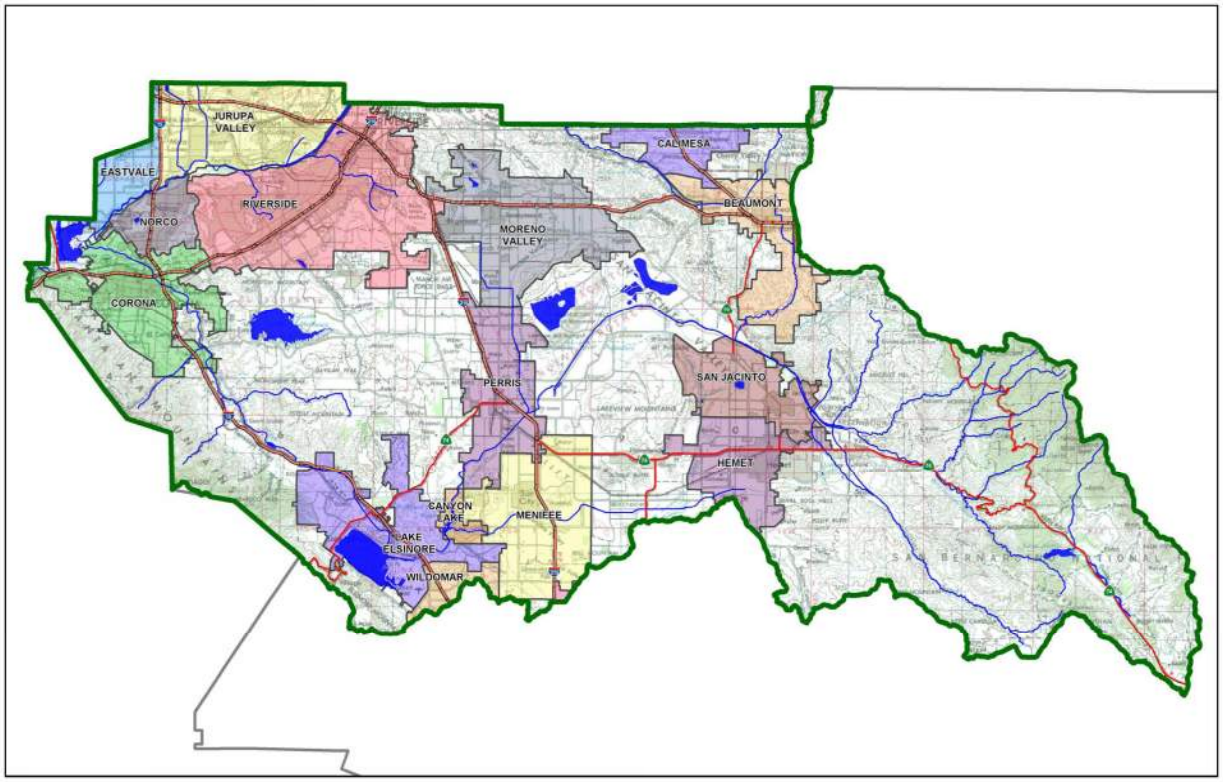
Project Specific Water Quality Management Plan

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

Project Title: TTM38264

Development No: TTM38264

Design Review/Case No: LWQ22-0011



☒ **Preliminary**
☐ **Final**

Original Date Prepared: January 2022

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Prepared for Compliance with
Regional Board Order No. **R8-2010-0033**
Template revised June 30, 2016

