14 in.
 Differential Settlement=0.570 to 0.753 in.

Depth ft	CRRm	CSRfs	F.S.	S_sat. in.	S_dry in.	S_all in.
0.00	2.00	0.59	5.00	0.00	1.14	1.14
5.00	2.00	0.58	5.00	0.00	1.13	1.13
10.00	2.00	0.58	5.00	0.00	1.09	1.09
15.00	2.00	0.57	5.00	0.00	1.00	1.00
20.00	2.00	0.56	5.00	0.00	0.77	0.77
25.00	2.00	0.56	5.00	0.00	0.61	0.61
30.00	1.96	0.55	5.00	0.00	0.47	0.47
35.00	1.90	0.53	5.00	0.00	0.32	0.32
40.00	1.85	0.50	5.00	0.00	0.17	0.17
45.00	1.80	0.48	5.00	0.00	0.09	0.09
50.00	1.75	0.45	5.00	0.00	0.00	0.00

* F.S.<1, Liquefaction Potential Zone
 (F.S. is limited to 5, CRR is limited to 2, CSR is limited to 2)

Units: Depth = ft, Stress or Pressure = atm (tsf), Unit Weight = pcf,
 Settlement = in.

1 atm (atmosphere) = 1 tsf (ton/ft²)

CRRm Cyclic resistance ratio from soils

CSRsf Cyclic stress ratio induced by a given earthquake (with user

UNTITLED.sum

request factor of safety)

F.S.	Factor of Safety against liquefaction, $F.S. = CRR_m / CSR_{sf}$
S_sat	Settlement from saturated sands
S_dry	Settlement from Unsaturated Sands
S_all	Total Settlement from Saturated and Unsaturated Sands
NoLiq	No-Liquefy Soils

Appendix 4: Historical Site Conditions

Phase I Environmental Site Assessment or Other Information on Past Site Use

“Not Applicable”

Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

An evaluation was conducted for Drainage Management Areas (DMA) 3, 4, 5, and 6 to assess the feasibility of implementing either an Infiltration Trench or a Bioretention Basin as Best Management Practices (BMPs) for stormwater management. These DMAs are located exclusively within the public right-of-way along Bradshaw Circle. The areas range from approximately 6,830 to 31,950 square feet, with the largest impervious surface area measuring 27,356 square feet and a corresponding design capture volume of 1,484 cubic feet.

Each DMA includes a 6-foot-wide landscaped strip, which is the only feasible location for implementing BMPs such as infiltration trenches. Using DMA 3 as a representative example, a conservative infiltration trench design would require a depth of 9 feet (8 feet of design storage plus 1 foot of pea gravel) and a minimum surface area of 356 square feet. However, due to site constraints—such as the presence of sewer cleanouts, communication vaults, electrical conduits, wall footings, and proximity to the back of the sidewalk—the trench width is limited to just 2 feet. This restriction necessitates a trench configuration of 2 feet wide by 178 feet long by 9 feet deep.

This design poses significant concerns regarding constructability, maintenance, and long-term performance. Moreover, it is not feasible to incorporate an emergency overflow system due to the absence of a nearby storm drain connection, further reducing its viability.

The Bioretention Basin alternative also presents limitations. The required surface area for bioretention is approximately 360 square feet, necessitating a minimum top width of 2 feet and a filter media depth of 3 feet. Achieving the design capture volume would require a total basin length of 180 feet. However, site conditions do not permit installation of a perforated underdrain, and spatial constraints make it impractical to accommodate the necessary dimensions.

Given these constraints, the bioretention basin is not considered a feasible solution for DMA 3. The same limitations—narrow available width, lack of drainage connectivity, and obstruction by existing infrastructure—apply equally to DMA 4, DMA 5, and DMA 6. Detailed sizing and volume requirements are provided in VBMP and Infiltration Trench Tables for Appendix 5.

Based on this comprehensive analysis, neither the Infiltration Trench nor the Bioretention Basin represents a practical BMP for the DMAs within Bradshaw Circle. Following the Low Impact Development (LID) feasibility hierarchy, the most appropriate course of action is to recommend a Biotreatment BMP as the preferred stormwater management strategy for DMA 3, DMA 4, DMA 5, and DMA 6.

From: Shay Mueller <smueller@rchobbs.com>

Sent: Wednesday, July 30, 2025 2:52:30 PM

To: Jordan Koga <jordank@moval.org>

Cc: Robert Beers <rmbeers777@hotmail.com>; Michael Brendecke <MBrendecke@adkan.com>; Israel Duque <IDuque@adkan.com>; Hoang Nguyen <hoangn@moval.org>

Subject: Re: PEN24-0021 TTM 37858 - PWQMP - offsite Bradshaw Circle area

CAUTION: EXTERNAL SENDER.

Hi Adkan team,

I wanted to check in with you and see if you would be able to provide an update to the questions from Jordan and when we can expect a response!

Thanks,
Shay

On Thu, Jul 24, 2025 at 10:24 AM Jordan Koga <jordank@moval.org> wrote:

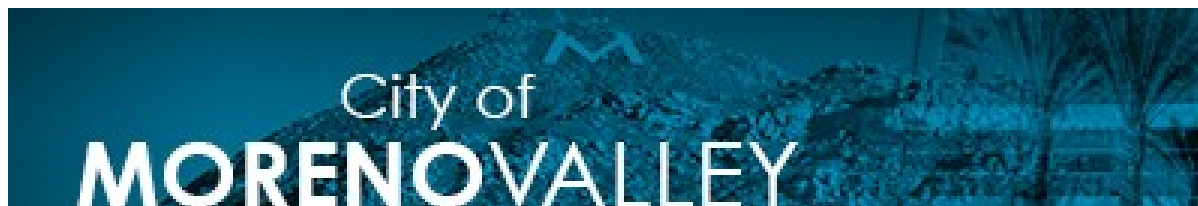
Hi Bob and Michael,

1. Are you able to provide documentation where the City approved the proprietary biotreatment BMPs as the BMP to use for the off-site treatment? The proprietary biotreatment BMPs may have been approved of as a BMP to use for biotreatment, but the BMP hierarchy would still need to be followed. Since infiltration is feasible, infiltration would need to be technically demonstrated as infeasible in these street locations. Bioretention BMPs would also need to be demonstrated as infeasible. Once both are demonstrated to be infeasible, biotreatment can be proposed.
2. Please indicate that no open trash receptacles nor trash enclosures are to be proposed in your response in the Digital Plan Room. This will ensure the CASC plan reviewer is updated with this information.
3. Detailed structural design calculations shall be provided in the F-WQMP/construction phase. Since the layout was previously approved of, this will be added as a condition for P-WQMP approval while noting the design may need to change pending the review of the design calculations.

Thank you,

Jordan Koga
Stormwater Program Consultant
Public Works
City of Moreno Valley

p: 951.413.3232 | e: jordank@moval.org | w: www.moval.org
14177 Frederick St., Moreno Valley, CA, 92553



From: Robert Beers <rmbeers777@hotmail.com>
Sent: Thursday, July 24, 2025 9:43 AM
To: Jordan Koga <jordank@moval.org>
Cc: Michael Brendecke <mbrendecke@adkan.com>; Israel Duque <iduque@adkan.com>; Shay Mueller <smueller@rchobbs.com>; Hoang Nguyen <hoangn@moval.org>
Subject: Re: PEN24-0021 TTM 37858 - PWQMP - offsite Bradshaw Circle area

Warning: External Email – Watch for Email Red Flags!

Jordan:

Regarding the three review comments:

We met with Clement Jimenez and Hoanh Nyguen in 2024 to discuss the outstanding issues for the WQMP for TTM 37858

The method of treatment for the offsite Bradshaw Circle flows on the "west loop" of Bradshaw Circle was discussed - City directed us to propose alternative method of treatment as we do not own the property at that location, so there is no basin "available" - hence the proposal for use of the proprietary BMP treatment.

We were told that was acceptable

There are no Open Trash Receptacles or trash enclosures

City previously approved the wall layout for the basins as a part of the original review process back in 2023.

We request your "re-approval" of these responses so we can finalize the resubmittal of the PWQMP

Thank you.

Robert Beers
rmbeers777@hotmail.com
(951) 317-2041

From: Jordan Koga <jordank@moval.org>
Sent: Wednesday, July 16, 2025 3:49 PM
To: Robert Beers <rmbeers777@hotmail.com>
Cc: Michael Brendecke <mbrendecke@adkan.com>; Israel Duque <iduque@adkan.com>; Shay Mueller

<smueller@rchobbs.com>; Hoang Nguyen <hoangn@moval.org>

Subject: Re: PEN24-0021 TTM 37858 - PWQMP - offsite Bradshaw Circle area

Hi Bob,

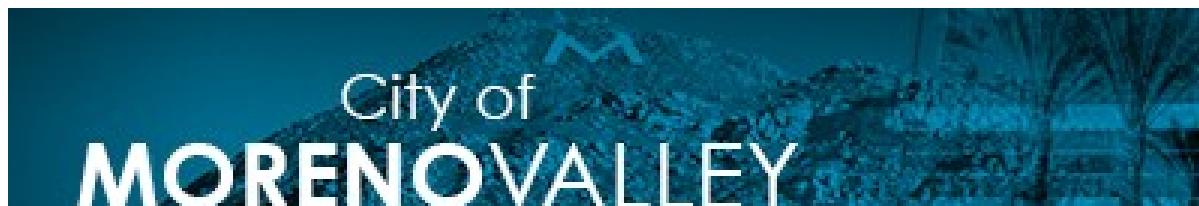
It looks like there are 3 comments still open, see screen shot below. It looks like proprietary biotreatment devices have been proposed for the off-site street improvement areas. Did you still want to meet prior to re-submittal? I will need to check with CASC regarding their availability as they have been revieweing the PWQMP.

Discipline	Title
LD CONSULTANT	034-Basin Retaining Walls
LD CONSULTANT	028 - Source Controls

Thank you,

Jordan Koga
Stormwater Program Consultant
Public Works
City of Moreno Valley

p: 951.413.3232 | e: jordank@moval.org | w: www.moval.org
14177 Frederick St., Moreno Valley, CA, 92553



From: Robert Beers <rmbeers777@hotmail.com>

Sent: Wednesday, July 16, 2025 3:04 PM

To: Jordan Koga <jordank@moval.org>

Cc: Michael Brendecke <mbrendecke@adkan.com>; Israel Duque <iduque@adkan.com>; Shay Mueller <smueller@rchobbs.com>

Subject: PEN24-0021 TTM 37858 - PWQMP - offsite Bradshaw Circle area

Warning: External Email – Watch for Email Red Flags!

Jordan:

We'd like to setup a meeting to discuss the outstanding issues on the PWQMP.

To the best of my recollection, the question was the method of treatment of the two catch basins on Bradshaw Circle (West loop) connection at Cactus Avenue.

Please advise as to your availability to meet and discuss.

A Zoom/Teams meeting is fine for this matter.

Robert Beers

rmbeers777@hotmail.com

(951) 317-2041

--

Shay Mueller, Vice President of Project Management

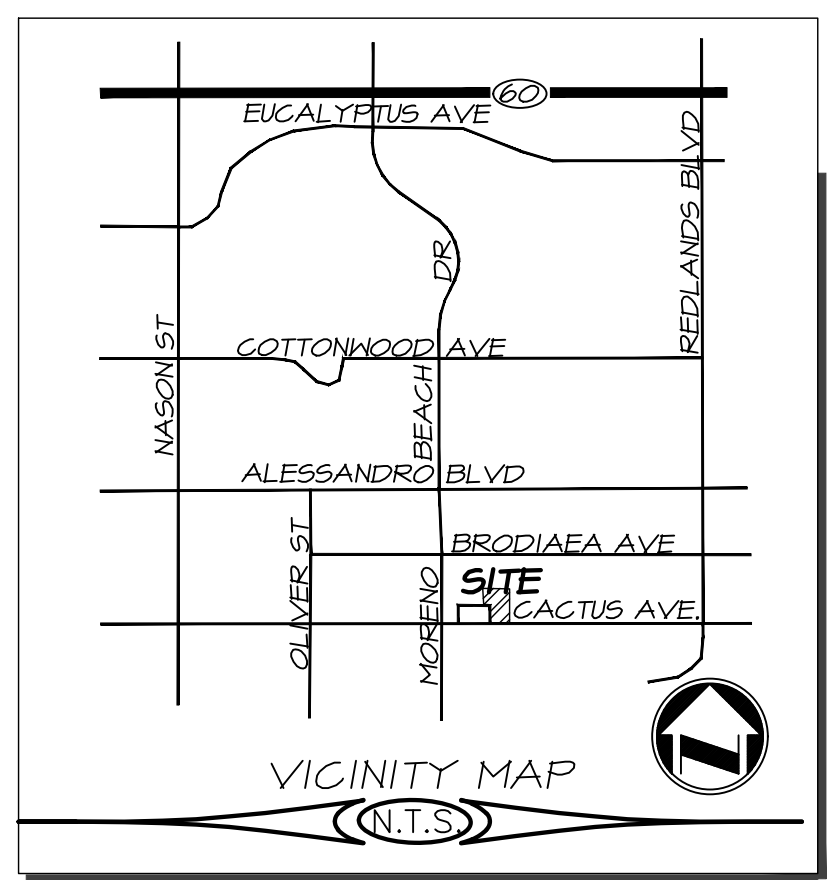
Office: [714.633.8100](tel:714.633.8100), Direct: 714.874.6572, Cell: 714.874.6572

1428 E. Chapman Ave, Orange, CA 92866



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BMP MAP
TRACT 37858



LEGEND

- DMA AREA SINGLE FAMILY RESIDENTIAL (65% IMPERVIOUS)
- STREETS (100% IMPERVIOUS)
- LANDSCAPING (10% IMPERVIOUS)
- DMA BOUNDARY
- DRAINAGE PATH

TRASH RECEPTACLE NOTE

HOUSEHOLD TRASH CONTAINERS TO BE PLACED CURBSIDE ON GARBAGE PICKUP DATE

BMP DATA DMA 1				
DMA	DMA CLASSIFICATION	NAME	SURFACE TYPE	AREA (SF)
1.1	D	STREETS	ASPHALT/CONCRETE	27,397
1.2	D	ROOF	ROOF	47,163
1.3	D	PAD LANDSCAPING	ORNAMENTAL LANDSCAPING	25,718
1.4	D	LANDSCAPING	ORNAMENTAL LANDSCAPING	5,360
TOTAL				105,622

BMP DATA DMA 2				
DMA	DMA CLASSIFICATION	NAME	SURFACE TYPE	AREA (SF)
2.1	D	STREETS	ASPHALT/CONCRETE	24,414
2.2	D	ROOF	ROOF	36,509
2.3	D	PAD LANDSCAPING	ORNAMENTAL LANDSCAPING	19,669
2.4	D	LANDSCAPING	ORNAMENTAL LANDSCAPING	12,348
TOTAL				92,940

SOURCE CONTROL BMPs

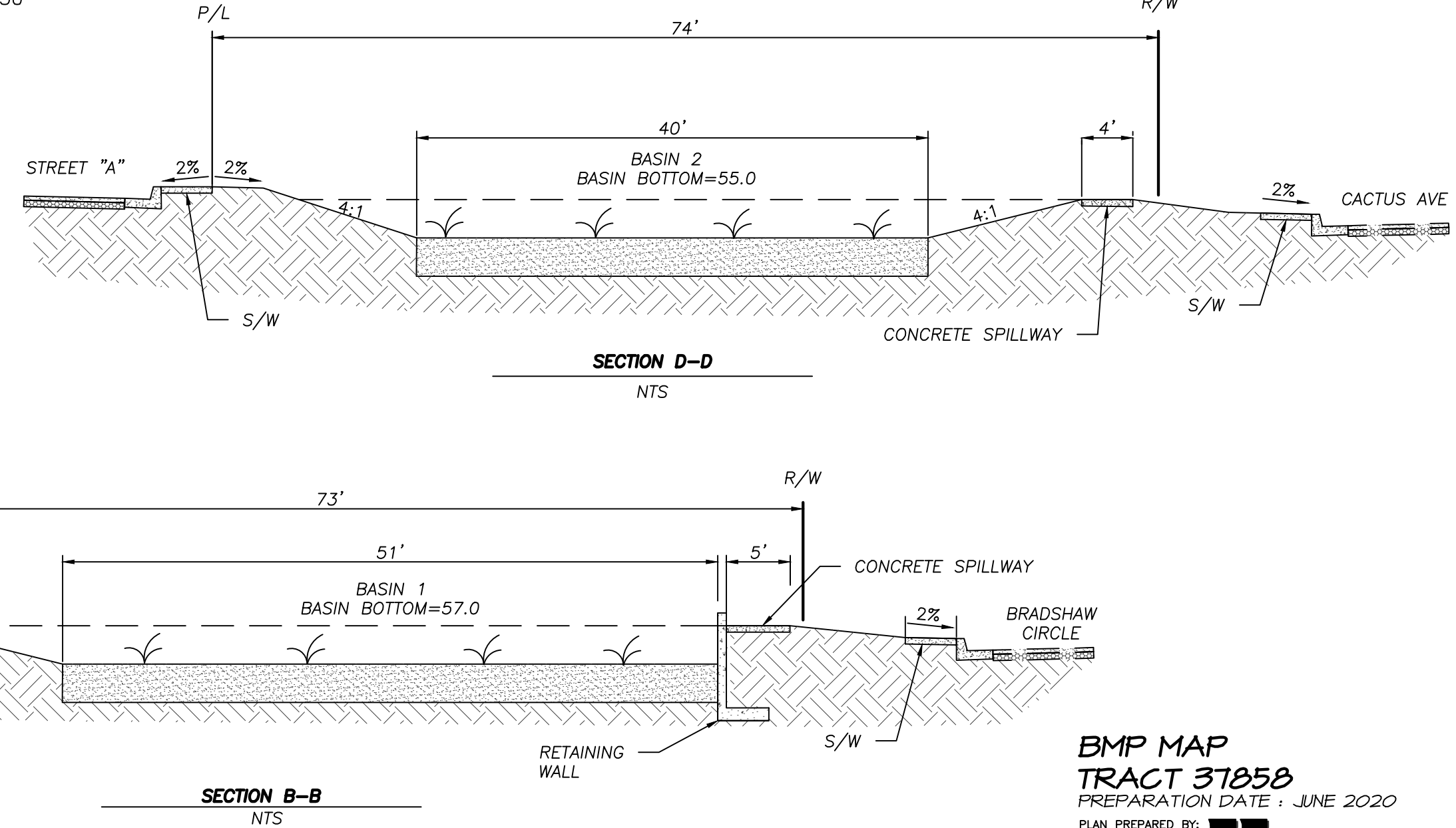
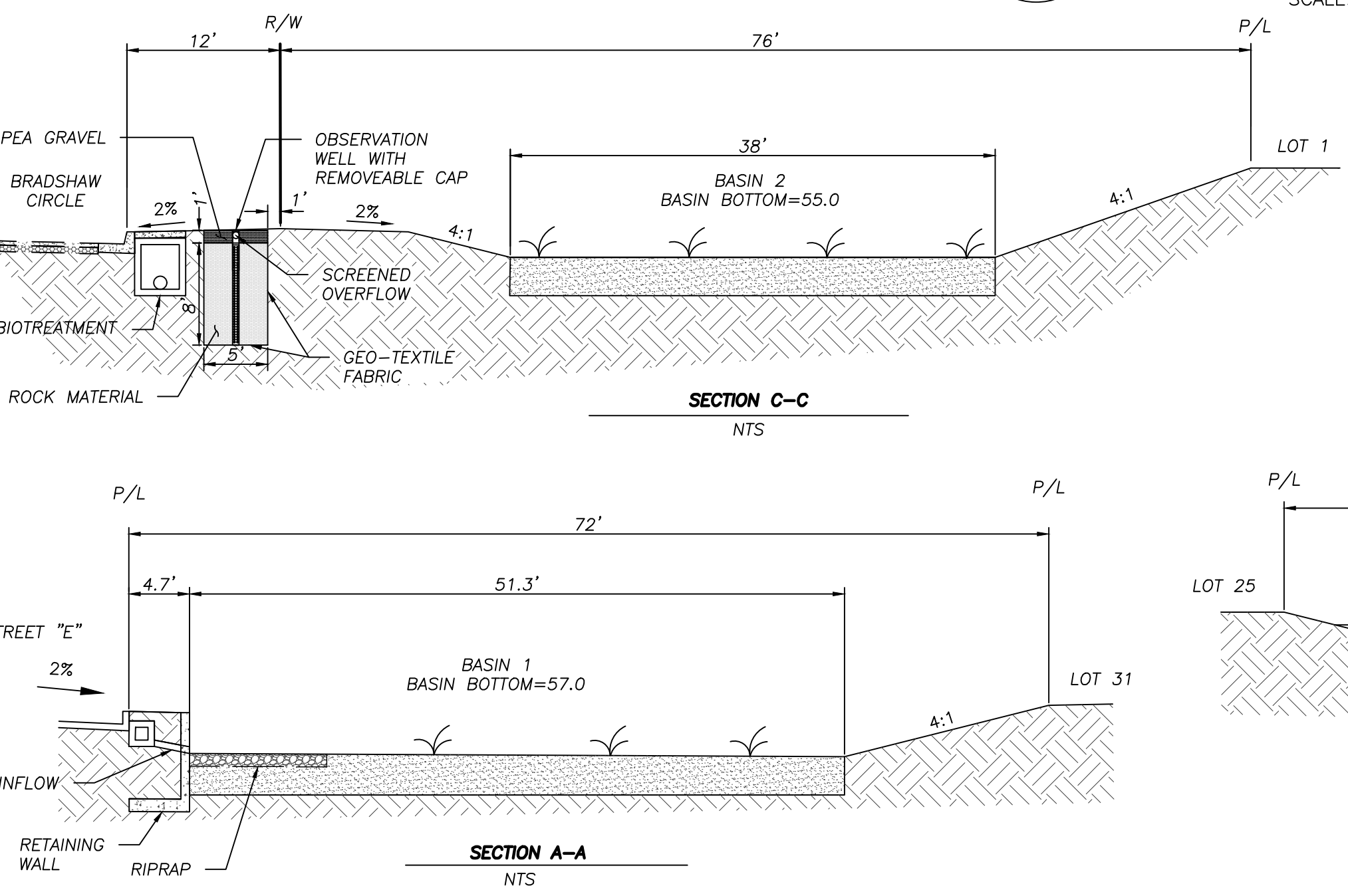
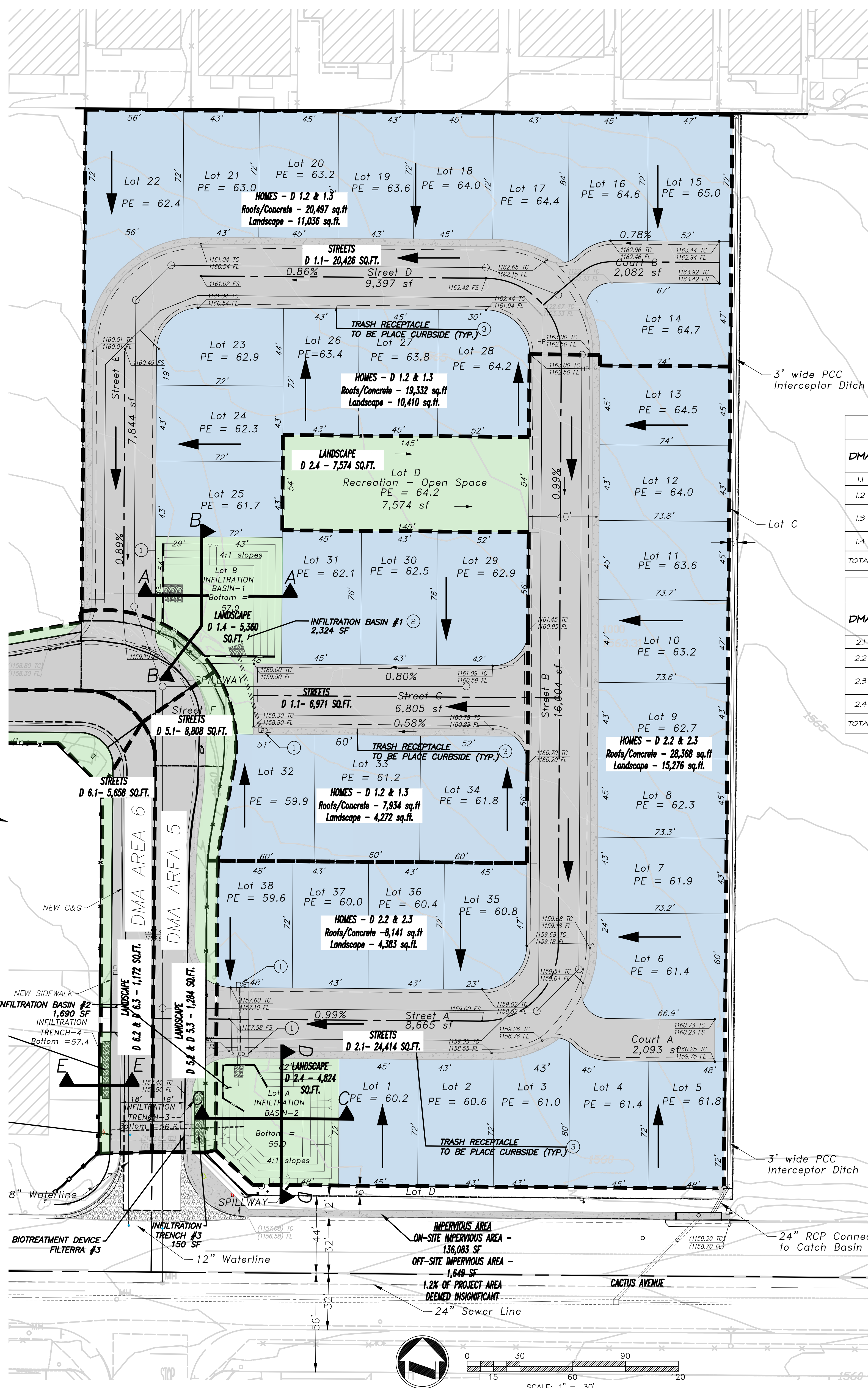
①	ON-SITE STORM DRAIN INLETS
②	LANDSCAPE/ OUTDOOR PESTICIDE USE
③	REFUSE AREAS



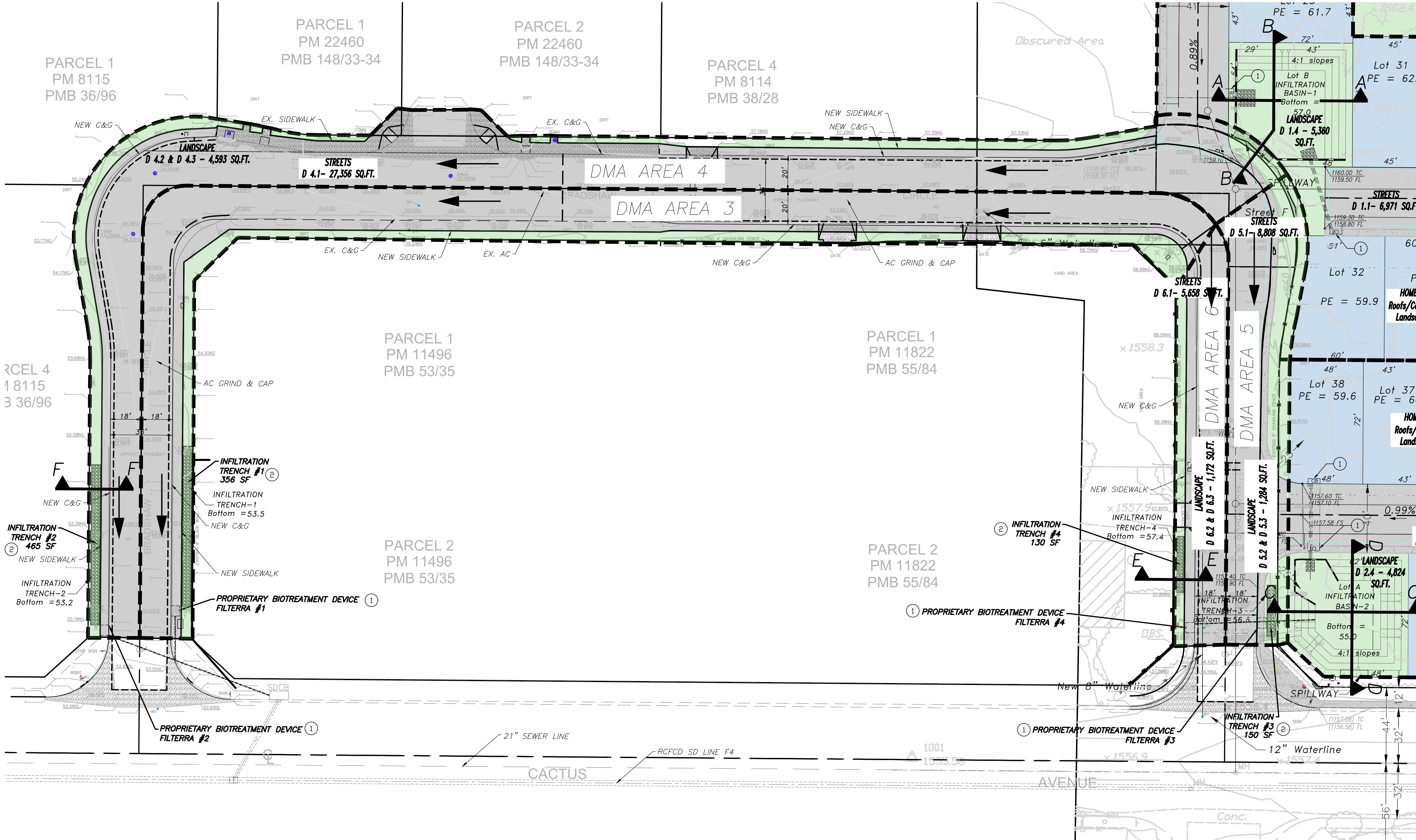
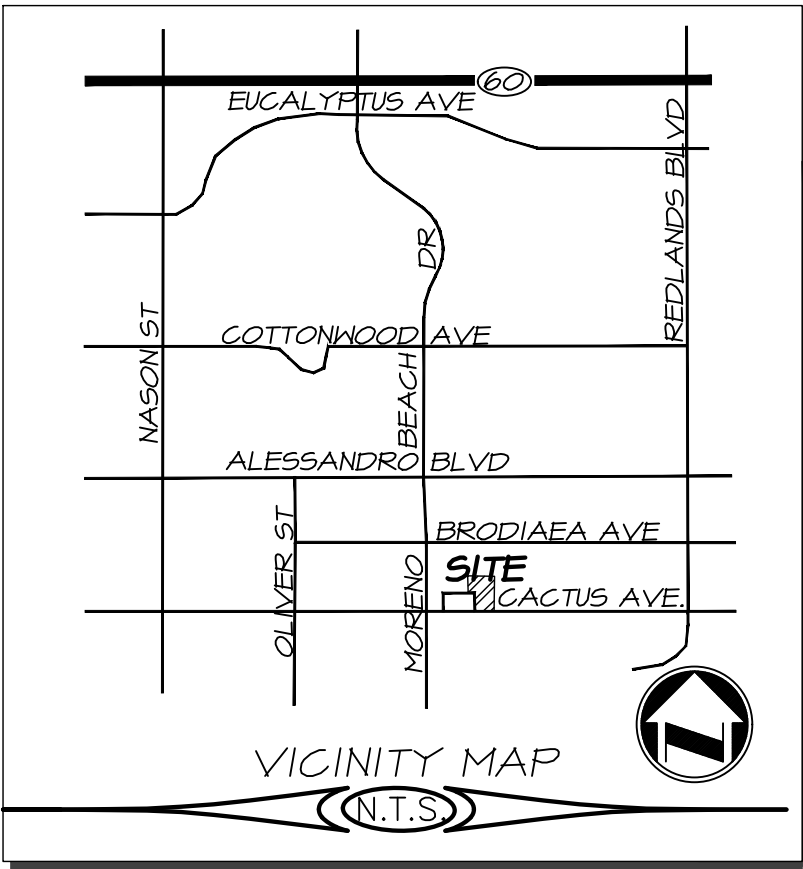
STORM DRAIN STENCIL

STORM DRAIN NOTE

PER CITY OF MORENO VALLEY STD NO. MVFE-300B-0 NOTE 13: STENCIL INLET STRUCTURE WITH "ONLY RAIN IN THE STORM DRAIN" METAL STORM DRAIN MARKET RECOMMENDED TO BE INSTALL ON ALL INLETS. SEE CALTRANS STD. D71



BMP MAP
TRACT 31858



BMP DATA DMA 3				
DMA	DMA CLASSIFICATION	NAME	SURFACE TYPE	AREA (SF)
3.1	D	STREETS	ASPHALT/CONCRETE	21,041
3.2	D	NATURAL SOIL	ORNAMENTAL LANDSCAPING	4,184
TOTAL				25,225

BMP DATA DMA 4				
DMA	DMA CLASSIFICATION	NAME	SURFACE TYPE	AREA (SF)
4.1	D	STREETS	ASPHALT/CONCRETE	21,356
4.2	D	NATURAL SOIL	NATURAL SOIL	4,128
4.3	D	INFILTRATION TRENCH	NATURAL SOIL	465
TOTAL				31,949

BMP DATA DMA 5				
DMA	DMA CLASSIFICATION	NAME	SURFACE TYPE	AREA (SF)
5.1	D	STREETS	ASPHALT/CONCRETE	8,208
5.2	D	NATURAL SOIL	NATURAL SOIL	1,134
5.3	D	INFILTRATION TRENCH	NATURAL SOIL	150
TOTAL				10,492

BMP DATA DMA 6				
DMA	DMA CLASSIFICATION	NAME	SURFACE TYPE	AREA (SF)
6.1	D	STREETS	ASPHALT/CONCRETE	5,658
6.2	D	NATURAL SOIL	NATURAL SOIL	1,042
6.3	D	INFILTRATION TRENCH	NATURAL SOIL	130
TOTAL				6,830

SOURCE CONTROL BMPs

①	ON-SITE STORM DRAIN INLETS
②	LANDSCAPE/ OUTDOOR PESTICIDE USE
③	REFUSE AREAS

LEGEND

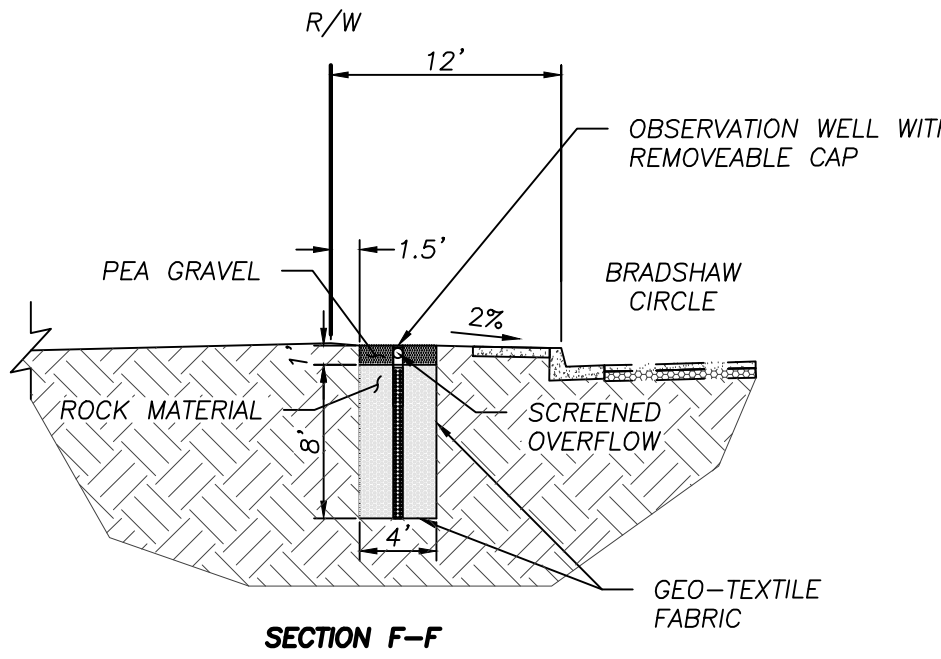
- DMA AREA SINGLE FAMILY RESIDENTIAL (65% IMPERVIOUS)
- STREETS (100% IMPERVIOUS)
- LANDSCAPING (10% IMPERVIOUS)
- DMA BOUNDARY
- DRAINAGE PATH



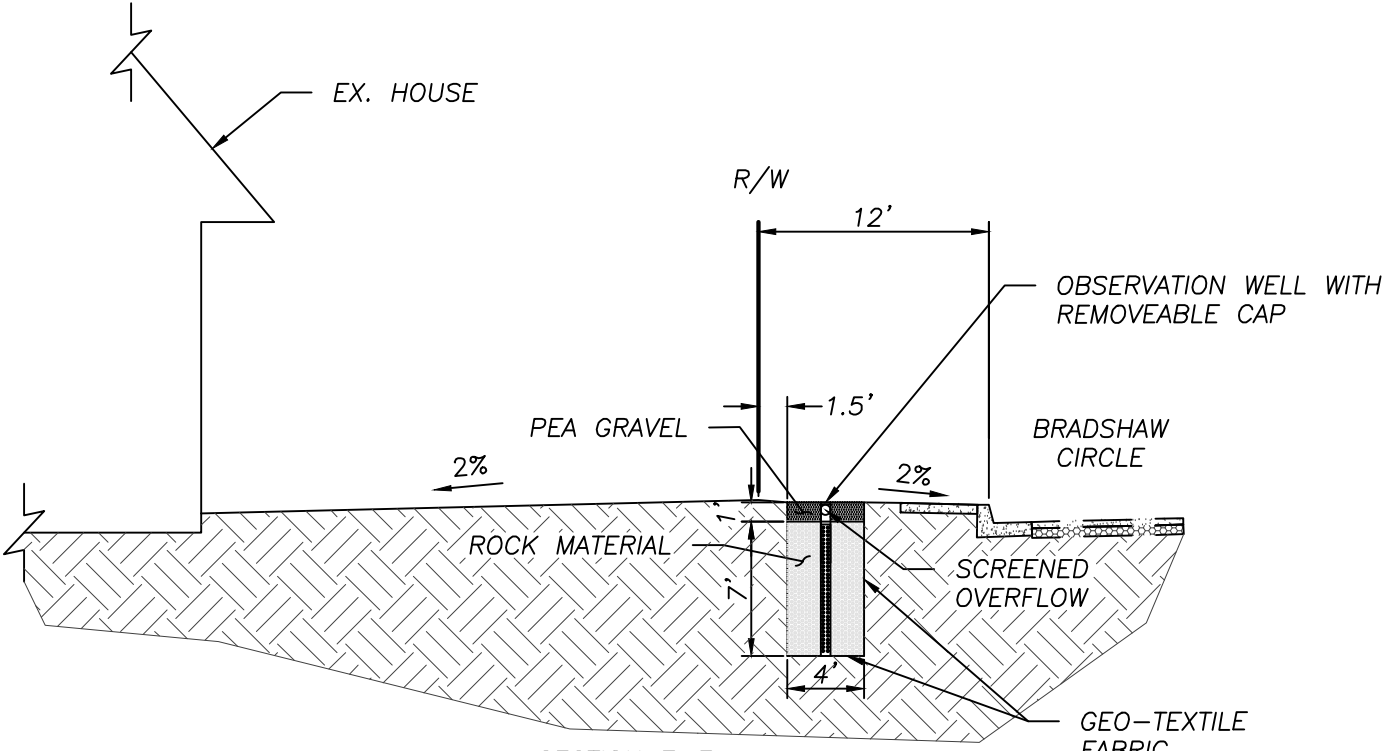
STORM DRAIN STENCIL

STORM DRAIN NOTE

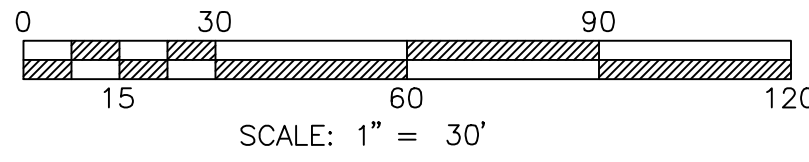
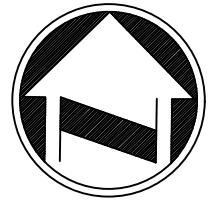
PER CITY OF MORENO VALLEY STD NO. MVFE-300B-0 NOTE 13: STENCIL INLET STRUCTURE WITH "ONLY RAIN IN THE STORM DRAIN" METAL STORM DRAIN MARKET RECOMMENDED TO BE INSTALL ON ALL INLETS. SEE CALTRANS STD. D71



SECTION F-F



SECTION E-E



BMP MAP

PREPARATION DATE : JULY 2024

PLAN PREPARED BY:

adkan ENGINEERS
Civil Engineering • Surveying • Planning
6879 Airport Drive, Riverside, CA 92504
Tel:(951) 686-0241-Fax:(951) 686-0399

Santa Ana Watershed - BMP Design Volume, V_{BMP} (Rev. 10-2011)						Legend: Required Entries Calculated Cells		
(Note this worksheet shall only be used in conjunction with BMP designs from the LID BMP Design Handbook)								
Company Name: Adkan Engineers						Date: 8/7/2025		
Designed by: Michael Soriano						Case No: LWQ20-0033		
Company Project Number/Name: TRACT 37858								
BMP Identification								
BMP NAME / ID: INF-1								
Must match Name/ID used on BMP Design Calculation Sheet								
Design Rainfall Depth								
85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E						$D_{85} = $ 0.70 inches		
Drainage Management Area Tabulation								
Insert additional rows if needed to accommodate all DMAs draining to the BMP								
DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective ImperVIOUS Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)
D.4.1	21099	Concrete or Asphalt	1	0.89	18820.3			
D.4.2	4789	Ornamental Landscaping	0.1	0.11	529			
25888		Total			19349.3			
Notes:								

(Rev. 10-2011)

Calculated Cells

Notes:

(Rev. 10-2011)

Calculated Cells

Notes:

(Rev. 10-2011)

Calculated Cells

Notes:

Infiltration Trench - Design Procedure		BMP ID	Legend:	Required Entries
		INF-1		Calculated Cells
Company Name:	Adkan Engineers		Date:	8/7/2025
Designed by:	Michael Soriano		County/City Case No.:	LWQ20-0033
Design Volume				
Enter the area tributary to this feature, Max = 10 acres			$A_t =$	1 acres
Enter V_{BMP} determined from Section 2.1 of this Handbook			$V_{BMP} =$	1,129 ft ³
Calculate Maximum Depth of the Reservoir Layer				
Enter Infiltration rate			$I =$	1.8 in/hr
Enter Factor of Safety, FS (unitless)			$FS =$	3
<i>Obtain from Table 1, Appendix A: "Infiltration Testing" of this BMP Handbook</i>				
Calculate D_1 .			$D_1 =$	9.15 ft
$D_1 = \frac{I \text{ (in/hr)} \times 72 \text{ hrs}}{12 \text{ (in/ft)} \times (n / 100) \times FS}$			$n =$	40 %
Enter depth to historic high groundwater mark (measured from finished grade)				20 ft
Enter depth to top of bedrock or impermeable layer (measured from finished grade)				30 ft
D_2 is the smaller of:				
Depth to groundwater - 11 ft; & Depth to impermeable layer - 6 ft			$D_2 =$	9.0 ft
D_{MAX} is the smaller value of D_1 and D_2 , must be less than or equal to 8 feet.			$D_{MAX} =$	8.0 ft
Trench Sizing				
Enter proposed reservoir layer depth D_R , must be $\leq D_{MAX}$			$D_R =$	8.00 ft
Calculate the design depth of water, d_w				
Design $d_w = (D_R) \times (n/100)$			Design $d_w =$	3.20 ft
Minimum Surface Area, A_S	$A_S =$	$\frac{V_{BMP}}{d_w}$	$A_S =$	353 ft ²
Proposed Design Surface Area			$A_D =$	356 ft ²
Minimum Width = $D_R + 1$ foot pea gravel				9.00 ft
Sediment Control Provided? (Use pulldown)	Yes			
Geotechnical report attached? (Use pulldown)	Yes			

If the trench has been designed correctly, there should be no error messages on the spreadsheet.

Infiltration Trench - Design Procedure		BMP ID	Legend:	Required Entries
		INF-2		Calculated Cells
Company Name:	Adkan Engineers		Date:	8/7/2025
Designed by:	Michael Soriano		County/City Case No.:	LWQ20-0033
Design Volume				
Enter the area tributary to this feature, Max = 10 acres			$A_t =$	1 acres
Enter V_{BMP} determined from Section 2.1 of this Handbook			$V_{BMP} =$	1,484 ft ³
Calculate Maximum Depth of the Reservoir Layer				
Enter Infiltration rate			$I =$	1.8 in/hr
Enter Factor of Safety, FS (unitless)			$FS =$	3
<i>Obtain from Table 1, Appendix A: "Infiltration Testing" of this BMP Handbook</i>				
Calculate D_1 .			$D_1 =$	9.15 ft
$D_1 = \frac{I \text{ (in/hr)} \times 72 \text{ hrs}}{12 \text{ (in/ft)} \times (n / 100) \times FS}$			$n =$	40 %
Enter depth to historic high groundwater mark (measured from finished grade)				20 ft
Enter depth to top of bedrock or impermeable layer (measured from finished grade)				30 ft
D_2 is the smaller of:				
Depth to groundwater - 11 ft; & Depth to impermeable layer - 6 ft			$D_2 =$	9.0 ft
D_{MAX} is the smaller value of D_1 and D_2 , must be less than or equal to 8 feet.			$D_{MAX} =$	8.0 ft
Trench Sizing				
Enter proposed reservoir layer depth D_R , must be $\leq D_{MAX}$			$D_R =$	8.00 ft
Calculate the design depth of water, d_w				
Design $d_w = (D_R) \times (n/100)$			Design $d_w =$	3.20 ft
Minimum Surface Area, A_S	$A_S =$	$\frac{V_{BMP}}{d_w}$	$A_S =$	464 ft ²
Proposed Design Surface Area			$A_D =$	465 ft ²
Minimum Width = $D_R + 1$ foot pea gravel				9.00 ft
Sediment Control Provided? (Use pulldown)	Yes			
Geotechnical report attached? (Use pulldown)	Yes			

If the trench has been designed correctly, there should be no error messages on the spreadsheet.