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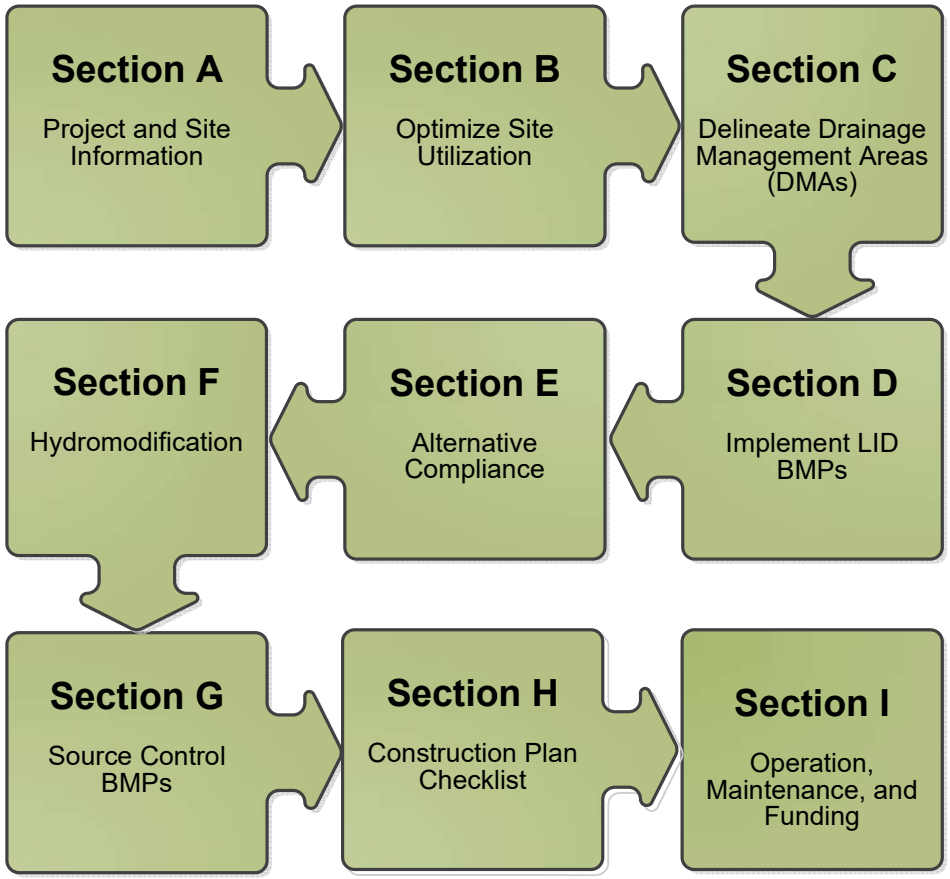
A Brief Introduction

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 Passco Pacifica, LLC by Adkan Engineers for the TTM 38264 project.

This WQMP is intended to comply with the requirements of City of Moreno Valley 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 Section 9.10.080).

"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	Date
Owner's Printed Name	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."

	09/08/2022
Preparer's Signature	Date
Michael Brendecke	Project Manager
Preparer's Printed Name	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:	TTM 38264	
PROJECT LOCATION		
Latitude & Longitude (DMS): 33.923060, -117.164316		
Project Watershed and Sub-Watershed: Santa Ana River		
Gross Acres: 18.15+/-		
APN(s): 478-250-001		
Map Book and Page No.: Map Book 163 Page 46		
PROJECT CHARACTERISTICS		
Proposed or Potential Land Use(s)	R5 Residential	
Proposed or Potential SIC Code(s)	1522	
Area of Impervious Project Footprint (SF)	783,960 SF	
Total Area of proposed Impervious Surfaces within the Project Footprint (SF)/or Replacement	518,327 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 existing Impervious Surfaces within the Project limits Footprint (SF)	0 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)	B	
What is the Water Quality Design Storm Depth for the project?	0.65	

The planned development will consist of 55 lots, street improvements and a Infiltration Basin for water quality located at the southwest corner near Quincy Street and Bay Ave. two other infiltration basins will be placed at the northeast corner and the south east corner to treat Cottonwood and Bay Avenue. Runoff from the site will connect to an existing drainage channel along the east side of Quincy Street

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)

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	N/A	N/A	Not a RARE water body
Perris Valley Channel	N/A	N/A	Not a RARE water body
San Jacinto River Reach 3	None	MUN, AGR, GWR, REC1, REC2, WARM, WILD	MUN, AGR, GWR, REC1, REC2, WARM, WILD
Canyon Lake (Railroad Canyon Reservoir)	Pathogens, Nutrients	MUN, AGR, GWR, REC1, REC2, WARM, WILD	Not a RARE water body
San Jacinto River Reach 1	None	MUN, AGR, GWR, REC1, REC2, WARM, WILD	MUN, AGR, GWR, REC1, REC2, WARM, WILD
Lake Elsinore	Nutrients, Organic Enrichment/Low Dissolved Oxygen	REC1, REC2, WARM, WILD	Not a RARE water body

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 *(please list in the space below as required)* 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, most of the existing drainage patterns on site drain towards the southeast. The proposed design has the flows go into a proposed basin which allows the project to use an existing drainage channel to the West. The existing drainage channel runs along the east side of Quincy Street. Per the Riverside County Flood Control Moreno Master Drainage Plan the project site is within area A-18, which ultimately drains into the Quincey Channel. RCFC Master Drainage Plan has been added to Appendix 1.