Infiltration Trench - Design Procedure		BMP ID	Legend:	Required Entries
		INF-3		Calculated Cells
Company Name:	Adkan Engineers		Date:	8/7/2025
Designed by:	Michael Soriano		County/City Case No.:	LWQ20-0033
Design Volume				
Enter the area tributary to this feature, Max = 10 acres			$A_t =$	0 acres
Enter V_{BMP} determined from Section 2.1 of this Handbook			$V_{BMP} =$	476 ft ³
Calculate Maximum Depth of the Reservoir Layer				
Enter Infiltration rate			$I =$	1.8 in/hr
Enter Factor of Safety, FS (unitless)			$FS =$	3
<i>Obtain from Table 1, Appendix A: "Infiltration Testing" of this BMP Handbook</i>				
Calculate D_1 .			$D_1 =$	9.15 ft
$D_1 = \frac{I \text{ (in/hr)} \times 72 \text{ hrs}}{12 \text{ (in/ft)} \times (n / 100) \times FS}$			$n =$	40 %
Enter depth to historic high groundwater mark (measured from finished grade)				20 ft
Enter depth to top of bedrock or impermeable layer (measured from finished grade)				30 ft
D_2 is the smaller of:				
Depth to groundwater - 11 ft; & Depth to impermeable layer - 6 ft			$D_2 =$	9.0 ft
D_{MAX} is the smaller value of D_1 and D_2 , must be less than or equal to 8 feet.			$D_{MAX} =$	8.0 ft
Trench Sizing				
Enter proposed reservoir layer depth D_R , must be $\leq D_{MAX}$			$D_R =$	8.00 ft
Calculate the design depth of water, d_w				
Design $d_w = (D_R) \times (n/100)$			Design $d_w =$	3.20 ft
Minimum Surface Area, A_S	$A_S =$	$\frac{V_{BMP}}{d_w}$	$A_S =$	149 ft ²
Proposed Design Surface Area			$A_D =$	150 ft ²
Minimum Width = $D_R + 1$ foot pea gravel				9.00 ft
Sediment Control Provided? (Use pulldown)	Yes			
Geotechnical report attached? (Use pulldown)	Yes			

If the trench has been designed correctly, there should be no error messages on the spreadsheet.

Infiltration Trench - Design Procedure		BMP ID	Legend:	Required Entries
		INF-4		Calculated Cells
Company Name:	Adkan Engineers		Date:	8/7/2025
Designed by:	Michael Soriano		County/City Case No.:	LWQ20-0033
Design Volume				
Enter the area tributary to this feature, Max = 10 acres			$A_t =$	0 acres
Enter V_{BMP} determined from Section 2.1 of this Handbook			$V_{BMP} =$	310 ft ³
Calculate Maximum Depth of the Reservoir Layer				
Enter Infiltration rate			$I =$	1.8 in/hr
Enter Factor of Safety, FS (unitless)			$FS =$	3
<i>Obtain from Table 1, Appendix A: "Infiltration Testing" of this BMP Handbook</i>				
Calculate D_1 .			$D_1 =$	9.15 ft
$D_1 = \frac{I \text{ (in/hr)} \times 72 \text{ hrs}}{12 \text{ (in/ft)} \times (n / 100) \times FS}$			$n =$	40 %
Enter depth to historic high groundwater mark (measured from finished grade)				20 ft
Enter depth to top of bedrock or impermeable layer (measured from finished grade)				30 ft
D_2 is the smaller of:				
Depth to groundwater - 11 ft; & Depth to impermeable layer - 6 ft			$D_2 =$	9.0 ft
D_{MAX} is the smaller value of D_1 and D_2 , must be less than or equal to 8 feet.			$D_{MAX} =$	8.0 ft
Trench Sizing				
Enter proposed reservoir layer depth D_R , must be $\leq D_{MAX}$			$D_R =$	6.00 ft
Calculate the design depth of water, d_w				
Design $d_w = (D_R) \times (n/100)$			Design $d_w =$	2.40 ft
Minimum Surface Area, A_S	$A_S =$	$\frac{V_{BMP}}{d_w}$	$A_S =$	129 ft ²
Proposed Design Surface Area			$A_D =$	130 ft ²
Minimum Width = $D_R + 1$ foot pea gravel				7.00 ft
Sediment Control Provided? (Use pulldown)	Yes			
Geotechnical report attached? (Use pulldown)	Yes			

If the trench has been designed correctly, there should be no error messages on the spreadsheet.

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation

Santa Ana Watershed

V_{BMP} and Q_{BMP} worksheets

These worksheets are to be used to determine the required

Design Capture Volume (V_{BMP})

or the

Design Flow Rate (Q_{BMP})

for BMPs in the Santa Ana Watershed

To verify which watershed your project is located within, visit

www.rcflood.org/npdes

and use the 'Locate my Watershed' tool

If your project is not located in the Santa Ana Watershed,

Do not use these worksheets! Instead visit

www.rcflood.org/npdes/developers.aspx

To access worksheets applicable to your watershed

Use the **tabs across the bottom
to access the worksheets for the Santa Ana Watershed**

[illegible]

[illegible]

[illegible]

(Rev. 10-2011)

Required Entries

Company Name	ADKAN ENGINEERS
--------------	-----------------

Designed by	Luis Bucio
-------------	------------

0

TRACT 37858

BMP Identification	
--------------------	--

FILTERRA 2

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

I = 0.20 in/hr

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

	DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (<i>use pull-down menu</i>)	Effective Imperivious Fraction, I _f	DMA Runoff Factor	DMA Areas x Runoff Factor	Design Rainfall Intensity (in/hr)	Design Flow Rate (cfs)	Proposed Flow Rate (cfs)
DMAs	D.4.1	27356	Concrete or Asphalt	1	0.89	24401.6			
	D.4.2	4593	Natural (C Soil)	0.3	0.225166	1034.2			

$Q_{\text{bmp}} = 0.117 \text{ (cfs)}$

Santa Ana Watershed - BMP Design Flow Rate, Q _{BMP}						Legend:		Required Entries	
(Rev. 10-2011)								Calculated Cells	
(Note this worksheet shall only be used in conjunction with BMP designs from the LID BMP Design Handbook)									
Company Name ADKAN ENGINEERS						Date 11/26/2024			
Designed by Luis Bucio						Case No.			
Company Project Number/Name TRACT 37858									
BMP Identification									
BMP NAME / ID FILTERRA 3									
Must match Name/ID used on BMP Design Calculation Sheet									
Design Rainfall Depth									
Design Rainfall Intensity						I = 0.20 in/hr			
Drainage Management Area Tabulation									
Insert additional rows if needed to accommodate all DMAs draining to the BMP									
DMAs	DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I _f	DMA Runoff Factor	DMA Areas x Runoff Factor	Design Rainfall Intensity (in/hr)	Design Flow Rate (cfs)	Proposed Flow Rate (cfs)
	D.5.1	8808	Concrete or Asphalt	1	0.89	7856.7			
	D.5.2	1284	Natural (C Soil)	0.3	0.225166	289.1			
	10092	Total			8145.8	0.20	0	1.42	

Notes:

Q_{bmp} =0.037 (cfs)

(Rev. 10-2011)

Required Entries

Company Name	ADKAN ENGINEERS
--------------	-----------------

Designed by	Luis Bucio
-------------	------------

TRACT 37858

BMP Identification	
--------------------	--

FILTERRA 4

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

I = 0.20 in/hr

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

	DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I _f	DMA Runoff Factor	DMA Areas x Runoff Factor	Design Rainfall Intensity (in/hr)	Design Flow Rate (cfs)	Proposed Flow Rate (cfs)
DMAs	D.6.1	5658	Concrete or Asphalt	1	0.89	5046.9			
	D.6.2	1172	Natural (C Soil)	0.3	0.225166	263.9			

$Q_{\text{bmp}} = 0.024 \text{ (cfs)}$

Effective Impervious Fraction

Developed Cover Types	Effective Impervious Fraction
Roofs	1.00
Concrete or Asphalt	1.00
Grouted or Gapless Paving Blocks	1.00
Compacted Soil (e.g. unpaved parking)	0.40
Decomposed Granite	0.40
Permeable Paving Blocks w/ Sand Filled Gap	0.25
Class 2 Base	0.30
Gravel or Class 2 Permeable Base	0.10
Pervious Concrete / Porous Asphalt	0.10
Open and Porous Pavers	0.10
Turf block	0.10
Ornamental Landscaping	0.10
Natural (A Soil)	0.03
Natural (B Soil)	0.15
Natural (C Soil)	0.30
Natural (D Soil)	0.40

Mixed Surface Types

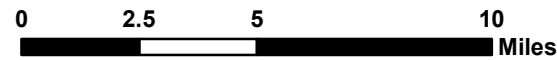
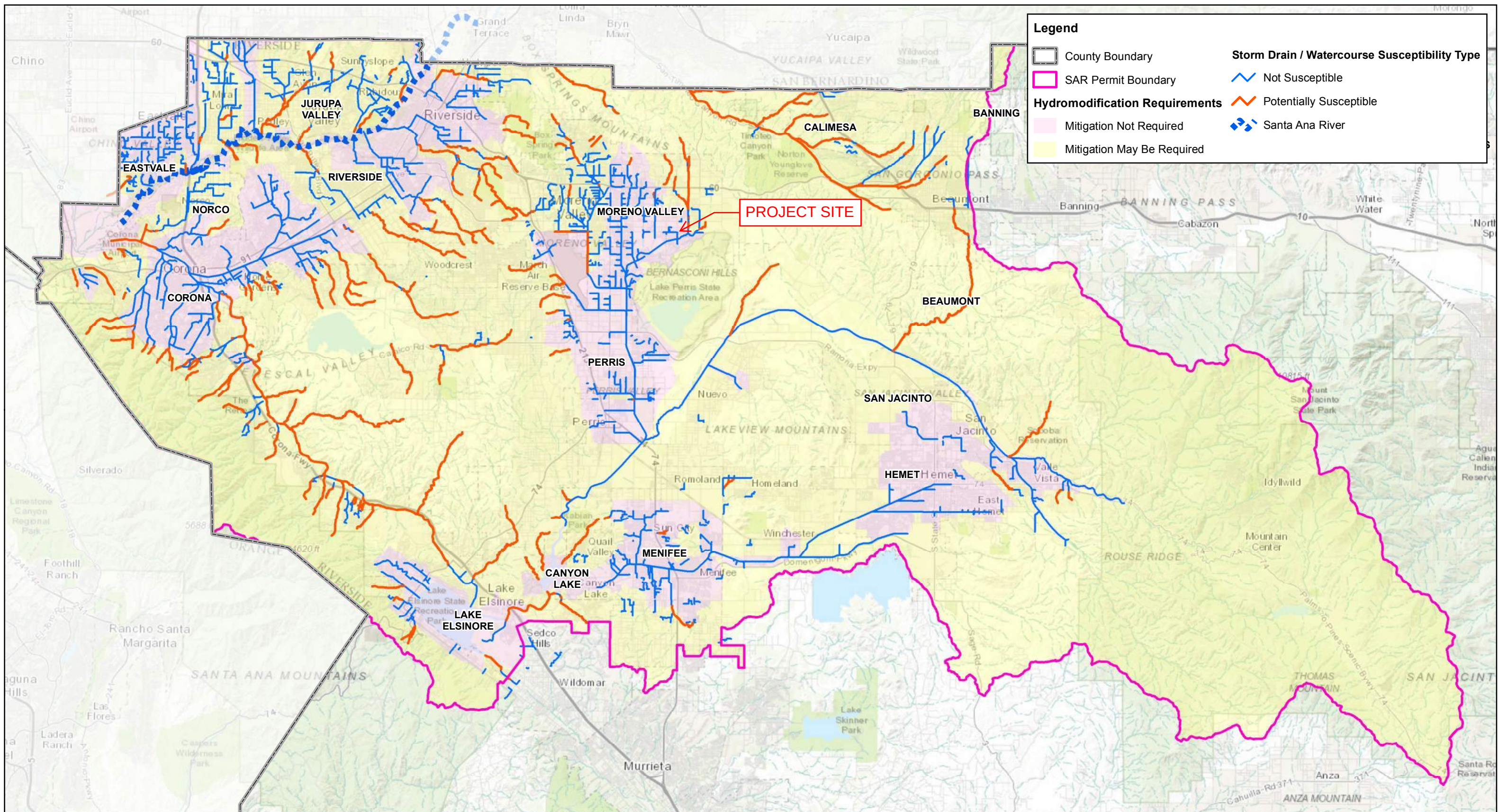
Use this table to determine the effective impervious fraction for the V_{BMP} and Q_{BMP} calculation sheets

Infiltration Basin - Design Procedure (Rev. 03-2012)		BMP ID Basin 1	Legend:	Required Entries Calculated Cells
Company Name:	Adkan Engineers		Date:	3/17/2021
Designed by:	Benjamin Rees		County/City Case No.:	
Design Volume				
a) Tributary area (BMP subarea)			$A_T =$	2.42 acres
b) Enter V_{BMP} determined from Section 2.1 of this Handbook			$V_{BMP} =$	4,643 ft ³
Maximum Depth				
a) Infiltration rate			$I =$	3.34 in/hr
b) Factor of Safety (See Table 1, Appendix A: "Infiltration Testing" from this BMP Handbook)			$FS =$	6
c) Calculate D_1	$D_1 = \frac{I \text{ (in/hr)} \times 72 \text{ hrs}}{12 \text{ (in/ft)} \times FS}$		$D_1 =$	3.3 ft
d) Enter the depth of freeboard (at least 1 ft)				1 ft
e) Enter depth to historic high ground water (measured from top of basin)				20 ft
f) Enter depth to top of bedrock or impermeable layer (measured from top of basin)				30 ft
g) D_2 is the smaller of:				
Depth to groundwater - (10 ft + freeboard) and			$D_2 =$	9.0 ft
Depth to impermeable layer - (5 ft + freeboard)				
h) D_{MAX} is the smaller value of D_1 and D_2 but shall not exceed 5 feet			$D_{MAX} =$	3.3 ft
Basin Geometry				
a) Basin side slopes (no steeper than 4:1)			$z =$	4 :1
b) Proposed basin depth (excluding freeboard)			$d_B =$	2 ft
c) Minimum bottom surface area of basin ($A_S = V_{BMP}/d_B$)			$A_S =$	2322 ft ²
d) Proposed Design Surface Area			$A_D =$	2,324 ft ²
Forebay				
a) Forebay volume (minimum 0.5% V_{BMP})			Volume =	23 ft ³
b) Forebay depth (height of berm/splashwall. 1 foot min.)			Depth =	1 ft
c) Forebay surface area (minimum)			Area =	23 ft ²
d) Full height notch-type weir			Width (W) =	36.0 in
Notes:				

Infiltration Basin - Design Procedure (Rev. 03-2012)		BMP ID Basin 2	Legend:	Required Entries Calculated Cells
Company Name:	Adkan Engineers	Date: 6/4/2020		
Designed by:	Jose Contreras	County/City Case No.:		
Design Volume				
a) Tributary area (BMP subarea)	$A_T =$		2.13	acres
b) Enter V_{BMP} determined from Section 2.1 of this Handbook	$V_{BMP} =$		3,376	ft ³
Maximum Depth				
a) Infiltration rate	$I =$		2	in/hr
b) Factor of Safety (See Table 1, Appendix A: "Infiltration Testing" from this BMP Handbook)	$FS =$		3	
c) Calculate D_1	$D_1 = \frac{I \text{ (in/hr)} \times 72 \text{ hrs}}{12 \text{ (in/ft)} \times FS}$		$D_1 =$	4.0 ft
d) Enter the depth of freeboard (at least 1 ft)			1	ft
e) Enter depth to historic high ground water (measured from top of basin)			20	ft
f) Enter depth to top of bedrock or impermeable layer (measured from top of basin)			30	ft
g) D_2 is the smaller of:				
Depth to groundwater - (10 ft + freeboard) and			$D_2 =$	9.0 ft
Depth to impermeable layer - (5 ft + freeboard)				
h) D_{MAX} is the smaller value of D_1 and D_2 but shall not exceed 5 feet			$D_{MAX} =$	4.0 ft
Basin Geometry				
a) Basin side slopes (no steeper than 4:1)	$z =$		4	:1
b) Proposed basin depth (excluding freeboard)	$d_B =$		2	ft
c) Minimum bottom surface area of basin ($A_S = V_{BMP}/d_B$)	$A_S =$		1688	ft ²
d) Proposed Design Surface Area	$A_D =$		1,690	ft ²
Forebay				
a) Forebay volume (minimum 0.5% V_{BMP})	Volume =		17	ft ³
b) Forebay depth (height of berm/splashwall. 1 foot min.)	Depth =		1	ft
c) Forebay surface area (minimum)	Area =		17	ft ²
d) Full height notch-type weir	Width (W) =		36.0	in

Appendix 7: Hydromodification

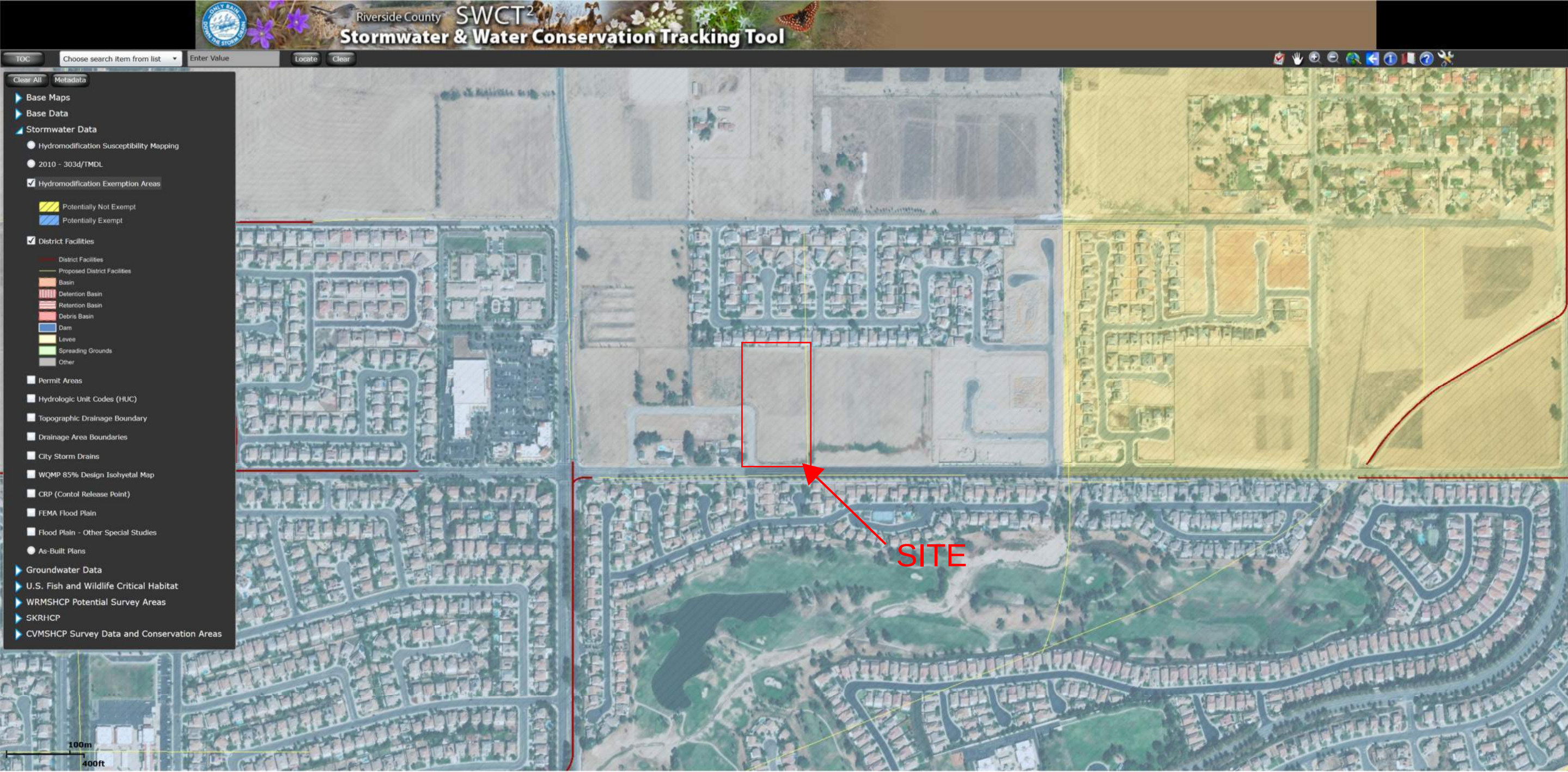
Supporting Detail Relating to Hydrologic Conditions of Concern



Updated February 2017

HCOC Applicability Map SAR Permittees

Map 2



**PRELIMINARY HYDROLOGY REPORT
FOR**

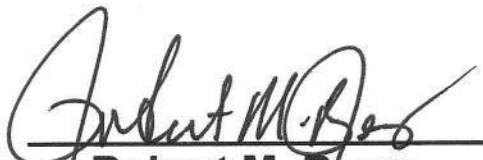
**TTM 37858
Moreno Valley, CA**

Prepared for:

**RC Hobbs Companies
1428 E. Chapman Avenue
Orange, CA 92866**

Initial Report: April 15, 2020

Prepared by:


**Robert M. Beers
8175 Limonite Avenue
Suite E
Riverside, CA 92509
(951) 317-2041**



Preliminary Drainage Report

Wednesday, April 15, 2020

INTRODUCTION

The following report and calculations were prepared to analyze the 2, 10 & 100-year storm runoff from the development of the TTM 37858 at the northeast corner of Bradshaw Circle and Cactus Avenue in the City of Moreno Valley, Ca. Two infiltration basins are proposed for both mitigation of increased runoff from the site and for onsite BMPs for treatment of site runoff.

SITE BACKGROUND

The proposed project is located on the north side of Cactus Avenue with Bradshaw Circle on the west side of the property. The property is vacant and undeveloped and slopes from east to west.

There is a large undeveloped parcel adjacent to the property on the east property line that drains to swale along the east property line and conveys that offsite drainage to Cactus Avenue at the southeast corner of the property. There are single family residential properties immediately adjacent to the site along the north property line.

The soil type for the area is Type B per Plate C-1.17 "Hydrologic Soils Group Map for Sunnymead" from the Riverside County Hydrology Manual.

METHODOLOGY

Subareas were determined based on the proposed grading of the site. A link-node model was created for each subarea, with flow path length and elevations shown for the upstream and downstream nodes for the subarea. Peak flowrates were determined for each subarea using the CivilDesign Corporation "RIV" rational method hydrology software. The results of those calculations are shown on the site hydrology map included with this report. Separate maps for the existing and developed condition are included with this report.

ANALYSES/DISCUSSION

Rational method hydrology calculations have been prepared for 2, 10 & 100-year existing and proposed condition for the project site. In the existing condition site drainage sheet flows across the property to the west towards Bradshaw Circle. There is a high point at the knuckle of Bradshaw Circle with a portion of the site drainage (Area 1) flowing southerly to Cactus Avenue where it is collected by a series of catch basins along the Cactus Avenue and placed into an offsite storm drain in the existing condition. Area 2 flows go offsite along Bradshaw Circle to the west and thence out to Cactus Avenue where the flows are collected by a series of catch basins along Cactus Avenue.

In the developed condition, the site has been designed to maintain the drainage area flow split with flows being routed through two onsite water quality infiltration basins. The infiltration basins will be located in the proposed landscape area onsite adjacent to Bradshaw Circle street right-of-way and will discharge to Bradshaw Circle.

The drainage areas and peak 2, 10 & 100-year discharges are summarized below:

Rational Method Calculations

Existing Condition

Description	Area (Ac.)	2-year discharge (cfs)	10-year discharge (cfs)	100-year discharge (cfs)	Tc min.
Area 1	2.93	1.62	3.48	5.90	15.27
Area 2	2.01	1.18	2.51	4.24	14.00

Proposed Condition

Description	Area (Ac.)	2-year discharge (cfs)	10-year discharge (cfs)	100-year discharge (cfs)	Tc min.
Area 1	2.13	1.84	3.08	4.91	11.92
Area 2	0.77	0.84	1.42	2.23	7.66
Area 3	1.68	1.46	2.44	3.89	11.85
2 & 3	2.45	6.60	12.28	21.60	13.85

PROPOSED PROJECT BMP's

Based on soil infiltration test results we have selected an infiltration basin onsite as the method for treatment of onsite flows. The details of the proposed infiltration basin system are described in detail in the Preliminary Water Quality Management Plan prepared for this project.

CONCLUSION

Based on the calculations and proposed improvements, onsite flows can be conveyed to suitable points of disposal, and the proposed site development will not impact offsite properties.

Appendix A

Existing Condition Rational Method Calculations

2-year
10-year
100-year

ttm37858ex2a

Riverside County Rational Hydrology Program

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

Rational Hydrology Study

Date: 04/15/20

File:ttm37858ex2a.out

TTM 37858 EXISTING CONDITION

2-year flow rates - Area 1

RMB

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

English (in-lb) Units used in input data file

Program License Serial Number 6288

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 2.00 Antecedent Moisture Condition = 1

Standard intensity-duration curves data (Plate D-4.1)

For the [Sunnymead-Moreno] area used.

10 year storm 10 minute intensity = 2.010(In/Hr)

10 year storm 60 minute intensity = 0.820(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 2.0

Calculated rainfall intensity data:

1 hour intensity = 0.554(In/Hr)

Slope of intensity duration curve = 0.5000

++++
Process from Point/Station 100.000 to Point/Station 101.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 604.000(Ft.)
 Top (of initial area) elevation = 67.400(Ft.)
 Bottom (of initial area) elevation = 56.300(Ft.)
 Difference in elevation = 11.100(Ft.)
 Slope = 0.01838 s(percent)= 1.84
 $TC = k(0.530)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 15.270 min.
 Rainfall intensity = 1.099(In/Hr) for a 2.0 year storm
 UNDEVELOPED (poor cover) subarea
 Runoff Coefficient = 0.503
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 1) = 60.60
 Pervious area fraction = 1.000; Impervious fraction = 0.000
 Initial subarea runoff = 1.620(CFS)
 Total initial stream area = 2.930(Ac.)
 Pervious area fraction = 1.000
 End of computations, total study area = 2.93 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.

 Area averaged pervious area fraction(A_p) = 1.000
 Area averaged RI index number = 78.0

ttm37858ex2b

Riverside County Rational Hydrology Program

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

Rational Hydrology Study

Date: 04/15/20

File:ttm37858ex2b.out

TTM 37858 EXISTING CONDITION

2-year flow rates Area 2

RMB

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

English (in-lb) Units used in input data file

Program License Serial Number 6288

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 2.00 Antecedent Moisture Condition = 1

Standard intensity-duration curves data (Plate D-4.1)

For the [Sunnymead-Moreno] area used.

10 year storm 10 minute intensity = 2.010(In/Hr)

10 year storm 60 minute intensity = 0.820(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 2.0

Calculated rainfall intensity data:

1 hour intensity = 0.554(In/Hr)

Slope of intensity duration curve = 0.5000

++++
Process from Point/Station 200.000 to Point/Station 201.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 516.000(Ft.)
 Top (of initial area) elevation = 69.200(Ft.)
 Bottom (of initial area) elevation = 58.500(Ft.)
 Difference in elevation = 10.700(Ft.)
 Slope = 0.02074 s(percent)= 2.07
 $TC = k(0.530)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 13.996 min.
 Rainfall intensity = 1.148(In/Hr) for a 2.0 year storm
 UNDEVELOPED (poor cover) subarea
 Runoff Coefficient = 0.513
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 1) = 60.60
 Pervious area fraction = 1.000; Impervious fraction = 0.000
 Initial subarea runoff = 1.183(CFS)
 Total initial stream area = 2.010(Ac.)
 Pervious area fraction = 1.000
 End of computations, total study area = 2.01 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.

 Area averaged pervious area fraction(A_p) = 1.000
 Area averaged RI index number = 78.0

ttm37858ex10a

Riverside County Rational Hydrology Program

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

Rational Hydrology Study

Date: 04/15/20

File:ttm37858ex10a.out

TTM 37858 EXISTING CONDITION

10-YEAR FLOW RATES - AREA 1

RMB

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

English (in-lb) Units used in input data file

Program License Serial Number 6288

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [Sunnymead-Moreno] area used.

10 year storm 10 minute intensity = 2.010(In/Hr)

10 year storm 60 minute intensity = 0.820(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 10.0

Calculated rainfall intensity data:

1 hour intensity = 0.820(In/Hr)

Slope of intensity duration curve = 0.5000

++++
Process from Point/Station 100.000 to Point/Station 101.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 604.000(Ft.)
 Top (of initial area) elevation = 67.400(Ft.)
 Bottom (of initial area) elevation = 56.300(Ft.)
 Difference in elevation = 11.100(Ft.)
 Slope = 0.01838 s(percent)= 1.84
 $TC = k(0.530)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 15.270 min.
 Rainfall intensity = 1.625(In/Hr) for a 10.0 year storm
 UNDEVELOPED (poor cover) subarea
 Runoff Coefficient = 0.731
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 2) = 78.00
 Pervious area fraction = 1.000; Impervious fraction = 0.000
 Initial subarea runoff = 3.481(CFS)
 Total initial stream area = 2.930(Ac.)
 Pervious area fraction = 1.000
 End of computations, total study area = 2.93 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.

 Area averaged pervious area fraction(A_p) = 1.000
 Area averaged RI index number = 78.0

ttm37858ex10b

Riverside County Rational Hydrology Program

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

Rational Hydrology Study

Date: 04/15/20

File:ttm37858ex10b.out

TTM 37858 EXISTING CONDITION
10-YEAR FLOW RATES - AREA 2
RMB

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

English (in-lb) Units used in input data file

Program License Serial Number 6288

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [Sunnymead-Moreno] area used.
10 year storm 10 minute intensity = 2.010(In/Hr)
10 year storm 60 minute intensity = 0.820(In/Hr)
100 year storm 10 minute intensity = 2.940(In/Hr)
100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 10.0
Calculated rainfall intensity data:
1 hour intensity = 0.820(In/Hr)
Slope of intensity duration curve = 0.5000

++++
Process from Point/Station 200.000 to Point/Station 201.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 516.000(Ft.)
 Top (of initial area) elevation = 69.200(Ft.)
 Bottom (of initial area) elevation = 58.500(Ft.)
 Difference in elevation = 10.700(Ft.)
 Slope = 0.02074 s(percent)= 2.07
 $TC = k(0.530)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 13.996 min.
 Rainfall intensity = 1.698(In/Hr) for a 10.0 year storm
 UNDEVELOPED (poor cover) subarea
 Runoff Coefficient = 0.737
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 2) = 78.00
 Pervious area fraction = 1.000; Impervious fraction = 0.000
 Initial subarea runoff = 2.514(CFS)
 Total initial stream area = 2.010(Ac.)
 Pervious area fraction = 1.000
 End of computations, total study area = 2.01 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.

 Area averaged pervious area fraction(A_p) = 1.000
 Area averaged RI index number = 78.0

ttm37858ex100a

Riverside County Rational Hydrology Program

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

Rational Hydrology Study

Date: 04/15/20

File:ttm37858ex100a.out

TTM 37858 EXISTING CONDITON
100-YEAR FLOW RATES - AREA 1
RMB

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

English (in-lb) Units used in input data file

Program License Serial Number 6288

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 3

Standard intensity-duration curves data (Plate D-4.1)

For the [Sunnymead-Moreno] area used.

10 year storm 10 minute intensity = 2.010(In/Hr)

10 year storm 60 minute intensity = 0.820(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 100.0

Calculated rainfall intensity data:

1 hour intensity = 1.200(In/Hr)

Slope of intensity duration curve = 0.5000

++++
Process from Point/Station 100.000 to Point/Station 101.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 604.000(Ft.)
 Top (of initial area) elevation = 67.400(Ft.)
 Bottom (of initial area) elevation = 56.300(Ft.)
 Difference in elevation = 11.100(Ft.)
 Slope = 0.01838 s(percent)= 1.84
 $TC = k(0.530)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 15.270 min.
 Rainfall intensity = 2.379(In/Hr) for a 100.0 year storm
 UNDEVELOPED (poor cover) subarea
 Runoff Coefficient = 0.846
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 3) = 89.80
 Pervious area fraction = 1.000; Impervious fraction = 0.000
 Initial subarea runoff = 5.897(CFS)
 Total initial stream area = 2.930(Ac.)
 Pervious area fraction = 1.000
 End of computations, total study area = 2.93 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.

 Area averaged pervious area fraction(A_p) = 1.000
 Area averaged RI index number = 78.0

ttm37858ex100b

Riverside County Rational Hydrology Program

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

Rational Hydrology Study

Date: 04/15/20

File:ttm37858ex100b.out

TTM 37858 EXISTING CONDITON
100-YEAR FLOW RATES - AREA 2
RMB

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

English (in-lb) Units used in input data file

Program License Serial Number 6288

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 3

Standard intensity-duration curves data (Plate D-4.1)

For the [Sunnymead-Moreno] area used.

10 year storm 10 minute intensity = 2.010(In/Hr)

10 year storm 60 minute intensity = 0.820(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 100.0

Calculated rainfall intensity data:

1 hour intensity = 1.200(In/Hr)

Slope of intensity duration curve = 0.5000

++++
Process from Point/Station 200.000 to Point/Station 201.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 516.000(Ft.)
 Top (of initial area) elevation = 69.200(Ft.)
 Bottom (of initial area) elevation = 58.500(Ft.)
 Difference in elevation = 10.700(Ft.)
 Slope = 0.02074 s(percent)= 2.07
 $TC = k(0.530)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 13.996 min.
 Rainfall intensity = 2.485(In/Hr) for a 100.0 year storm
 UNDEVELOPED (poor cover) subarea
 Runoff Coefficient = 0.848
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 3) = 89.80
 Pervious area fraction = 1.000; Impervious fraction = 0.000
 Initial subarea runoff = 4.236(CFS)
 Total initial stream area = 2.010(Ac.)
 Pervious area fraction = 1.000
 End of computations, total study area = 2.01 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.

 Area averaged pervious area fraction(A_p) = 1.000
 Area averaged RI index number = 78.0

Appendix B
Proposed Condition Rational Method Calculations

2-year
10-year
100-year

TTM37858dev2a

Riverside County Rational Hydrology Program

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

Rational Hydrology Study

Date: 03/28/20

File:TTM37858dev2a.out

TTM 37858 - Drainage Area A
Developed Condition - 2 year flow rates
RMB

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

English (in-lb) Units used in input data file

Program License Serial Number 6288

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 2.00 Antecedent Moisture Condition = 1

Standard intensity-duration curves data (Plate D-4.1)
For the [Sunnymead-Moreno] area used.
10 year storm 10 minute intensity = 2.010(In/Hr)
10 year storm 60 minute intensity = 0.820(In/Hr)
100 year storm 10 minute intensity = 2.940(In/Hr)
100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 2.0
Calculated rainfall intensity data:
1 hour intensity = 0.554(In/Hr)
Slope of intensity duration curve = 0.5000

++++
Process from Point/Station 101.000 to Point/Station 102.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 636.000(Ft.)
 Top (of initial area) elevation = 64.500(Ft.)
 Bottom (of initial area) elevation = 57.100(Ft.)
 Difference in elevation = 7.400(Ft.)
 Slope = 0.01164 s(percent)= 1.16
 $TC = k(0.370)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 11.924 min.
 Rainfall intensity = 1.244(In/Hr) for a 2.0 year storm
 CONDOMINIUM subarea type
 Runoff Coefficient = 0.693
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 1) = 36.00
 Pervious area fraction = 0.350; Impervious fraction = 0.650
 Initial subarea runoff = 1.840(CFS)
 Total initial stream area = 2.134(Ac.)
 Pervious area fraction = 0.350

++++++
 Process from Point/Station 102.000 to Point/Station 103.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 53.500(Ft.)
 Downstream point/station elevation = 53.000(Ft.)
 Pipe length = 9.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 1.840(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 1.840(CFS)
 Normal flow depth in pipe = 3.32(In.)
 Flow top width inside pipe = 13.97(In.)
 Critical Depth = 6.12(In.)
 Pipe flow velocity = 8.21(Ft/s)
 Travel time through pipe = 0.02 min.
 Time of concentration (TC) = 11.94 min.
 End of computations, total study area = 2.13 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.350
 Area averaged RI index number = 56.0

TTM37858dev2b

Riverside County Rational Hydrology Program

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

Rational Hydrology Study

Date: 03/28/20

File:TTM37858dev2b.out

TTM 37858 - Drainage Area B
Developed Condition - 2 year flow rates
RMB

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

English (in-lb) Units used in input data file

Program License Serial Number 6288

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 2.00 Antecedent Moisture Condition = 1

Standard intensity-duration curves data (Plate D-4.1)

For the [Sunnymead-Moreno] area used.

10 year storm 10 minute intensity = 2.010(In/Hr)

10 year storm 60 minute intensity = 0.820(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 2.0

Calculated rainfall intensity data:

1 hour intensity = 0.554(In/Hr)

Slope of intensity duration curve = 0.5000

++++
Process from Point/Station 201.000 to Point/Station 202.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 250.000(Ft.)
 Top (of initial area) elevation = 62.900(Ft.)
 Bottom (of initial area) elevation = 58.800(Ft.)
 Difference in elevation = 4.100(Ft.)
 Slope = 0.01640 s(percent)= 1.64
 $TC = k(0.370)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 7.663 min.
 Rainfall intensity = 1.551(In/Hr) for a 2.0 year storm
 CONDOMINIUM subarea type
 Runoff Coefficient = 0.710
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 1) = 36.00
 Pervious area fraction = 0.350; Impervious fraction = 0.650
 Initial subarea runoff = 0.848(CFS)
 Total initial stream area = 0.770(Ac.)
 Pervious area fraction = 0.350

++++++
 Process from Point/Station 202.000 to Point/Station 203.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 55.800(Ft.)
 Downstream point/station elevation = 55.000(Ft.)
 Pipe length = 67.50(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 0.848(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 0.848(CFS)
 Normal flow depth in pipe = 3.32(In.)
 Flow top width inside pipe = 13.96(In.)
 Critical Depth = 4.11(In.)
 Pipe flow velocity = 3.79(Ft/s)
 Travel time through pipe = 0.30 min.
 Time of concentration (TC) = 7.96 min.

++++++
 Process from Point/Station 202.000 to Point/Station 203.000
 **** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
 In Main Stream number: 1
 Stream flow area = 0.770(Ac.)
 Runoff from this stream = 0.848(CFS)

TTM37858dev2b
Time of concentration = 7.96 min.
Rainfall intensity = 1.522(In/Hr)
Program is now starting with Main Stream No. 2

+++++
Process from Point/Station 101.000 to Point/Station 302.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 580.000(Ft.)
Top (of initial area) elevation = 64.500(Ft.)
Bottom (of initial area) elevation = 58.700(Ft.)
Difference in elevation = 5.800(Ft.)
Slope = 0.01000 s(percent)= 1.00
 $TC = k(0.370)*[(length^3)/(elevation\ change)]^{0.2}$
Initial area time of concentration = 11.846 min.
Rainfall intensity = 1.248(In/Hr) for a 2.0 year storm
CONDOMINIUM subarea type
Runoff Coefficient = 0.694
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 1) = 36.00
Pervious area fraction = 0.350; Impervious fraction = 0.650
Initial subarea runoff = 1.458(CFS)
Total initial stream area = 1.685(Ac.)
Pervious area fraction = 0.350

+++++
Process from Point/Station 302.000 to Point/Station 303.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 55.700(Ft.)
Downstream point/station elevation = 55.000(Ft.)
Pipe length = 43.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.458(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 1.458(CFS)
Normal flow depth in pipe = 4.01(In.)
Flow top width inside pipe = 14.98(In.)
Critical Depth = 5.43(In.)
Pipe flow velocity = 4.97(Ft/s)
Travel time through pipe = 0.14 min.
Time of concentration (TC) = 11.99 min.

+++++
 Process from Point/Station 302.000 to Point/Station 303.000
 **** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:

In Main Stream number: 2

Stream flow area = 1.685(Ac.)

Runoff from this stream = 1.458(CFS)

Time of concentration = 11.99 min.

Rainfall intensity = 1.240(In/Hr)

Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	0.848	7.96	1.522
---	-------	------	-------

2	1.458	11.99	1.240
---	-------	-------	-------

Largest stream flow has longer time of concentration

$Q_p = 1.458 + \text{sum of}$

$Q_b \quad I_a/I_b$

$0.848 * 0.815 = 0.691$

$Q_p = 2.149$

Total of 2 main streams to confluence:

Flow rates before confluence point:

0.848 1.458

Area of streams before confluence:

0.770 1.685

Results of confluence:

Total flow rate = 2.149(CFS)

Time of concentration = 11.990 min.

Effective stream area after confluence = 2.455(Ac.)

End of computations, total study area = 2.46 (Ac.)

The following figures may
 be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(A_p) = 0.350

Area averaged RI index number = 56.0

TTM37893dev10

Riverside County Rational Hydrology Program

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

Rational Hydrology Study

Date: 03/28/20

File:TTM37893dev10.out

TTM 37893 - Mission & Agate
Developed Condition - 10 year flow rates
Including offsite area - mini warehouse storage
RMB

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

English (in-lb) Units used in input data file

Program License Serial Number 6288

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [Mira Loma] area used.

10 year storm 10 minute intensity = 1.960(In/Hr)

10 year storm 60 minute intensity = 0.760(In/Hr)

100 year storm 10 minute intensity = 3.100(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 10.0

Calculated rainfall intensity data:

1 hour intensity = 0.760(In/Hr)

Slope of intensity duration curve = 0.5300

++++
Process from Point/Station 100.000 to Point/Station 101.000
**** INITIAL AREA EVALUATION ****

TTM37893dev10

Initial area flow distance = 928.000(Ft.)
Top (of initial area) elevation = 102.700(Ft.)
Bottom (of initial area) elevation = 85.000(Ft.)
Difference in elevation = 17.700(Ft.)
Slope = 0.01907 s(percent)= 1.91
TC = $k(0.390)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$
Initial area time of concentration = 13.243 min.
Rainfall intensity = 1.693(In/Hr) for a 10.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.728
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.500; Impervious fraction = 0.500
Initial subarea runoff = 2.920(CFS)
Total initial stream area = 2.370(Ac.)
Pervious area fraction = 0.500

++++
Process from Point/Station 101.500 to Point/Station 201.500
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 79.500(Ft.)
Downstream point/station elevation = 79.200(Ft.)
Pipe length = 36.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.920(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 2.920(CFS)
Normal flow depth in pipe = 6.81(In.)
Flow top width inside pipe = 17.46(In.)
Critical Depth = 7.79(In.)
Pipe flow velocity = 4.76(Ft/s)
Travel time through pipe = 0.13 min.
Time of concentration (TC) = 13.37 min.

++++
Process from Point/Station 101.500 to Point/Station 201.500
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 2.370(Ac.)
Runoff from this stream = 2.920(CFS)
Time of concentration = 13.37 min.

TTM37893dev10

Rainfall intensity = 1.684(In/Hr)

Program is now starting with Main Stream No. 2

+++++
Process from Point/Station 200.000 to Point/Station 201.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 957.000(Ft.)
Top (of initial area) elevation = 103.000(Ft.)
Bottom (of initial area) elevation = 85.000(Ft.)
Difference in elevation = 18.000(Ft.)
Slope = 0.01881 s(percent)= 1.88
TC = $k(0.390)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$
Initial area time of concentration = 13.445 min.
Rainfall intensity = 1.679(In/Hr) for a 10.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.727
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.500; Impervious fraction = 0.500
Initial subarea runoff = 3.565(CFS)
Total initial stream area = 2.920(Ac.)
Pervious area fraction = 0.500

+++++
Process from Point/Station 201.000 to Point/Station 201.500
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:

In Main Stream number: 2
Stream flow area = 2.920(Ac.)
Runoff from this stream = 3.565(CFS)
Time of concentration = 13.44 min.
Rainfall intensity = 1.679(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	2.920	13.37	1.684
2	3.565	13.44	1.679

Largest stream flow has longer time of concentration

TTM37893dev10

Qp = 3.565 + sum of
 Qb Ia/Ib
 2.920 * 0.997 = 2.912

Qp = 6.477

Total of 2 main streams to confluence:

Flow rates before confluence point:

2.920 3.565

Area of streams before confluence:

2.370 2.920

Results of confluence:

Total flow rate = 6.477(CFS)

Time of concentration = 13.445 min.

Effective stream area after confluence = 5.290(Ac.)

+++++

Process from Point/Station 101.000 to Point/Station 201.000

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1

Stream flow area = 5.290(Ac.)

Runoff from this stream = 6.477(CFS)

Time of concentration = 13.44 min.

Rainfall intensity = 1.679(In/Hr)

+++++

Process from Point/Station 300.000 to Point/Station 301.000

**** INITIAL AREA EVALUATION ****

Initial area flow distance = 807.000(Ft.)

Top (of initial area) elevation = 113.300(Ft.)

Bottom (of initial area) elevation = 98.100(Ft.)

Difference in elevation = 15.200(Ft.)

Slope = 0.01884 s(percent)= 1.88

TC = $k(0.300)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$

Initial area time of concentration = 9.658 min.