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

No, existing natural vegetation will not be protected. All existing vegetation consists of weeds and will be replaced by drought tolerant vegetation. The past use of the site was open, flat, graded parcel.

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

Yes, natural infiltration will be used in the 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. In order to redirect flows to the west, impervious areas have been added, but kept to a minimum. To mitigate for the increase in impervious area the site incorporates a BMP Basin to treat all flows from impervious areas prior to discharging into existing storm drain system.

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 flow into the infiltration Basin for water quality and mitigation prior to draining into the existing Quincey Channel at the Southwest corner of the project site.

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)[1][2]	Area (Sq. Ft.)	DMA Type
D.1.1	Homes	490,481	D
D.1.2	Concrete/Asphalt	199,514	D
D.1.3	Landscaping	93,965	D
D.2.1	Concrete/Asphalt	27,938	D
D.2.2	Landscaping	4,387	D
D.3.1	Concrete/Asphalt	8,513	D
D.3.2	Landscaping	4,796	D

[1]Reference Table 2-1 in the WQMP Guidance Document to populate this column
[2]If 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		Area (square feet)	Ratio
	[A]		[B]	[C] = [A] x [B]	DMA name /ID	[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
D.1.2	Infiltration Basin
D.1.3	Infiltration Basin
D.2.1	Bio-Retention
D.2.2	Bio-Retention
D.3.1	Bio-Retention
D.3.2	Bio-Retention

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 Copermittee 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: **7.95**

Type of Landscaping (Conservation Design or Active Turf): **Conservation Design**

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: **10.20**

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: **1.05**

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: **10.71**

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)
10.71	**7.95**

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: **116 * 6.73 = 780.68**

Project Type: **Residential**

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: **10.20**

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 or toilet users per tributary impervious acre (TUTIA).

Enter your TUTIA factor: **116**

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: **1,183.20**

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)
1,183.20	**780.68**

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.2.1	☐	☐	☒	☐	☐
D.2.2	☐	☐	☒	☐	☐
D.3.1	☐	☐	☒	☐	☐
D.3.2	☐	☐	☒	☐	☐

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.

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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*		
	[A]		[B]	[C]	[A] x [C]			
D.1.1	*490,481*	*Homes*	*0.50*	*0.34*	*166,395.70*	*Design Storm Depth (in)*	*Design Capture Volume,* **V_{BMP}** *(cubic feet)*	*Proposed Volume on Plans (cubic feet)*
D.1.2	*199,514*	*Concrete/Asphalt*	*1.00*	*0.89*	*177,966.50*			
D.1.3	*93,965*	*Landscaping*	*0.10*	*0.11*	*10,379.20*			
	783,960				354,741.40	0.65	19,215.20	***19,216***

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Cottonwood Avenue Bio-retention Basin*		
	[A]		[B]	[C]	[A] x [C]			
D.2.1	*27,938*	*Concrete/Asphalt*	*1.0*	*0.89*	*24,920.70*	*Design Storm Depth (in)*	*Design Capture Volume,* **V_{BMP}** *(cubic feet)*	*Proposed Volume on Plans (cubic feet)*
D.2.2	*4,387*	*Landscaping*	*0.10*	*0.11*	*484.60*			
	32,325				25,405.30	0.65	1,376.10	***1,377***

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Bay Avenue* *Bio-retention Basin*		
	[A]		[B]	[C]	[A] x [C]			
D.3.1	*8,513*	*Concrete/Asphalt*	*1.0*	*0.89*	*7,593.60*	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
D.3.2	*4,796*	*Landscaping*	*0.10*	*0.11*	*529.80*			
	783,960				354,741.40	0.65	440	***440***

[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 Development 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]
Total Credit Percentage[1]	

[1]Cannot Exceed 50%

[2]Obtain 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 = Σ[A]				Σ= [D]	[E]	$[F] = \frac{[D]x[E]}{[G]}$	[F] X (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 concentration[1] 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:

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,"
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.	
Street Sweeping		See applicable operational BMPs in Appendix 10.