Rainfall intensity = 2.001(In/Hr) for a 10.0 year storm

COMMERCIAL subarea type

Runoff Coefficient = 0.869

Decimal fraction soil group A = 0.000

Decimal fraction soil group B = 1.000

Decimal fraction soil group C = 0.000

Decimal fraction soil group D = 0.000

RI index for soil(AMC 2) = 56.00

TTM37893dev10

Pervious area fraction = 0.100; Impervious fraction = 0.900
Initial subarea runoff = 6.660(CFS)
Total initial stream area = 3.830(Ac.)
Pervious area fraction = 0.100

+++++
Process from Point/Station 301.000 to Point/Station 302.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 98.100(Ft.)
Downstream point/station elevation = 79.500(Ft.)
Pipe length = 957.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 6.660(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 6.660(CFS)
Normal flow depth in pipe = 7.49(In.)
Flow top width inside pipe = 22.24(In.)
Critical Depth = 10.97(In.)
Pipe flow velocity = 7.96(Ft/s)
Travel time through pipe = 2.00 min.
Time of concentration (TC) = 11.66 min.

+++++
Process from Point/Station 302.000 to Point/Station 201.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 3.830(Ac.)
Runoff from this stream = 6.660(CFS)
Time of concentration = 11.66 min.
Rainfall intensity = 1.811(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	6.477	13.44	1.679
2	6.660	11.66	1.811

Largest stream flow has longer or shorter time of concentration

Qp = 6.660 + sum of
Qa Tb/Ta
6.477 * 0.867 = 5.618
Qp = 12.278

Total of 2 streams to confluence:

TTM37893dev10

Flow rates before confluence point:

6.477 6.660

Area of streams before confluence:

5.290 3.830

Results of confluence:

Total flow rate = 12.278(CFS)

Time of concentration = 11.661 min.

Effective stream area after confluence = 9.120(Ac.)

End of computations, total study area = 9.12 (Ac.)

The following figures may

be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(A_p) = 0.332

Area averaged RI index number = 56.0

TTM37858dev10B

Riverside County Rational Hydrology Program

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

Rational Hydrology Study

Date: 02/16/20

File:TTM37858dev10B.out

TTM 37858 - Drainage Area B
Developed Condition - 10 year flow rates
RMB

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

English (in-lb) Units used in input data file

Program License Serial Number 6288

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)

For the [Sunnymead-Moreno] area used.

10 year storm 10 minute intensity = 2.010(In/Hr)

10 year storm 60 minute intensity = 0.820(In/Hr)

100 year storm 10 minute intensity = 2.940(In/Hr)

100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 10.0

Calculated rainfall intensity data:

1 hour intensity = 0.820(In/Hr)

Slope of intensity duration curve = 0.5000

++++
Process from Point/Station 201.000 to Point/Station 202.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 250.000(Ft.)
 Top (of initial area) elevation = 62.900(Ft.)
 Bottom (of initial area) elevation = 58.800(Ft.)
 Difference in elevation = 4.100(Ft.)
 Slope = 0.01640 s(percent)= 1.64
 $TC = k(0.370)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 7.663 min.
 Rainfall intensity = 2.294(In/Hr) for a 10.0 year storm
 CONDOMINIUM subarea type
 Runoff Coefficient = 0.801
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 2) = 56.00
 Pervious area fraction = 0.350; Impervious fraction = 0.650
 Initial subarea runoff = 1.416(CFS)
 Total initial stream area = 0.770(Ac.)
 Pervious area fraction = 0.350

++++++
 Process from Point/Station 202.000 to Point/Station 203.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 55.800(Ft.)
 Downstream point/station elevation = 55.000(Ft.)
 Pipe length = 67.50(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 1.416(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 1.416(CFS)
 Normal flow depth in pipe = 4.28(In.)
 Flow top width inside pipe = 15.32(In.)
 Critical Depth = 5.34(In.)
 Pipe flow velocity = 4.40(Ft/s)
 Travel time through pipe = 0.26 min.
 Time of concentration (TC) = 7.92 min.

++++++
 Process from Point/Station 202.000 to Point/Station 203.000
 **** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
 In Main Stream number: 1
 Stream flow area = 0.770(Ac.)
 Runoff from this stream = 1.416(CFS)

TTM37858dev10B
Time of concentration = 7.92 min.
Rainfall intensity = 2.257(In/Hr)
Program is now starting with Main Stream No. 2

+++++
Process from Point/Station 101.000 to Point/Station 302.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 580.000(Ft.)
Top (of initial area) elevation = 64.500(Ft.)
Bottom (of initial area) elevation = 58.700(Ft.)
Difference in elevation = 5.800(Ft.)
Slope = 0.01000 s(percent)= 1.00
 $TC = k(0.370)*[(length^3)/(elevation\ change)]^{0.2}$
Initial area time of concentration = 11.846 min.
Rainfall intensity = 1.845(In/Hr) for a 10.0 year storm
CONDOMINIUM subarea type
Runoff Coefficient = 0.786
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 56.00
Pervious area fraction = 0.350; Impervious fraction = 0.650
Initial subarea runoff = 2.444(CFS)
Total initial stream area = 1.685(Ac.)
Pervious area fraction = 0.350

+++++
Process from Point/Station 302.000 to Point/Station 303.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 55.700(Ft.)
Downstream point/station elevation = 55.000(Ft.)
Pipe length = 43.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.444(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 2.444(CFS)
Normal flow depth in pipe = 5.20(In.)
Flow top width inside pipe = 16.32(In.)
Critical Depth = 7.10(In.)
Pipe flow velocity = 5.77(Ft/s)
Travel time through pipe = 0.12 min.
Time of concentration (TC) = 11.97 min.

+++++
 Process from Point/Station 302.000 to Point/Station 303.000
 **** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:

In Main Stream number: 2

Stream flow area = 1.685(Ac.)

Runoff from this stream = 2.444(CFS)

Time of concentration = 11.97 min.

Rainfall intensity = 1.836(In/Hr)

Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
------------	-----------------	----------	----------------------------

1	1.416	7.92	2.257
---	-------	------	-------

2	2.444	11.97	1.836
---	-------	-------	-------

Largest stream flow has longer time of concentration

$Q_p = 2.444 + \text{sum of}$

$Q_b \quad I_a/I_b$

$1.416 * 0.813 = 1.151$

$Q_p = 3.595$

Total of 2 main streams to confluence:

Flow rates before confluence point:

1.416 2.444

Area of streams before confluence:

0.770 1.685

Results of confluence:

Total flow rate = 3.595(CFS)

Time of concentration = 11.970 min.

Effective stream area after confluence = 2.455(Ac.)

End of computations, total study area = 2.46 (Ac.)

The following figures may

be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(A_p) = 0.350

Area averaged RI index number = 56.0

ttm37858dev100

Riverside County Rational Hydrology Program

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

Rational Hydrology Study

Date: 02/16/20

File:ttm37858dev100.out

TTM 37858 Drainage Area A
Developed Condition - 100-year flow rates
RMB

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

English (in-lb) Units used in input data file

Program License Serial Number 6288

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 3

Standard intensity-duration curves data (Plate D-4.1)
For the [Sunnymead-Moreno] area used.
10 year storm 10 minute intensity = 2.010(In/Hr)
10 year storm 60 minute intensity = 0.820(In/Hr)
100 year storm 10 minute intensity = 2.940(In/Hr)
100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity = 1.200(In/Hr)
Slope of intensity duration curve = 0.5000

++++
Process from Point/Station 101.000 to Point/Station 102.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 636.000(Ft.)
 Top (of initial area) elevation = 64.500(Ft.)
 Bottom (of initial area) elevation = 57.100(Ft.)
 Difference in elevation = 7.400(Ft.)
 Slope = 0.01164 s(percent)= 1.16
 $TC = k(0.370)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 11.924 min.
 Rainfall intensity = 2.692(In/Hr) for a 100.0 year storm
 CONDOMINIUM subarea type
 Runoff Coefficient = 0.855
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 3) = 74.80
 Pervious area fraction = 0.350; Impervious fraction = 0.650
 Initial subarea runoff = 4.911(CFS)
 Total initial stream area = 2.134(Ac.)
 Pervious area fraction = 0.350

++++++
 Process from Point/Station 102.000 to Point/Station 103.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 53.500(Ft.)
 Downstream point/station elevation = 53.000(Ft.)
 Pipe length = 9.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 4.911(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 4.911(CFS)
 Normal flow depth in pipe = 5.44(In.)
 Flow top width inside pipe = 16.53(In.)
 Critical Depth = 10.22(In.)
 Pipe flow velocity = 10.92(Ft/s)
 Travel time through pipe = 0.01 min.
 Time of concentration (TC) = 11.94 min.
 End of computations, total study area = 2.13 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.350
 Area averaged RI index number = 56.0

TTM37858dev100B

Riverside County Rational Hydrology Program

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

Rational Hydrology Study

Date: 02/16/20

File:TTM37858dev100B.out

TTM 37858 Drainage Areas B & C
Developed Condition - 100-year flow rates
RMB

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

English (in-lb) Units used in input data file

Program License Serial Number 6288

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 3

Standard intensity-duration curves data (Plate D-4.1)
For the [Sunnymead-Moreno] area used.
10 year storm 10 minute intensity = 2.010(In/Hr)
10 year storm 60 minute intensity = 0.820(In/Hr)
100 year storm 10 minute intensity = 2.940(In/Hr)
100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity = 1.200(In/Hr)
Slope of intensity duration curve = 0.5000

++++
Process from Point/Station 201.000 to Point/Station 202.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 250.000(Ft.)
 Top (of initial area) elevation = 62.900(Ft.)
 Bottom (of initial area) elevation = 58.800(Ft.)
 Difference in elevation = 4.100(Ft.)
 Slope = 0.01640 s(percent)= 1.64
 $TC = k(0.370)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 7.663 min.
 Rainfall intensity = 3.358(In/Hr) for a 100.0 year storm
 CONDOMINIUM subarea type
 Runoff Coefficient = 0.863
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 3) = 74.80
 Pervious area fraction = 0.350; Impervious fraction = 0.650
 Initial subarea runoff = 2.231(CFS)
 Total initial stream area = 0.770(Ac.)
 Pervious area fraction = 0.350

++++++
 Process from Point/Station 202.000 to Point/Station 203.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 55.800(Ft.)
 Downstream point/station elevation = 55.000(Ft.)
 Pipe length = 67.50(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 2.231(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 2.231(CFS)
 Normal flow depth in pipe = 5.39(In.)
 Flow top width inside pipe = 16.49(In.)
 Critical Depth = 6.76(In.)
 Pipe flow velocity = 5.02(Ft/s)
 Travel time through pipe = 0.22 min.
 Time of concentration (TC) = 7.89 min.

++++++
 Process from Point/Station 202.000 to Point/Station 203.000
 **** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
 In Main Stream number: 1
 Stream flow area = 0.770(Ac.)
 Runoff from this stream = 2.231(CFS)

TTM37858dev100B
 Time of concentration = 7.89 min.
 Rainfall intensity = 3.310(In/Hr)
 Program is now starting with Main Stream No. 2

+++++
 Process from Point/Station 101.000 to Point/Station 302.000
 **** INITIAL AREA EVALUATION ****

Initial area flow distance = 580.000(Ft.)
 Top (of initial area) elevation = 64.500(Ft.)
 Bottom (of initial area) elevation = 58.700(Ft.)
 Difference in elevation = 5.800(Ft.)
 Slope = 0.01000 s(percent)= 1.00
 $TC = k(0.370)*[(length^3)/(elevation\ change)]^{0.2}$
 Initial area time of concentration = 11.846 min.
 Rainfall intensity = 2.701(In/Hr) for a 100.0 year storm
 CONDOMINIUM subarea type
 Runoff Coefficient = 0.855
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 1.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 RI index for soil(AMC 3) = 74.80
 Pervious area fraction = 0.350; Impervious fraction = 0.650
 Initial subarea runoff = 3.891(CFS)
 Total initial stream area = 1.685(Ac.)
 Pervious area fraction = 0.350

+++++
 Process from Point/Station 302.000 to Point/Station 303.000
 **** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 55.700(Ft.)
 Downstream point/station elevation = 55.000(Ft.)
 Pipe length = 43.00(Ft.) Manning's N = 0.013
 No. of pipes = 1 Required pipe flow = 3.891(CFS)
 Given pipe size = 18.00(In.)
 Calculated individual pipe flow = 3.891(CFS)
 Normal flow depth in pipe = 6.64(In.)
 Flow top width inside pipe = 17.37(In.)
 Critical Depth = 9.04(In.)
 Pipe flow velocity = 6.57(Ft/s)
 Travel time through pipe = 0.11 min.
 Time of concentration (TC) = 11.96 min.

+++++
 Process from Point/Station 302.000 to Point/Station 303.000
 **** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:

In Main Stream number: 2

Stream flow area = 1.685(Ac.)

Runoff from this stream = 3.891(CFS)

Time of concentration = 11.96 min.

Rainfall intensity = 2.688(In/Hr)

Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
---------------	--------------------	-------------	-------------------------------

1	2.231	7.89	3.310
---	-------	------	-------

2	3.891	11.96	2.688
---	-------	-------	-------

Largest stream flow has longer time of concentration

$Q_p = 3.891 + \text{sum of}$

$Q_b \quad I_a/I_b$

$2.231 * 0.812 = 1.812$

$Q_p = 5.703$

Total of 2 main streams to confluence:

Flow rates before confluence point:

2.231 3.891

Area of streams before confluence:

0.770 1.685

Results of confluence:

Total flow rate = 5.703(CFS)

Time of concentration = 11.955 min.

Effective stream area after confluence = 2.455(Ac.)

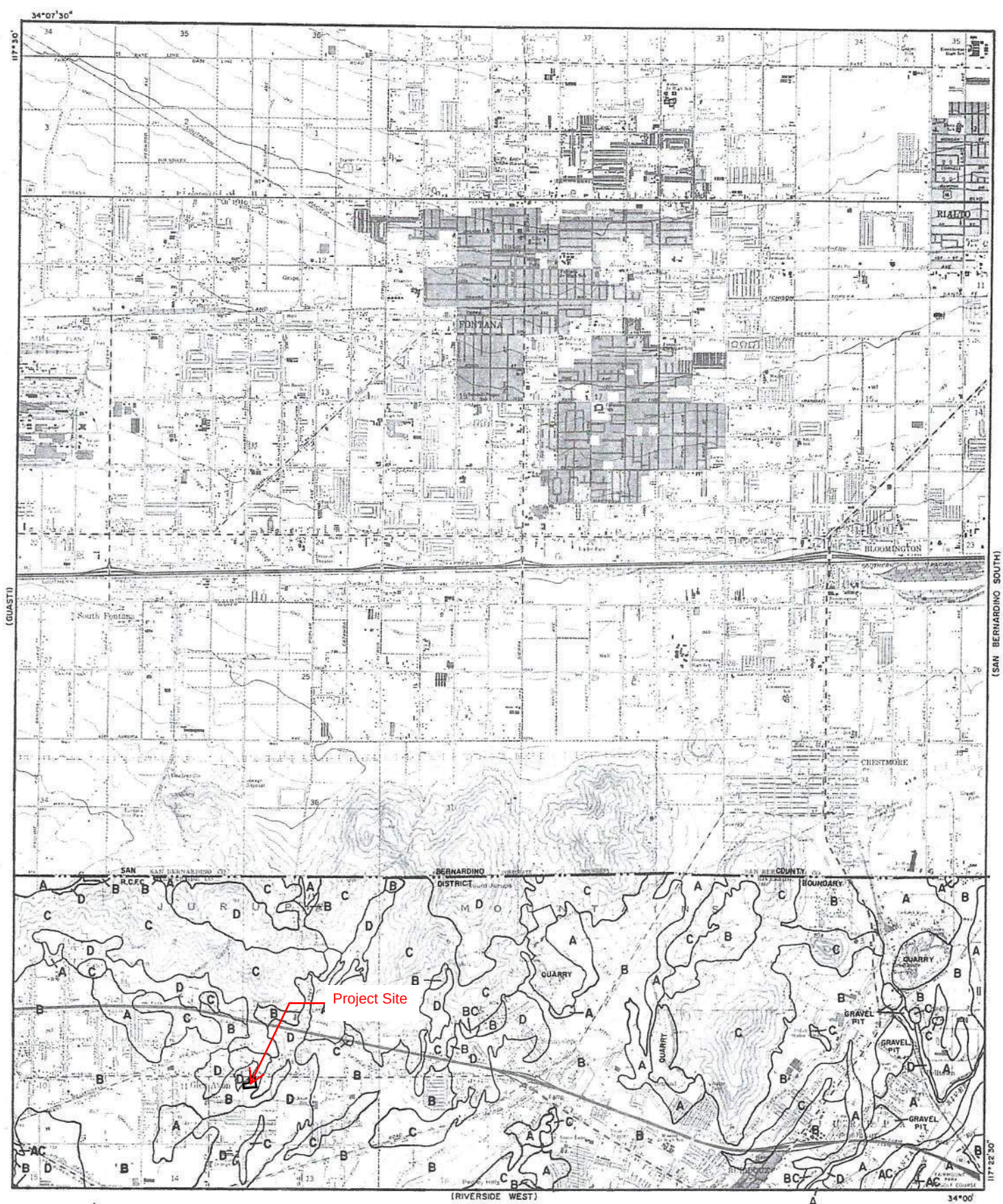
End of computations, total study area = 2.46 (Ac.)

The following figures may

be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(A_p) = 0.350

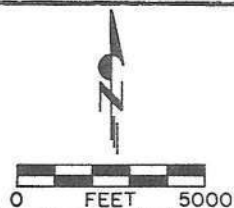
Area averaged RI index number = 56.0



LEGEND

- SOILS GROUP BOUNDARY
- A SOILS GROUP DESIGNATION

RCFC&WCD
HYDROLOGY MANUAL



HYDROLOGIC SOILS GROUP MAP FOR FONTANA

Appendix C
Reference Materials

Soils Map

Hydrology Maps

TENTATIVE TRACT MAP NO. 37893

LEGAL DESCRIPTION:

THE LAND IS SITUATED IN THE COUNTY OF RIVERSIDE, CITY OF JURUPA VALLEY, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

PARCELS 2 AND 3 OF PARCEL MAP 21212, IN THE CITY OF JURUPA VALLEY, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS SHOWN BY MAP ON FILE IN BOOK 153, PAGES 34 & 35, OF PARCEL MAPS, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

APNS: 171-101-072-3 & 171-101-073-7

DEVELOPER

RC HOBBS COMPANIES, INC.
1428 E. CHAPMAN AVENUE
ORANGE, CA 92866
ATTN: ROGER HOBBS
714-633-8100

HYDROLOGY DATA

100 YEAR - 1 YEAR RAINFALL INTENSITY = 1.20 INCH

10 YEAR - 1 HOUR RAINFALL INTENSITY = 0.82 INCH

SLOPE USED FOR RAINFALL INTENSITY CURVE = 0.500

AMC I USED FOR 2-YEAR STORM RUNOFF CALCULATIONS
AMC II USED FOR 10-YEAR STORM RUNOFF CALCULATIONS
AMC III USED FOR 100-YEAR STORM RUNOFF CALCULATIONS

ASSUMED HYDROLOGIC LAND USE: UNDEVELOPED

SOIL TYPE B

HYDROLOGY LEGEND

Q100 = 100-YEAR FLOW RATE

Q10 = 10-YEAR FLOW RATE

Q2 = 2-YEAR FLOW RATE

Tc = TIME OF CONCENTRATION - MINUTES

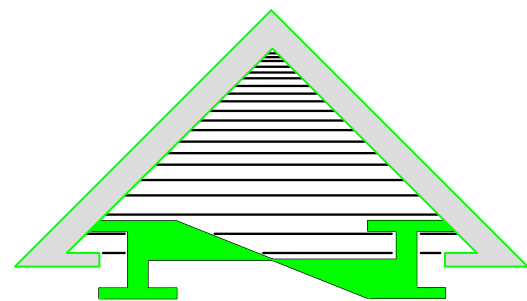
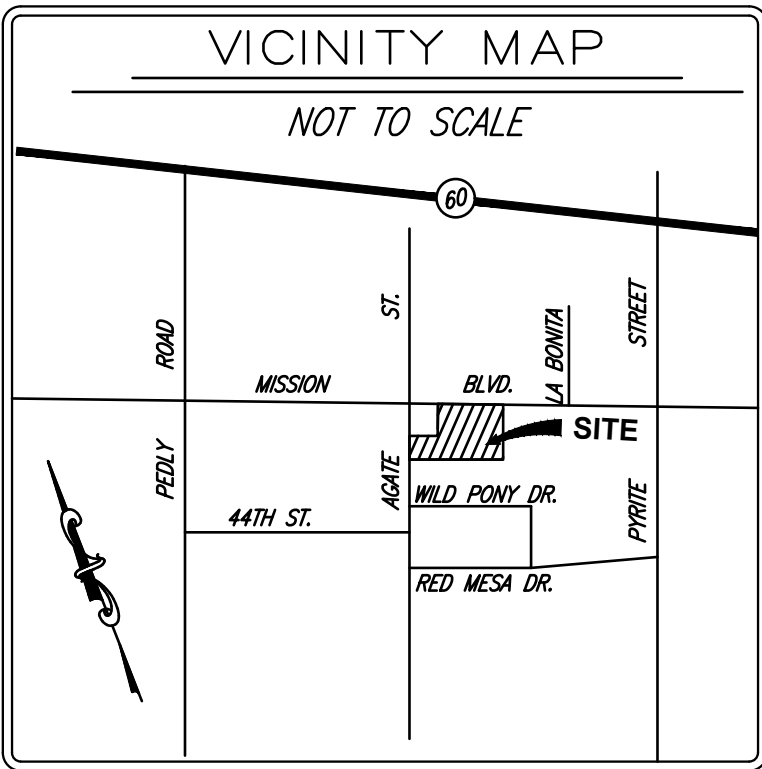
L = FLOW PATH LENGTH IN FEET

101
54.8

NODE NUMBER
ELEVATION

----- DRAINAGE AREA BOUNDARY

----- DRAINAGE FLOW PATH



GRAPHIC SCALE



(IN FEET)
1 inch = 40 ft.



ROBERT BEERS

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Ph. (951) 317-2041 Fax (909) 360-2070

Date Robert M. Beers

R.C.E. 39405
Expires 12-31-21

FIELD BOOK REF.

MARK REVISIONS APPR. DATE

PREPARED FOR:

RC Hobbs Companies
1428 E. Chapman Avenue
Orange, CA 92866
PHONE: (714) 633-8100

TTM 37893
Existing Condition Hydrology Map
City of Jurupa Valley
CALIFORNIA

DATE March 26, 2020

JOB NO. .

DRAWN BY R.A.H.

CHECKED BY R.M.B.

SHEET 1 OF 1

Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

How to use this worksheet (also see instructions in Section G of the WQMP Template):

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.
2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your WQMP Exhibit.
3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in your WQMP. Use the format shown in Table G.1 on page 23 of this WQMP Template. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternative BMPs for those shown here.

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☒ A. On-site storm drain inlets	☒ Locations of inlets.	☒ Mark all inlets with the words “Only Rain Down the Storm Drain” or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify.	☒ Maintain and periodically repaint or replace inlet markings. ☒ Provide stormwater pollution prevention information to new site owners, lessees, or operators. ☒ See applicable operational BMPs in Fact Sheet SC-44, “Drainage System Maintenance,” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com ☒ Include the following in lease agreements: “Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains.”
☐ B. Interior floor drains and elevator shaft sump pumps		☐ State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.	☐ Inspect and maintain drains to prevent blockages and overflow.
☐ C. Interior parking garages		☐ State that parking garage floor drains will be plumbed to the sanitary sewer.	☐ Inspect and maintain drains to prevent blockages and overflow.

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ D1. Need for future indoor & structural pest control		☐ Note building design features that discourage entry of pests.	☐ Provide Integrated Pest Management information to owners, lessees, and operators.
☒ D2. Landscape/ Outdoor Pesticide Use	☐ Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained. ☐ Show self-retaining landscape areas, if any. ☒ Show stormwater treatment and hydrograph modification management BMPs. (See instructions in Chapter 3, Step 5 and guidance in Chapter 5.)	State that final landscape plans will accomplish all of the following. ☐ Preserve existing native trees, shrubs, and ground cover to the maximum extent possible. ☒ Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution. ☒ Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions. ☒ Consider using pest-resistant plants, especially adjacent to hardscape. To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	☒ Maintain landscaping using minimum or no pesticides. ☒ See applicable operational BMPs in “What you should know for.....Landscape and Gardening” at http://rcflood.org/stormwater/Error! at Hyperlink reference not valid. ☒ Provide IPM information to new owners, lessees and operators.

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ E. Pools, spas, ponds, decorative fountains, and other water features.	☐ Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. (Exception: Public pools must be plumbed according to County Department of Environmental Health Guidelines.)	If the Co-Permittee requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.	☐ See applicable operational BMPs in “Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain” at http://rcflood.org/stormwater/
☐ F. Food service	☐ For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment. ☐ On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.	☐ Describe the location and features of the designated cleaning area. ☐ Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.	☐ See the brochure, “The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries” at http://rcflood.org/stormwater/ Provide this brochure to new site owners, lessees, and operators.
☐ G. Refuse areas	☐ Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas. ☐ If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area. ☐ Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.	☐ State how site refuse will be handled and provide supporting detail to what is shown on plans. ☐ State that signs will be posted on or near dumpsters with the words “Do not dump hazardous materials here” or similar.	☐ State how the following will be implemented: Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post “no hazardous materials” signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, “Waste Handling and Disposal” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ H. Industrial processes.	☐ Show process area.	☐ If industrial processes are to be located on site, state: “All process activities to be performed indoors. No processes to drain to exterior or to storm drain system.”	☐ See Fact Sheet SC-10, “Non-Stormwater Discharges” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com See the brochure “Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities” at http://rcflood.org/stormwater/

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ I. Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)	☐ Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area. ☐ Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults. ☐ Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.	Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains. Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for: ▪ Hazardous Waste Generation ▪ Hazardous Materials Release Response and Inventory ▪ California Accidental Release (CalARP) ▪ Aboveground Storage Tank ▪ Uniform Fire Code Article 80 Section 103(b) & (c) 1991 ▪ Underground Storage Tank www.cchealth.org/groups/hazmat/	☐ See the Fact Sheets SC-31, “Outdoor Liquid Container Storage” and SC-33, “Outdoor Storage of Raw Materials ” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ J. Vehicle and Equipment Cleaning	☐ Show on drawings as appropriate: (1) Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses. (2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use). (3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer. (4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.	☐ If a car wash area is not provided, describe any measures taken to discourage on-site car washing and explain how these will be enforced.	Describe operational measures to implement the following (if applicable): ☐ Wastewater from vehicle and equipment washing operations shall not be discharged to the storm drain system. Refer to “Outdoor Cleaning Activities and Professional Mobile Service Providers” for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/ ☐ Car dealerships and similar may rinse cars with water only.

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ K. Vehicle/Equipment Repair and Maintenance	☐ Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater. ☐ Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas. ☐ Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.	☐ State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area. ☐ State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements. ☐ State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.	In the Stormwater Control Plan, note that all of the following restrictions apply to use the site: ☐ No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains. ☐ No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately. ☐ No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment. Refer to "Automotive Maintenance & Car Care Best Management Practices for Auto Body Shops, Auto Repair Shops, Car Dealerships, Gas Stations and Fleet Service Operations". Brochure can be found at http://rcflood.org/stormwater/ Refer to Outdoor Cleaning Activities and Professional Mobile Service Providers for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ L. Fuel Dispensing Areas	☐ Fueling areas ⁶ shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable. ☐ Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area ¹ .] The canopy [or cover] shall not drain onto the fueling area.		☐ The property owner shall dry sweep the fueling area routinely. ☐ See the Fact Sheet SD-30 , “Fueling Areas” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

⁶ The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ M. Loading Docks	☐ Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer. ☐ Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation. ☐ Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.		☐ Move loaded and unloaded items indoors as soon as possible. ☐ See Fact Sheet SC-30, “Outdoor Loading and Unloading,” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ N. Fire Sprinkler Test Water		☐ Provide a means to drain fire sprinkler test water to the sanitary sewer.	☐ See the note in Fact Sheet SC-41, “Building and Grounds Maintenance,” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com
O. Miscellaneous Drain or Wash Water or Other Sources ☐ Boiler drain lines ☐ Condensate drain lines ☐ Rooftop equipment ☐ Drainage sumps ☒ Roofing, gutters, and trim. ☐ Other sources		☐ Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system. ☐ Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system. Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment. ☐ Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water. ☒ Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff. Include controls for other sources as specified by local reviewer.	

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
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☒ P. Plazas, sidewalks, and parking lots.			☒ Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.

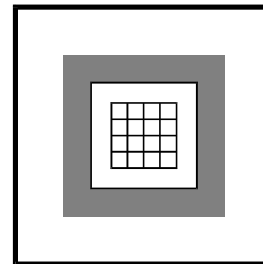
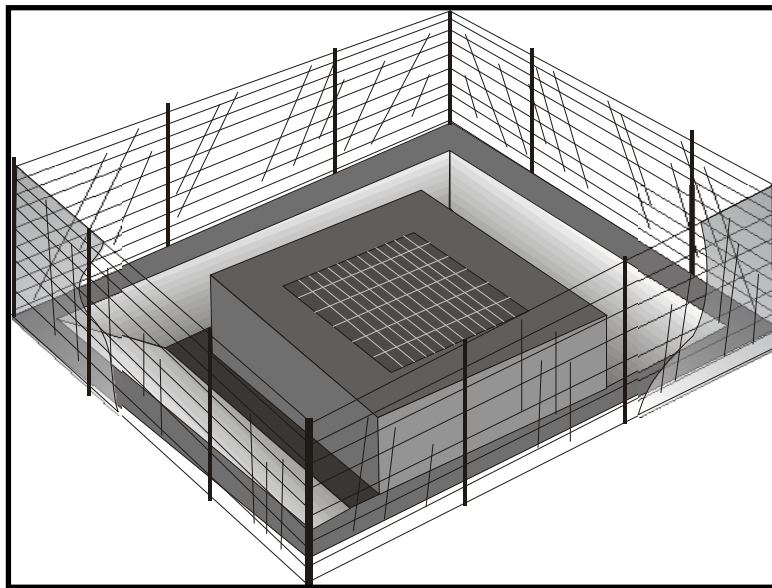
Appendix 9: O&M

Operation and Maintenance Plan and Documentation of Finance, Maintenance and Recording Mechanisms

“Will be provided in Final WQMP”

Appendix 10: Educational Materials

BMP Fact Sheets, Maintenance Guidelines and Other End-User BMP Information



Standard Symbol

BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Devices used at storm drain inlets that are subject to runoff from construction activities to detain and/or to filter sediment-laden runoff to allow sediment to settle and/or to filter sediment prior to discharge into storm drainage systems or watercourses.

Appropriate Applications

- Where ponding will not encroach into highway traffic.
- Where sediment laden surface runoff may enter an inlet.
- Where disturbed drainage areas have not yet been permanently stabilized.
- Where the drainage area is 0.4 ha (1 ac) or less.
- Appropriate during wet and snow-melt seasons.

Limitations

- Requires an adequate area for water to pond without encroaching upon traveled way and should not present itself to be an obstacle to oncoming traffic.
- May require other methods of temporary protection to prevent sediment-laden storm water and non-storm water discharges from entering the storm drain system.
- Sediment removal may be difficult in high flow conditions or if runoff is heavily sediment laden. If high flow conditions are expected, use other on-site sediment trapping techniques (e.g. check dams) in conjunction with inlet protection.
- Frequent maintenance is required.
- For drainage areas larger than 0.4 ha (1 ac), runoff shall be routed to a sediment trapping device designed for larger flows. See BMPs SC-2, "Sediment/Desilting Basin," and SC-3 "Sediment Trap."

- Filter fabric fence inlet protection is appropriate in open areas that are subject to sheet flow and for flows not exceeding 0.014 m³/s (0.5 cfs).
- Gravel bag barriers for inlet protection are applicable when sheet flows or concentrated flows exceed 0.014 m³/s (0.5 cfs), and it is necessary to allow for overtopping to prevent flooding.
- Fiber rolls and foam barriers are not appropriate for locations where they cannot be properly anchored to the surface.
- Excavated drop inlet sediment traps are appropriate where relatively heavy flows are expected and overflow capability is needed.

Standards and Specifications

Identify existing and/or planned storm drain inlets that have the potential to receive sediment-laden surface runoff. Determine if storm drain inlet protection is needed, and which method to use.

Methods and Installation

- **DI Protection Type 1 - Filter Fabric Fence** - The filter fabric fence (Type 1) protection is illustrated on Page 5. Similar to constructing a silt fence. See BMP SC-1, "Silt Fence." Do not place filter fabric underneath the inlet grate since the collected sediment may fall into the drain inlet when the fabric is removed or replaced.
- **DI Protection Type 2 - Excavated Drop Inlet Sediment Trap** - The excavated drop inlet sediment trap (Type 2) is illustrated in Page 6. Similar to constructing a temporary silt fence, See BMP SC-1, "Silt Fence." Size excavated trap to provide a minimum storage capacity calculated at the rate of 130 m³/ha (67 yd³/ac) of drainage area.
- **DI Protection Type 3 – Gravel bag** - The gravel bag barrier (Type 3) is illustrated in Page 7. Flow from a severe storm shall not overtop the curb. In areas of high clay and silts, use filter fabric and gravel as additional filter media. Construct gravel bags in accordance with BMP SC-6, "Gravel Bag Berm." Gravel bags shall be used due to their high permeability.
- **DI Protection Type 4 – Foam Barriers and Fiber Rolls** – Foam barrier or fiber roll (Type 4) is placed around the inlet and keyed and anchored to the surface. Foam barriers and fiber rolls are intended for use as inlet protection where the area around the inlet is unpaved and the foam barrier or fiber roll can be secured to the surface. RE or Construction Storm Water Coordinator approval is required.

Maintenance and Inspection

General

- Inspect all inlet protection devices before and after every rainfall event, and weekly during the rest of the rainy season. During extended rainfall events, inspect inlet protection devices at least once every 24 hours.

- Inspect the storm drain inlet after severe storms in the rainy season to check for bypassed material.
- Remove all inlet protection devices within thirty days after the site is stabilized, or when the inlet protection is no longer needed.
 - Bring the disturbed area to final grade and smooth and compact it. Appropriately stabilize all bare areas around the inlet.
 - Clean and re-grade area around the inlet and clean the inside of the storm drain inlet as it must be free of sediment and debris at the time of final inspection.

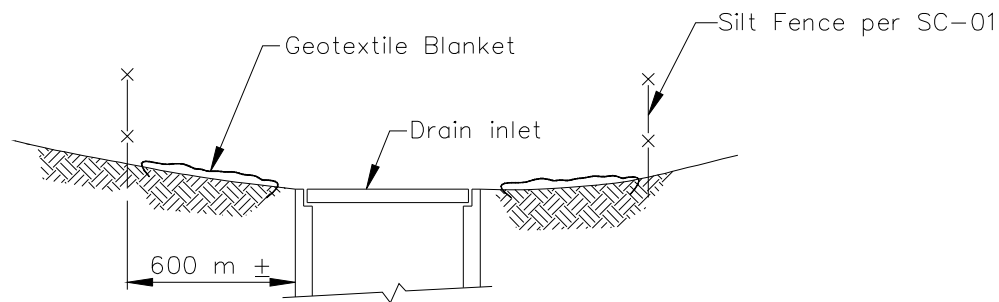
Requirements by Method

- ***Type 1 - Filter Fabric Fence***
 - This method shall be used for drain inlets requiring protection in areas where finished grade is established and erosion control seeding has been applied or is pending.
 - Make sure the stakes are securely driven in the ground and are structurally sound (i.e., not bent, cracked, or splintered, and are reasonably perpendicular to the ground). Replace damaged stakes.
 - Replace or clean the fabric when the fabric becomes clogged with sediment. Make sure the fabric does not have any holes or tears. Repair or replace fabric as needed or as directed by the RE.
 - At a minimum, remove the sediment behind the fabric fence when accumulation reaches one-third the height of the fence or barrier height. Removed sediment shall be incorporated in the project at locations designated by the RE or disposed of outside the highway right-of-way in conformance with the Standard Specifications Section 7-1.13.
- ***Type 2 – Excavated Drop Inlet Sediment Trap***
 - This method may be used for drain inlets requiring protection in areas that have been cleared and grubbed, and where exposed soil areas are subject to grading.
 - Remove sediment from basin when the volume of the basin has been reduced by one-half.
- ***Type 3 - Gravel Bag Barrier***
 - This method may be used for drain inlets surrounded by AC or paved surfaces.
 - Inspect bags for holes, gashes, and snags.

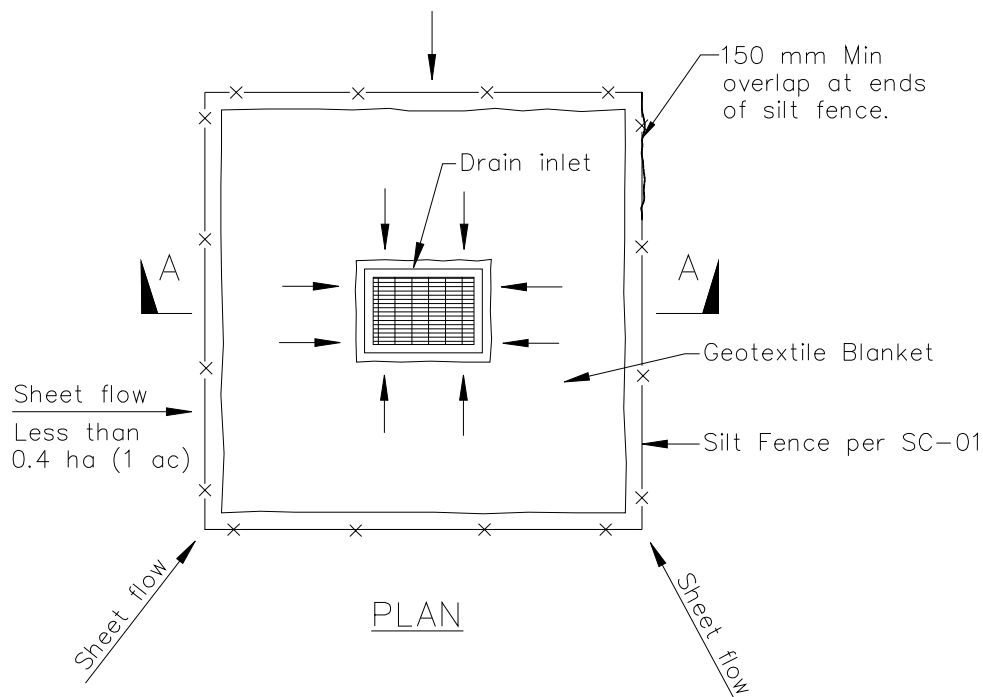
- Check gravel bags for proper arrangement and displacement. Remove the sediment behind the barrier when it reaches one-third the height of the barrier. Removed sediment shall be incorporated in the project at locations designated by the RE or disposed of outside the highway right-of-way in conformance with the Standard Specifications Section 7-1.13.

■ ***Type 4 Foam Barriers and Fiber Rolls***

- This method may be used for drain inlets requiring protection in areas that have been cleared and grubbed, and where exposed soil areas subject to grading. RE or Construction Storm Coordinator approval is required.
- Check foam barrier or fiber roll for proper arrangement and displacement. Remove the sediment behind the barrier when it reaches one-third the height of the barrier. Removed sediment shall be incorporated in the project at locations designated by the RE or disposed of outside the highway right-of-way in conformance with the Standard Specifications.



SECTION A-A

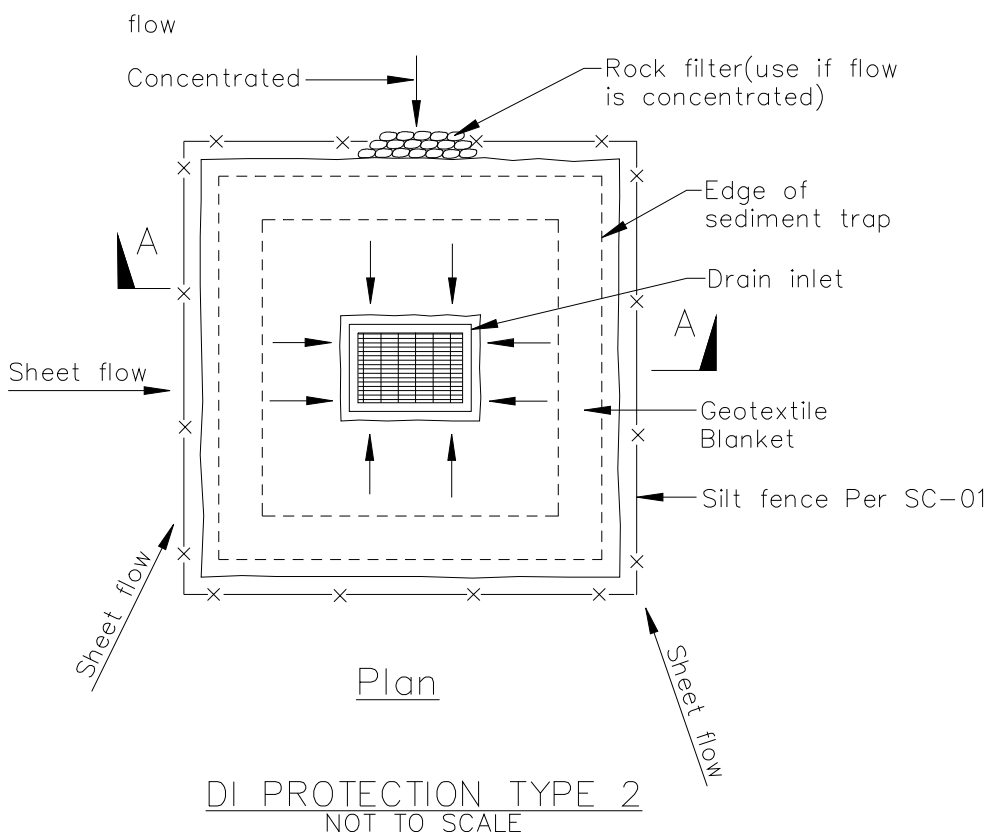
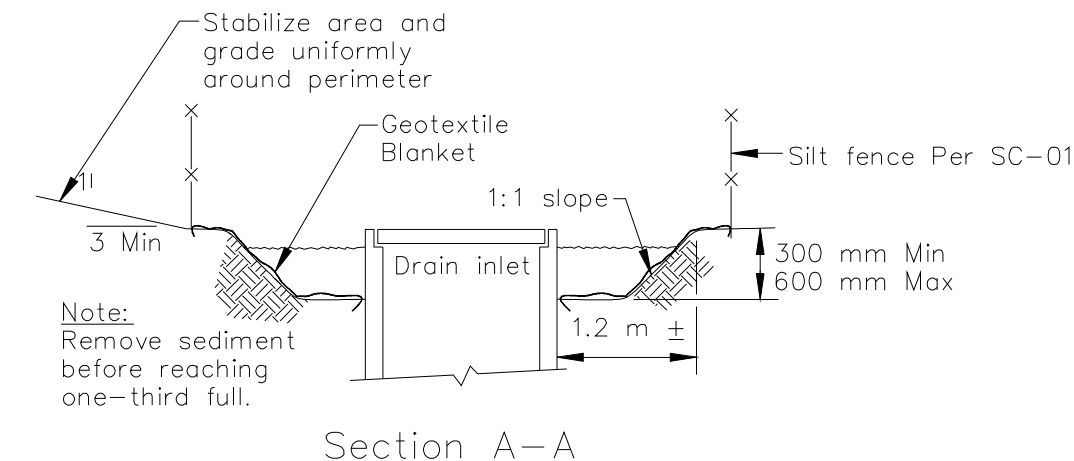


PLAN

DI PROTECTION TYPE 1
NOT TO SCALE

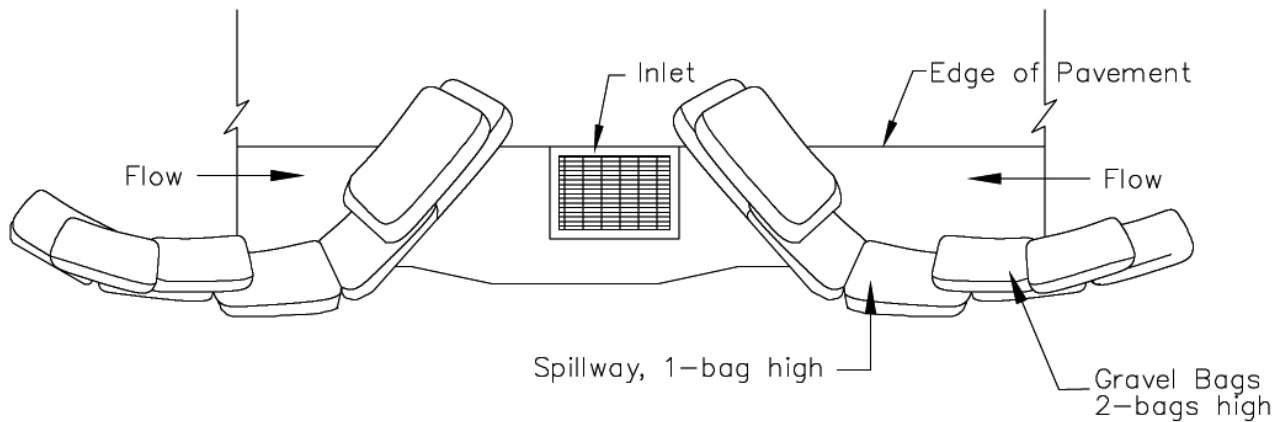
NOTES:

1. For use in areas where grading has been completed and final soil stabilization and seeding are pending.
2. Not applicable in paved areas.
3. Not applicable with concentrated flows.

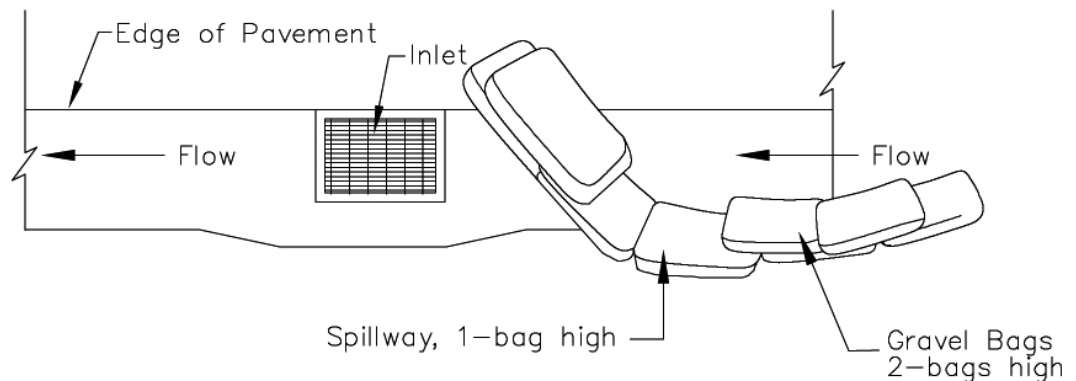


Notes

1. For use in cleared and grubbed and in graded areas.
2. Shape basin so that longest inflow area faces longest length of trap.
3. For concentrated flows, shape basin in 2:1 ratio with length oriented towards direction of flow.



TYPICAL PROTECTION FOR INLET WITH OPPOSING FLOW DIRECTIONS



TYPICAL PROTECTION FOR INLET WITH SINGLE FLOW DIRECTION

NOTES:

1. Intended for short-term use.
2. Use to inhibit non-storm water flow.
3. Allow for proper maintenance and cleanup.
4. Bags must be removed after adjacent operation is completed
5. Not applicable in areas with high silts and clays without filter fabric.

Spill Prevention, Control & Cleanup SC-11



Photo Credit: Geoff Brosseau

Objectives

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

Description

Many activities that occur at an industrial or commercial site have the potential to cause accidental or illegal spills. Preparation for accidental or illegal spills, with proper training and reporting systems implemented, can minimize the discharge of pollutants to the environment.

Spills and leaks are one of the largest contributors of stormwater pollutants. Spill prevention and control plans are applicable to any site at which hazardous materials are stored or used. An effective plan should have spill prevention and response procedures that identify potential spill areas, specify material handling procedures, describe spill response procedures, and provide spill clean-up equipment. The plan should take steps to identify and characterize potential spills, eliminate and reduce spill potential, respond to spills when they occur in an effort to prevent pollutants from entering the stormwater drainage system, and train personnel to prevent and control future spills.

Approach

Pollution Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.
- Develop a Spill Prevention Control and Countermeasure (SPCC) Plan. The plan should include:

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓



SC-11 Spill Prevention, Control & Cleanup

- Description of the facility, owner and address, activities and chemicals present
 - Facility map
 - Notification and evacuation procedures
 - Cleanup instructions
 - Identification of responsible departments
 - Identify key spill response personnel
- Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of process materials that are brought into the facility.

Suggested Protocols (including equipment needs)

Spill Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.
- If consistent illegal dumping is observed at the facility:
 - Post “No Dumping” signs with a phone number for reporting illegal dumping and disposal. Signs should also indicate fines and penalties applicable for illegal dumping.
 - Landscaping and beautification efforts may also discourage illegal dumping.
 - Bright lighting and/or entrance barriers may also be needed to discourage illegal dumping.
- Store and contain liquid materials in such a manner that if the tank is ruptured, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters, or groundwater.
- If the liquid is oil, gas, or other material that separates from and floats on water, install a spill control device (such as a tee section) in the catch basins that collects runoff from the storage tank area.
- Routine maintenance:
 - Place drip pans or absorbent materials beneath all mounted taps, and at all potential drip and spill locations during filling and unloading of tanks. Any collected liquids or soiled absorbent materials must be reused/recycled or properly disposed.
 - Store and maintain appropriate spill cleanup materials in a location known to all near the tank storage area; and ensure that employees are familiar with the site’s spill control plan and/or proper spill cleanup procedures.
 - Sweep and clean the storage area monthly if it is paved, *do not hose down the area to a storm drain.*

Spill Prevention, Control & Cleanup SC-11

- Check tanks (and any containment sumps) daily for leaks and spills. Replace tanks that are leaking, corroded, or otherwise deteriorating with tanks in good condition. Collect all spilled liquids and properly dispose of them.
- Label all containers according to their contents (e.g., solvent, gasoline).
- Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
- Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).
- Identify key spill response personnel.

Spill Control and Cleanup Activities

- Follow the Spill Prevention Control and Countermeasure Plan.
- Clean up leaks and spills immediately.
- Place a stockpile of spill cleanup materials where it will be readily accessible (e.g., near storage and maintenance areas).
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. 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. Physical methods for the cleanup of dry chemicals include the use of brooms, shovels, sweepers, or plows.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Chemical cleanups of material can be achieved with the use of adsorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Reporting

- Report spills that pose an immediate threat to human health or the environment 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).
- Report spills to local agencies, such as the fire department; they can assist in cleanup.
- Establish a system for tracking incidents. The system should be designed to identify the following:
 - Types and quantities (in some cases) of wastes
 - Patterns in time of occurrence (time of day/night, month, or year)

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- Mode of dumping (abandoned containers, “midnight dumping” from moving vehicles, direct dumping of materials, accidents/spills)
- Responsible parties

Training

- Educate employees about spill prevention and cleanup.
- Well-trained employees can reduce human errors that lead to accidental releases or spills:
 - The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
 - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Employees should be educated about aboveground storage tank requirements. Employees responsible for aboveground storage tanks and liquid transfers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.
- Train employees to recognize and report illegal dumping incidents.

Other Considerations (Limitations and Regulations)

- 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 (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, prohibiting any hard connections to the storm drain.

Requirements

Costs (including capital and operation & maintenance)

- 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 contaminated soil or water can be quite expensive.

Maintenance (including administrative and staffing)

- 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.

Spill Prevention, Control & Cleanup SC-11

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 facility and the effectiveness of BMPs. A good record keeping system helps the facility minimize incident recurrence, correctly respond with appropriate 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 sewer. 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.

Aboveground Tank Leak and Spill Control

Accidental releases of materials from aboveground liquid storage tanks present the potential for contaminating stormwater with many different pollutants. Materials spilled, leaked, or lost from

SC-11 Spill Prevention, Control & Cleanup

tanks may accumulate in soils or on impervious surfaces and be carried away by stormwater runoff.

The most common causes of unintentional releases are:

- Installation problems
- Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves)
- External corrosion and structural failure
- Spills and overfills due to operator error
- Leaks during pumping of liquids or gases from truck or rail car to a storage tank or vice versa

Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code. Practices listed below should be employed to enhance the code requirements:

- Tanks should be placed in a designated area.
- Tanks located in areas where firearms are discharged should be encapsulated in concrete or the equivalent.
- Designated areas should be impervious and paved with Portland cement concrete, free of cracks and gaps, in order to contain leaks and spills.
- Liquid materials should be stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10 percent of the volume of all of the containers or 110 percent of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain.
- For used oil or dangerous waste, a dead-end sump should be installed in the drain.
- All other liquids should be drained to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Accumulated stormwater in petroleum storage areas should be passed through an oil/water separator.

Maintenance is critical to preventing leaks and spills. Conduct routine inspections and:

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanger, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.

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- Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Frequently relocate accumulated stormwater during the wet season.
- Periodically conduct integrity testing by a qualified professional.

Vehicle Leak and Spill Control

Major spills on roadways and other public areas are generally handled by highly trained Hazmat teams from local fire departments or environmental health departments. The measures listed below pertain to leaks and smaller spills at vehicle maintenance shops.

In addition to implementing the spill prevention, control, and clean up practices above, use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- Perform all vehicle fluid removal or changing inside or under cover to prevent the run-on of stormwater and the runoff of spills.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Immediately drain all fluids from wrecked vehicles.
- Store wrecked vehicles or damaged equipment under cover.
- Place drip pans or absorbent materials under heavy equipment when not in use.
- Use adsorbent materials on small spills rather than hosing down the spill.
- Remove the adsorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- Oil filters disposed of in trashcans or dumpsters can leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

SC-11 Spill Prevention, Control & Cleanup

- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- Design the fueling area to prevent the run-on of stormwater and the runoff of spills:
 - Cover fueling area if possible.
 - Use a perimeter drain or slope pavement inward with drainage to a sump.
 - Pave fueling area with concrete rather than asphalt.
- If dead-end sump is not used to collect spills, install an oil/water separator.
- Install vapor recovery nozzles to help control drips as well as air pollution.
- Discourage “topping-off” of fuel tanks.
- Use secondary containment when transferring fuel from the tank truck to the fuel tank.
- Use adsorbent materials on small spills and general cleaning rather than hosing down the area. Remove the adsorbent materials promptly.
- Carry out all Federal and State requirements regarding underground storage tanks, or install above ground tanks.
- Do not use mobile fueling of mobile industrial equipment around the facility; rather, transport the equipment to designated fueling areas.
- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Train employees in proper fueling and cleanup procedures.

Industrial Spill Prevention Response

For the purposes of developing a spill prevention and response program to meet the stormwater regulations, facility managers should use information provided in this fact sheet and the spill prevention/response portions of the fact sheets in this handbook, for specific activities. The program should:

- Integrate with existing emergency response/hazardous materials programs (e.g., Fire Department)
- Develop procedures to prevent/mitigate spills to storm drain systems
- Identify responsible departments
- Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures
- Address spills at municipal facilities, as well as public areas

Spill Prevention, Control & Cleanup SC-11

- Provide training concerning spill prevention, response and cleanup to all appropriate personnel

References and Resources

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

Clark County Storm Water Pollution Control Manual
<http://www.co.clark.wa.us/pubworks/bmpman.pdf>

King County Storm Water Pollution Control Manual <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Santa Clara Valley Urban Runoff Pollution Prevention Program <http://www.scvurppp.org>

The Stormwater Managers Resource Center <http://www.stormwatercenter.net/>



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

Approach

Pollution Prevention

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Suggested Protocols

Catch Basins/Inlet Structures

- Staff should regularly inspect facilities to ensure compliance with 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 SC34 Waste Handling and Disposal).

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	
Bacteria	✓
Oil and Grease	
Organics	



SC-44 Drainage System Maintenance

- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- 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.
- 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 if necessary 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. Do not dewater near a storm drain or stream.

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 and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and 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 Stream 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

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
 - 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 upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
- Eliminate the discharge once the origin of flow is established.
- Stencil or demarcate 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

- Inspect and clean up hot spots and other storm drainage areas regularly 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.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Allow only properly trained individuals to handle hazardous materials/wastes.
- Have staff involved in detection and removal of illicit connections trained in the following:
 - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).

SC-44 Drainage System Maintenance

- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).
- Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Spill Response and Prevention

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.
- Clean up all spills and leaks using “dry” methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.
- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

Other Considerations (Limitations and Regulations)

- Clean-up 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 prohibition against disposal of flushed effluent to sanitary sewer in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.
- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:
 - Purchase and installation of signs.
 - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.
 - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.
 - Purchase of landfill space to dispose of illegally-dumped items and material.

- 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.

Maintenance

- Two-person teams may be required to clean catch basins with vacuor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

Supplemental Information

Further Detail of the BMP

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents “plug flow” discharges of concentrated pollutant loadings and sediments. 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, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect 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 recollect 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% for organics and 55-65% 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 sewer flushing.

SC-44 Drainage System Maintenance

References and Resources

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

Clark County Storm Water Pollution Control Manual
<http://www.co.clark.wa.us/pubworks/bmpman.pdf>

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, Journal of Soil and Water Conservation.

King County Storm Water Pollution Control Manual <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

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

Santa Clara Valley Urban Runoff Pollution Prevention Program <http://www.scvurppp.org>

The Storm Water Managers Resource Center <http://www.stormwatercenter.net>

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

Site Design & Landscape Planning SD-10



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.



SD-10 Site Design & Landscape Planning

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

Site Design & Landscape Planning SD-10

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.

SD-10 Site Design & Landscape Planning

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.



Rain Garden

Design Objectives

- ☒ Maximize Infiltration
- ☒ Provide Retention
- ☒ Slow Runoff
 - Minimize Impervious Land Coverage
 - Prohibit Dumping of Improper Materials
- ☒ Contain Pollutants
 - Collect and Convey

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain



barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say $\frac{1}{4}$ to $\frac{1}{2}$ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

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.

Supplemental Information

Examples

- City of Ottawa’s Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

Other Resources

Hager, Marty Catherine, Stormwater, “Low-Impact Development”, January/February 2003.
www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD.
www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition



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.



- 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.



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



– 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.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.



Design Considerations

- Soil for Infiltration
- Slope
- Aesthetics

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

Targeted Constituents

- | | | |
|-------------------------------------|----------------|---|
| ☒ | Sediment | ■ |
| ☒ | Nutrients | ■ |
| ☒ | Trash | ■ |
| ☒ | Metals | ■ |
| ☒ | Bacteria | ■ |
| ☒ | Oil and Grease | ■ |
| ☒ | Organics | ■ |

Legend (Removal Effectiveness)

- | | |
|----------|--------|
| ● Low | ■ High |
| ▲ Medium | |



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 stabilized. 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 (m²)

WQV = water quality volume (m³)

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/ft³ 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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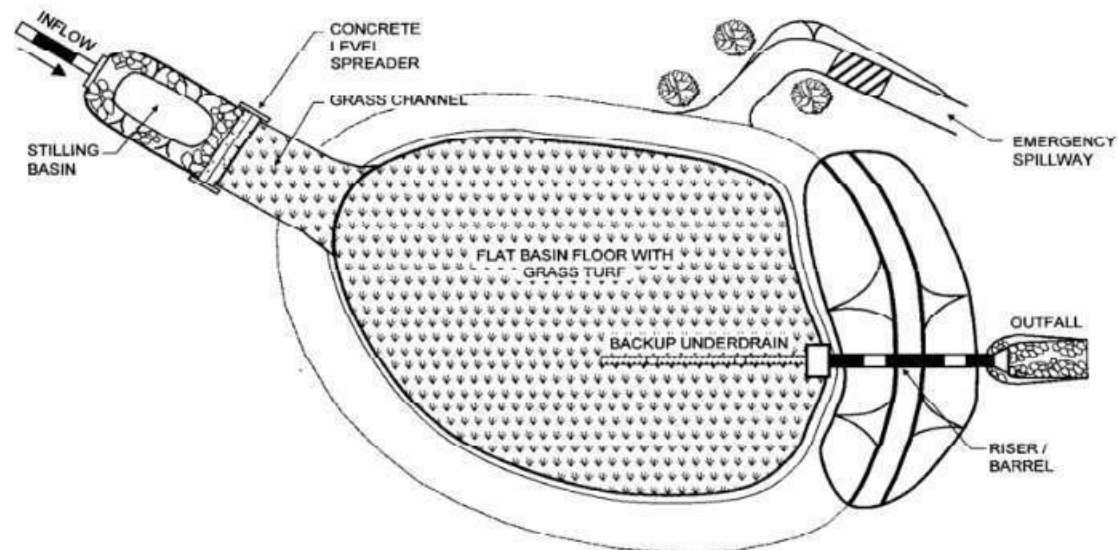
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Information Resources

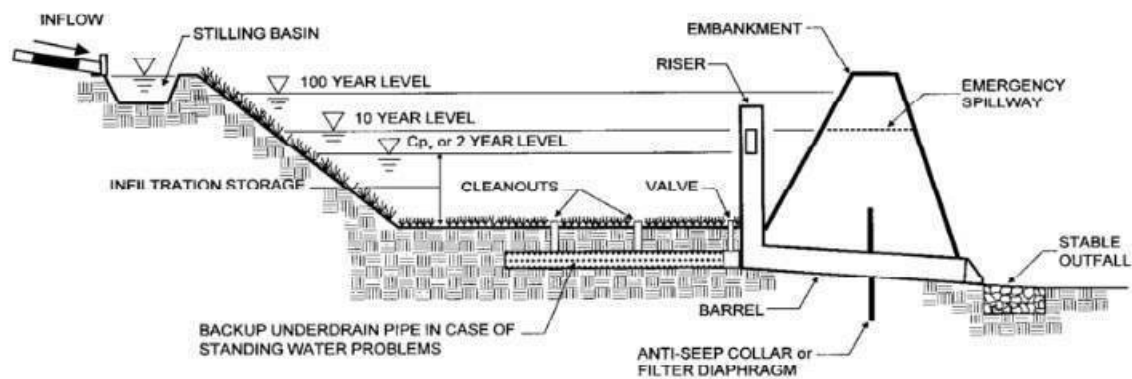
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PLAN VIEW



PROFILE

SECTION (____)
Filtterra®– Vault Configuration
Bioretention System Standard Specification

1.0 GENERAL

- 1.1 This item shall govern the furnishing and installation of the Filtterra® Bioretention System by Contech Engineered Solutions LLC, complete and operable as shown and as specified herein, in accordance with the requirements of the plans and contract documents.
- 1.2 Contractor shall furnish all labor, materials, equipment and incidentals necessary to install the bioretention system, appurtenances and incidentals in accordance with the Drawings and as specified herein.
- 1.3 Bioretention system shall utilize the physical, chemical and biological mechanisms of an engineered biofiltration media, plant and microbe complex to remove pollutants typically found in urban stormwater runoff. The treatment system shall be a fully equipped, pre-constructed, drop-in-place unit designed for applications in the urban landscape to treat contaminated runoff from impervious surfaces.
- 1.4 Bioretention system shall be capable of stand-alone stormwater treatment.
- 1.5 Bioretention plants shall be incorporated into the system with plant material extending into the treatment zone of the engineered media at time of Activation.
- 1.6 The bioretention system shall be of a type that has been installed and in use for a minimum of five (5) consecutive years preceding the date of installation of the system. The Manufacturer shall have been, during the same consecutive five (5) year period, engaged in the engineering design and production of systems deployed for the treatment of stormwater runoff and which have a history of successful production, acceptable to the Engineer of Record and/or the approving Jurisdiction. The Manufacturer of the Filtterra Bioretention System shall be, without exception:

Contech Engineered Solutions LLC
9100 Centre Pointe Drive
West Chester, OH, 45069
Tel: 1 800 338 1122

- 1.7 Applicable provisions of any Division shall govern work in this section.
- 1.8 American Society for Testing and Materials (ASTM) Reference Specifications
 - 1.8.1 ASTM C857: Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
 - 1.8.2 ASTM C858: Standard Specification of Underground Precast Concrete Utility Structures

- 1.8.3 ASTM C990: Standard Specification for Joints for Precast Box Sections Using Preformed Flexible Joint Sealants
- 1.8.4 ASTM C109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
- 1.9 Manufacturer or authorized supplier to submit shop drawings for bioretention System with the vault, engineered biofiltration media and accessory equipment. Drawings shall include principal dimensions, engineered biofiltration media placement, location of piping and unit foundation.
 - 1.9.1 Manufacturer or authorized supplier shall submit installation instructions to the contractor.
 - 1.9.2 Manufacturer or authorized supplier shall submit Operations and Maintenance Manual to the contractor.
 - 1.9.3 Before installation of the bioretention system, Contractor shall obtain the written approval of the Engineer of Record for the system drawings.
- 1.10 No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the Engineer of Record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

2.0 MATERIALS

- 2.1 Internal components including engineered biofiltration media, underdrain stone, PVC underdrain piping, and mulch must be included as part of the bioretention system and shall be provided by Contech Engineered Solutions LLC. Note that vegetation is an essential component of bioretention systems, and shall be provided at time of Activation by the contractor.
 - 2.1.1 Engineered biofiltration media shall consist of both organic and inorganic components. Stormwater shall be directed to flow vertically through the media profile, saturating the full media profile without downstream flow control.
 - 2.1.2 Underdrain stone shall be of size and shape to provide adequate bridging between the media and stone for the prevention of migration of fine particles. Underdrain stone must also be able to convey the design flow rate of the system without restriction and be approved for use in the Filterra Bioretention System by Contech Engineered Solutions LLC.
 - 2.1.3 PVC Underdrain Piping shall be SDR35 with perforation pattern designed to

convey system design flow rate without restriction.

- 2.1.4 Mulch shall be double shredded wood or bark mulch approved for use with the Filterra Bioretention System by Contech Engineered Solutions LLC.
- 2.2 Precast concrete vault shall be provided by Manufacturer or authorized supplier according to ASTM C857 and C858.
 - 2.2.1 Vault joint sealant shall be Conseal CS-101 or approved equal. Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990.
 - 2.2.2 If interior concrete baffle walls are provided, baffle walls shall be cast-in or sealed to the interior vault walls and floor with a polyurethane construction sealant rated for use below the waterline, SikaFlex 1a or equal. Contractor to provide sealant material and installation unless completed prior to shipment.
- 2.3 Tree grates and access covers shall be cast iron. Tree grate frames shall be galvanized steel.
- 2.4 Curb Nosing (where applicable) shall be galvanized steel and where specified shall be cast into a top slab designed to support a minimum of H5 loading at the curb.
- 2.5 All contractor-provided components shall meet the requirements of this section, the plans specifications and contract documents. In the case of conflict, the more stringent specification shall apply.
 - 2.5.1 Crushed rock base material shall be six-inch minimum layer of ¾-inch minus rock. Compact undisturbed sub-grade materials to 95% of maximum density at +/-2% of optimum moisture content. Unsuitable material below sub-grade shall be replaced to engineer's approval.
 - 2.5.2 Concrete shall have an unconfined compressive strength at 28 days of at least 3000 psi, with ¾-inch round rock, a 4-inch slump maximum, and shall be placed within 90 minutes of initial mixing.
 - 2.5.3 Silicone Sealant shall be pure RTV silicone conforming to Federal Specification Number TT S001543A or TT S00230C or Engineer approved.
 - 2.5.4 Grout shall be non-shrink grout meeting the requirements of Corps of Engineers CRD-C588. Specimens molded, cured and tested in accordance with ASTM C-109 shall have minimum compressive strength of 6,200 psi. Grout shall not exhibit visible bleeding.
 - 2.5.5 Backfill material shall be ¾-inch minus crushed rock, or approved equal.
 - 2.5.6 Vegetation shall comply with the type and size required by the approved drawings and shall be alive and free of obvious signs of disease. Vegetation shall be of species listed in approved Filterra Plant list or otherwise approved by Manufacturer. Vegetation shall be supplied by Contractor prior to Activation.

3.0 PERFORMANCE

3.1 Treatment Capabilities shall be verified via third-party report following either TAPE or TARP protocols.

3.1.1 Engineered biofiltration media minimum treatment flow rate shall be 140"/hr. The system shall be designed to ensure that high flow events shall bypass the engineered biofiltration media preventing erosion and resuspension of pollutants.

3.1.2 The system shall remove a minimum of 85% Total Suspended Solids (TSS).

3.1.3 The system shall remove a minimum of 62% Total Phosphorus (TP).

3.1.4 The system shall remove a minimum of 34% Total Nitrogen (TN).

3.2 The system shall have General Use Level Designation from Washington Department of Ecology for Basic (TSS), Phosphorus, Enhanced (Metals), and Oil/Grease and have Certification by New Jersey Department of Environment.

3.3 Quality Assurance and Quality Control procedures shall be followed for all batches of engineered biofiltration media produced. Engineered biofiltration media shall be certified by the Manufacturer for performance and composition.

3.3.1 Media particle size distribution and composition shall be verified as per relevant ASTM Standards.

3.3.2 Media pollutant removal performance shall be verified as per relevant ASTM Standards as well as a minimum of one scientific method approved by the USEPA.

3.3.3 Media hydraulic performance shall be verified as per relevant ASTM Standards.

3.3.4 Media fertility shall be verified as per a minimum of one published scientific method.

3.4 The Manufacturer shall ensure through third party full scale field testing of installed units that the design flow rate of the system is not reduced over time. Studies shall be performed on a minimum of 10 systems of various ages, maintenance frequencies, and land uses. At least 80% of the tested systems shall have been installed 2.5 or more years. At least 50% of the systems shall have previous maintenance intervals greater than 2 times the manufacturer's recommendation.

4.0 EXECUTION

4.1 Set precast vault on crushed rock base material that has been placed in maximum 6-inch lifts, loose thickness, and compacted to at least 95-percent of the maximum dry density as determined by the standard Proctor compaction test, ASTM D698, at moisture content of +/- 2% of optimum water content.

- 4.2 Inlet and outlet pipes shall be attached to provided couplers or grouted in and connected to precast concrete vault according to Engineer's requirements and specifications.
- 4.3 All throat and grate protection covers shall remain in place until the system is activated.
- 4.4 Contractor to cast-in-place throat inlet to convey stormwater into bioretention System according to Engineer's requirements and specifications.
- 4.5 Engineered biofiltration media shall be delivered installed in the vault, unless otherwise agreed upon with the Manufacturer. Contractor shall take appropriate action to protect the media from sediment and other debris during construction. The method ultimately selected shall be at Contractor's discretion and Contractor's risk.
- 4.5.1 If media is shipped separately from vault, Manufacturer or a Manufacturer's certified representative shall install media into the vault or be present to supervise installation in order to ensure proper installation.
- 4.6 The bioretention system shall not be placed in operation (activated) until the project site is clean and stabilized (construction erosion control measures no longer required). The project site includes any surface that contributes storm drainage to the system. All impermeable surfaces shall be clean and free of dirt and debris. All catch basins, manholes and pipes shall be free of dirt and sediment. Activation shall be provided by Manufacturer or authorized supplier, and includes planting of the vegetation provided by the Contractor.
- 4.7 Each correctly installed system shall include a Final Inspection performed by Manufacturer or authorized supplier upon request between 6-12 months after Activation. The cost of this service shall be included in the price of the system and include the following.
- 4.7.1 System inspection to help owner establish proper routine maintenance intervals.
- 4.7.2 Routine maintenance: removal of foreign debris, silt, loose plant material and trash; mulch removal; engineered biofiltration media evaluation; plant health evaluation and pruning; replacement of mulch; disposal of all maintenance refuse items; and updating of maintenance records.
- 4.8 To ensure long term performance of the bioretention system, continuing annual maintenance programs should be performed or purchased by the owner per the latest Filterra Bioretention System Operation and Maintenance manual.

Filterra[®] High Performance Bioretention



The experts you need to solve your stormwater challenges

Contech is the leader in stormwater solutions, helping engineers, contractors and owners with infrastructure and land development projects throughout North America.

With our responsive team of stormwater experts, local regulatory expertise and flexible solutions, Contech is the trusted partner you can count on for stormwater management solutions.

Your Contech Team



STORMWATER CONSULTANT

It's my job to recommend the best solution to meet permitting requirements.



STORMWATER DESIGN ENGINEER

I work with consultants to design the best approved solution to meet your project's needs.



REGULATORY MANAGER

I understand the local stormwater regulations and what solutions will be approved.



SALES ENGINEER

I make sure our solutions meet the needs of the contractor during construction.

Contech is your partner in stormwater management solutions



Low Impact Development in a Small Footprint – Filterra®

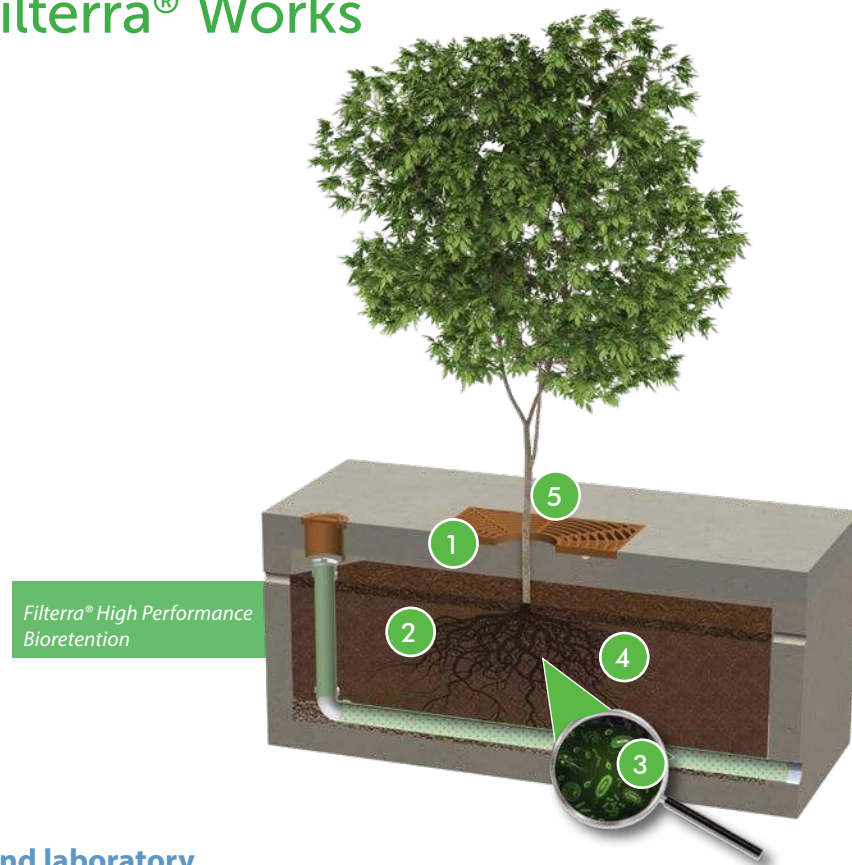
Filterra is an engineered high-performance bioretention system. While it operates similar to traditional bioretention, its high flow media allows for a reduction in footprint of up to 95% versus traditional bioretention practices. Filterra provides a Low Impact Development (LID) solution for tight, highly developed sites such as urban development projects, commercial parking lots, residential streets, and streetscapes. Its small footprint also reduces installation and life cycle costs versus traditional bioretention. Filterra can be configured in many different ways to enhance site aesthetics, integrate with other LID practices, or increase runoff reduction through infiltration below or downstream of the system.

At the Manchester Stormwater Park seen above, the Filterra systems surrounding the central courtyard allowed for the creation of a community space with parking, sidewalks, and benches in a quaint downtown area. A traditional bioretention system treating the same drainage area would have occupied the entire park area leaving no room for these amenities.



 filterra Bioscape®

How the Filterra® Works



Tested in the field and laboratory ...

- 1 Stormwater enters the Filterra through a pipe, curb inlet, or sheet flow and ponds over the pretreatment mulch layer, capturing heavy sediment and debris. Organics and microorganisms within the mulch trap and degrade metals and hydrocarbons. The mulch also provides water retention for the system's vegetation.
- 2 Stormwater flows through engineered Filterra media which filters fine pollutants and nutrients. Organic material in the media removes dissolved metals and acts as a food source for root-zone microorganisms. Treated water exits through an underdrain pipe or infiltrates (if designed accordingly).
- 3 Rootzone microorganisms digest and transform pollutants into forms easily absorbed by plants.
- 4 Plant roots absorb stormwater and pollutants that were transformed by microorganisms, regenerating the media's pollutant removal capacity. The roots grow, provide a hospitable environment for the rootzone microorganisms and penetrate the media, maintaining hydraulic conductivity.
- 5 The plant trunk and foliage utilize nutrients such as Nitrogen and Phosphorus for plant health, sequester heavy metals into the biomass, and provide evapotranspiration of residual water within the system.



Plants and organic material are vital to the long term performance of bioretention systems

Filterra® Features and Benefits

FEATURE	BENEFITS
High biofiltration media flow rate (up to 175"/hr+)	Greatly reduced footprint versus traditional bioretention and LID solutions
Filterra system is packaged, including all components necessary for system performance	Quality control for easy, fast and successful installation
Quick and easy maintenance	Low lifecycle costs
Variety of configurations and aesthetic options	Integrates easily into any site or landscape plan
Natural stormwater management processes featuring organics and vegetation	Meets Low Impact Development requirements and ensures long-term performance



The Filterra system can be configured with many different aesthetic options

Select Filterra® Approvals

Filterra is approved through numerous local, state and federal verification programs, including:

- New Jersey Department of Environmental Protection (NJ DEP)
- Washington Department of Ecology (GULD) – Basic, Enhanced, Phosphorus, and Oil
- Maryland Department of the Environment - Environmental Site Design (ESD)
- Texas Commission on Environmental Quality (TCEQ)
- Virginia Department of Environmental Quality (VA DEQ)
- Maine Department of Environmental Protection (ME DEP)
- Atlanta, GA Regional Commission
- Los Angeles County, CA - Alternate to Attachment H
- City of Portland, Oregon Bureau of Environmental Services
- North Carolina Department of Environmental Quality (NC DEQ)



Filterra® Performance Testing Results



APPLICATION TIPS

- The Filterra system has been tested under industry standard protocols and has proven its pollutant removal performance and system longevity.
- Contech invests significant resources in media blending calibration and product testing to ensure our media meets our strict performance specifications every time.
- Keep regulators and owners happy by selecting a product with predictable and proven maintenance longevity.



POLLUTANT OF CONCERN	MEDIAN REMOVAL EFFICIENCY	MEDIAN EFFLUENT CONCENTRATION (MG/L)
Total Suspended Solids (TSS)	86%	3.3
Total Phosphorus - TAPE (TP)	70%	0.05
Total Nitrogen (TN)	34%	0.54
Total Copper (TCu)	55%	0.004
Total Dissolved Copper	43%	0.003
Total Zinc (TZn)	56%	0.04
Total Dissolved Zinc	54%	0.1
Total Petroleum Hydrocarbons	87%	0.71

Each batch of Filterra® media has been extensively tested to ensure consistent performance every time.

Sources:

UVA (TARP) Field Study - 2006
Herrera (TAPE) Study - 2009
Herrera (TAPE) Study - 2014
NC State Study - 2015

Note: Some jurisdictions recognize higher removal rates. Contact your Contech Stormwater Consultant for performance expectations.

Field tested and performance verified

Filterra® Maintenance

Activation and vegetation selection guidance is included with every system.

With proper routine maintenance, the engineered media within the Filterra system should last as long as traditional bioretention media.

Maintenance is low-cost, low-tech and simple:

- Remove trash, sediment, and mulch
- Replace with a fresh 3" layer of mulch
- No confined space entry or special tools
- Easily performed by landscape contractor or facilities maintenance provider



Filterra offers high performance bioretention for advanced pollutant removal with easy maintenance.



Watch the Filterra Maintenance video at www.ContechES.com/filterra



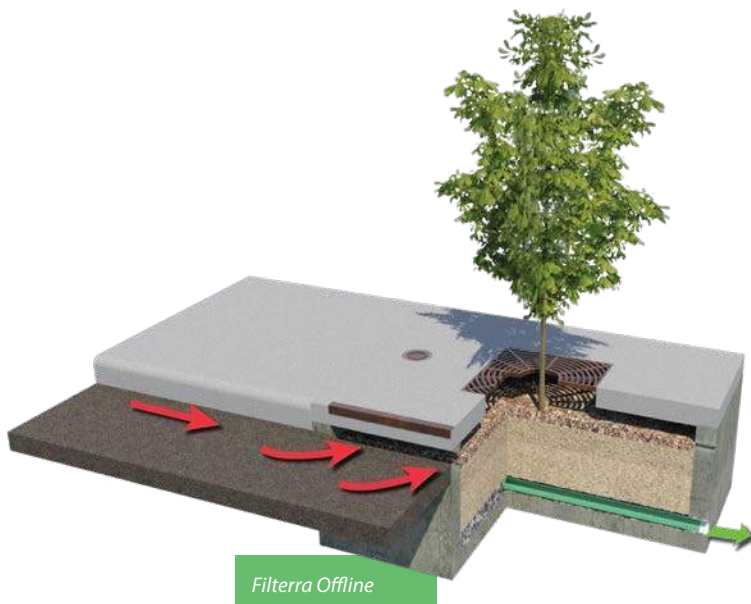
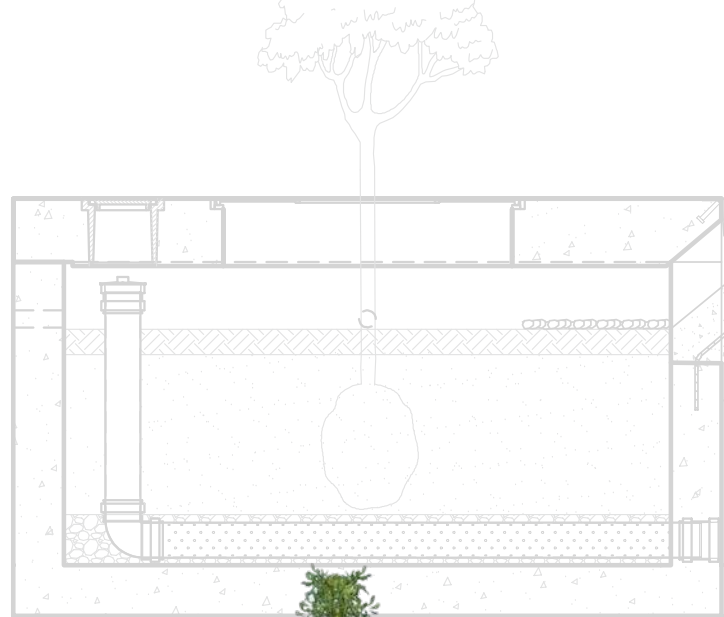
Plant health evaluation and pruning is important to encourage growth.

All stormwater treatment systems require maintenance for effective operation.

Filterra® Configurations

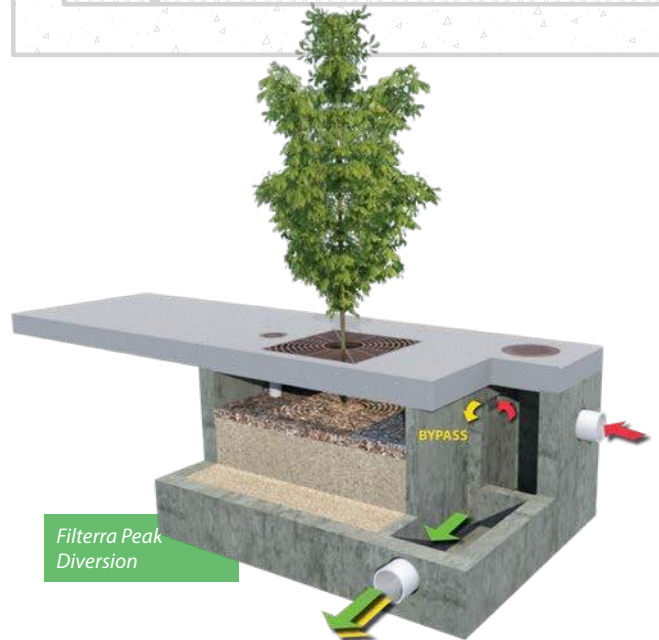
Multiple system configurations integrate with site hydraulic design and layout ...

The Filterra is available in a variety of precast configurations as well as Filterra Bioscape, which can be installed directly into an excavated basin.



Filterra Offline

Bypass via downstream catch basin.



Filterra Peak Diversion



Filterra Internal Bypass Curb



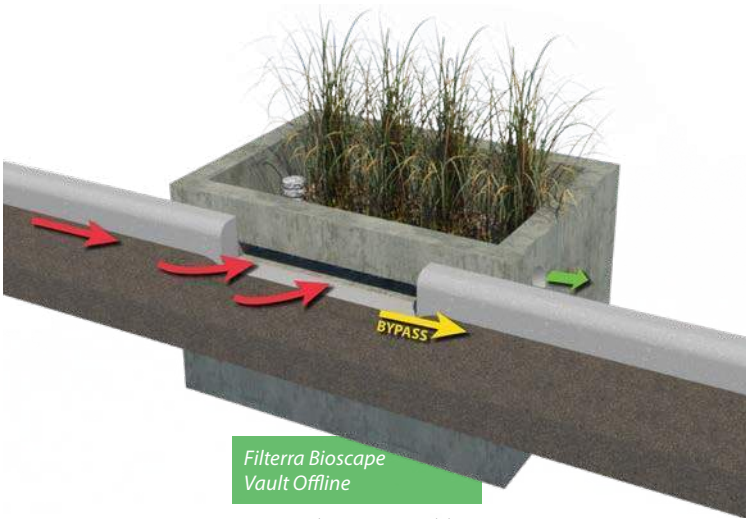
Filterra Sedimentation Chamber (Maryland Only)

Bypass via downstream catch basin.

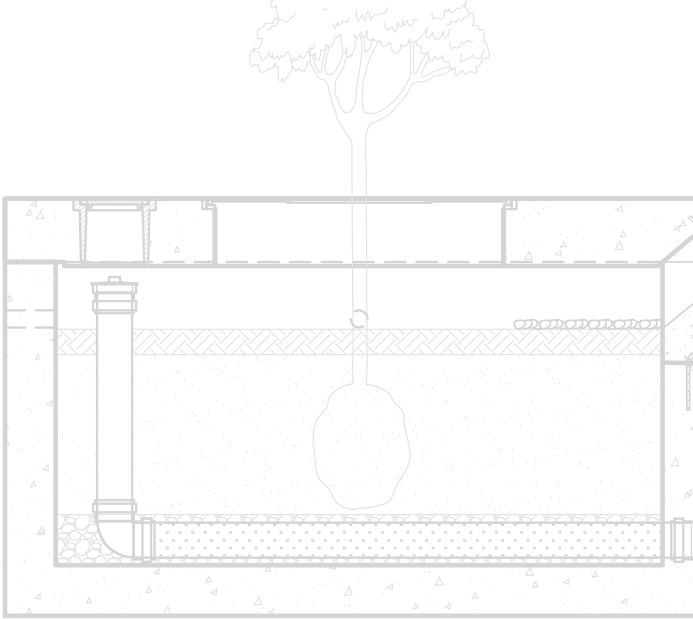
*Additional configurations available, including offline - pipe, peak diversion - grate, and internal bypass curb-chamber.

Multiple configurations allow for easy site integration

Filterra® Bioscape® Configurations



Filterra Bioscape
 Vault Offline
 Bypass via downstream catch basin.



Filterra Bioscape
 Vault Basin
 Bypass via upstream structure.
 Multiple inlet options.

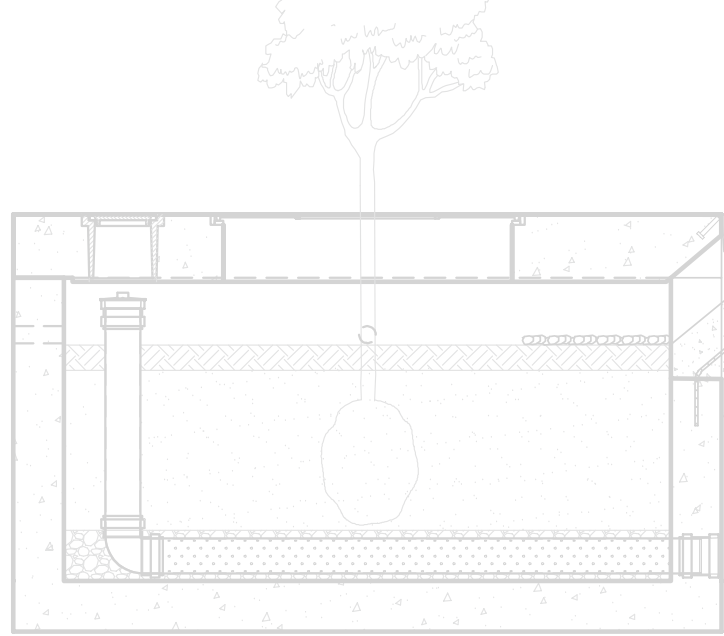


Filterra Bioscape
 Bypass via upstream structure.
 Multiple inlet options.

*Additional configurations available, including bioscape vault offline pipe.

Filterra® Aesthetic Options

Multiple aesthetic options to enhance the appearance and integrate with landscaping ...



Standard Tree Grate



Custom/Decorative Tree Grate



Full Grate with Grasses



Recessed Top Slab



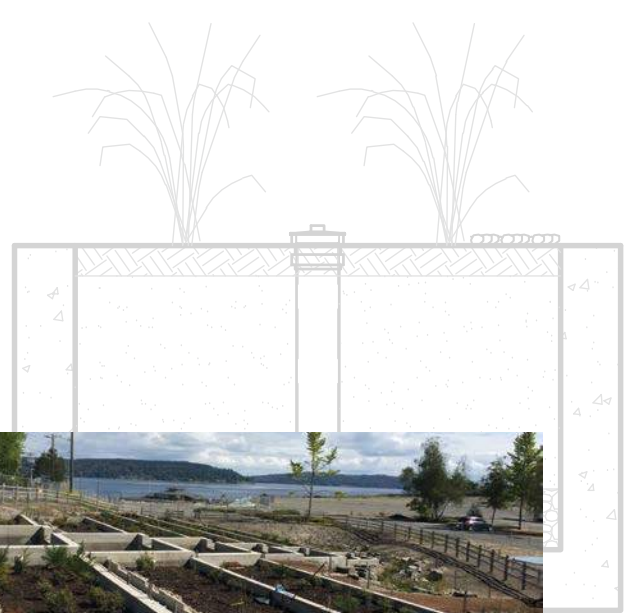
Open Top Planter - Filterra Bioscape



Street Tree

An aesthetic solution to meet your bioretention needs

Filterra® Bioscape®



Large-scale Filterra that can be customized to your site ...

- Ideal for Filterra systems greater than 300 square feet
- Design with or without containment structure
- Incorporate infiltration directly below the system, where required
- Combine with upstream storage or downstream infiltration
- Use as an alternative to larger regional traditional bioretention systems
- Easily add pretreatment Hydrodynamic Separator for large-scale or heavy pollutant loading applications



A partner you can rely on



STORMWATER
SOLUTIONS



PIPE
SOLUTIONS



STRUCTURES
SOLUTIONS

Few companies offer the wide range of high-quality stormwater resources you can find with us — state-of-the-art products, decades of expertise, and all the maintenance support you need to operate your system cost-effectively.

THE CONTECH WAY

Contech® Engineered Solutions provides innovative, cost-effective site solutions to engineers, contractors, and developers on projects across North America. Our portfolio includes bridges, drainage, erosion control, retaining wall, sanitary sewer and stormwater management products.

TAKE THE NEXT STEP

For more information: www.ContechES.com

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