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)
Basin	Infiltration Basin	TTM38264	33.921290, -117.165151
Bio 1	Bioretention Basin 1	TTM38264	33.924545, -117.163413
Bio 2	Bioretention Basin 2	TTM38264	33.921100, -117.163402

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: HOA

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

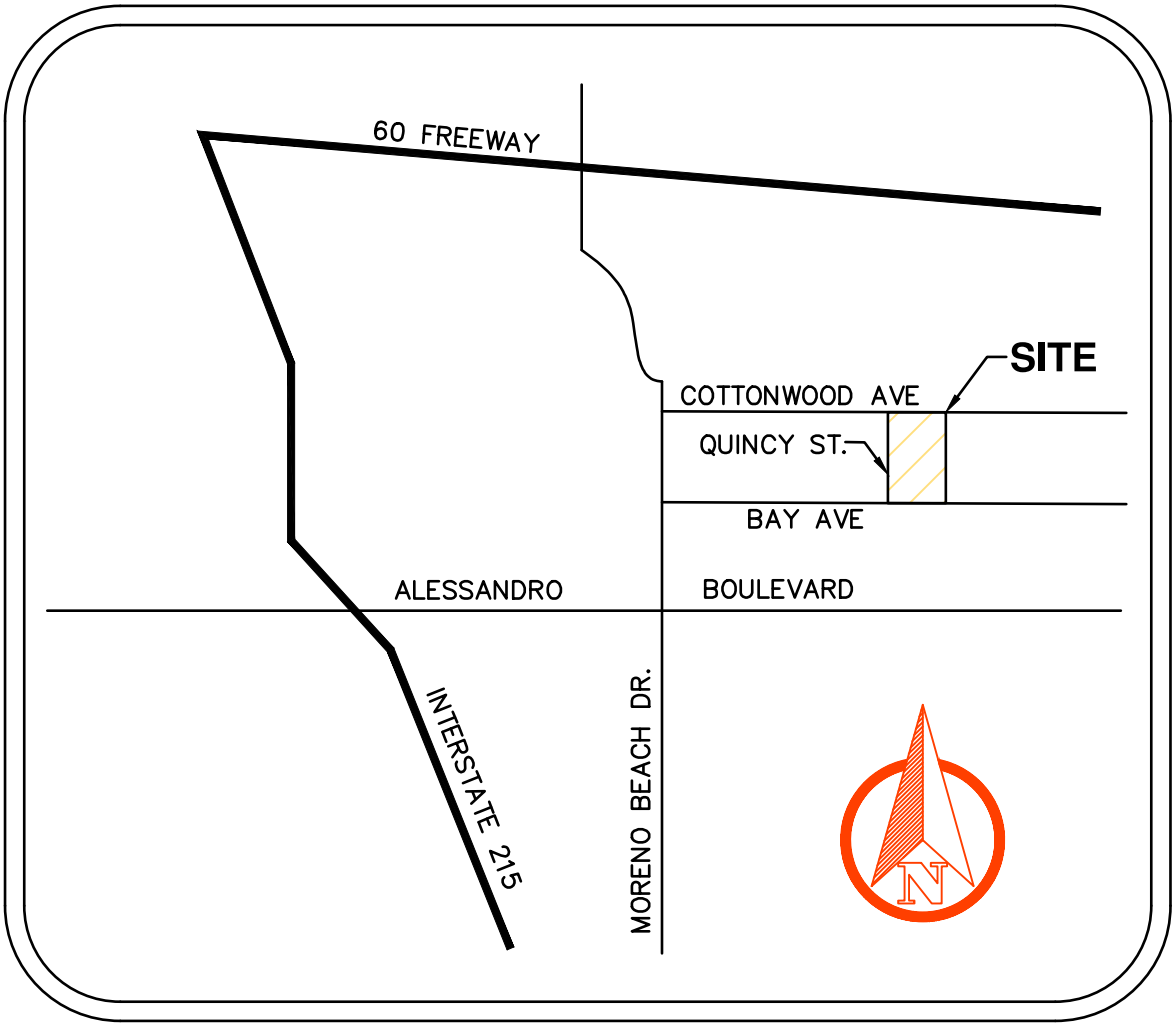
☒ Y ☐ N

Owner will be responsible prior to the formation of the HOA.

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.

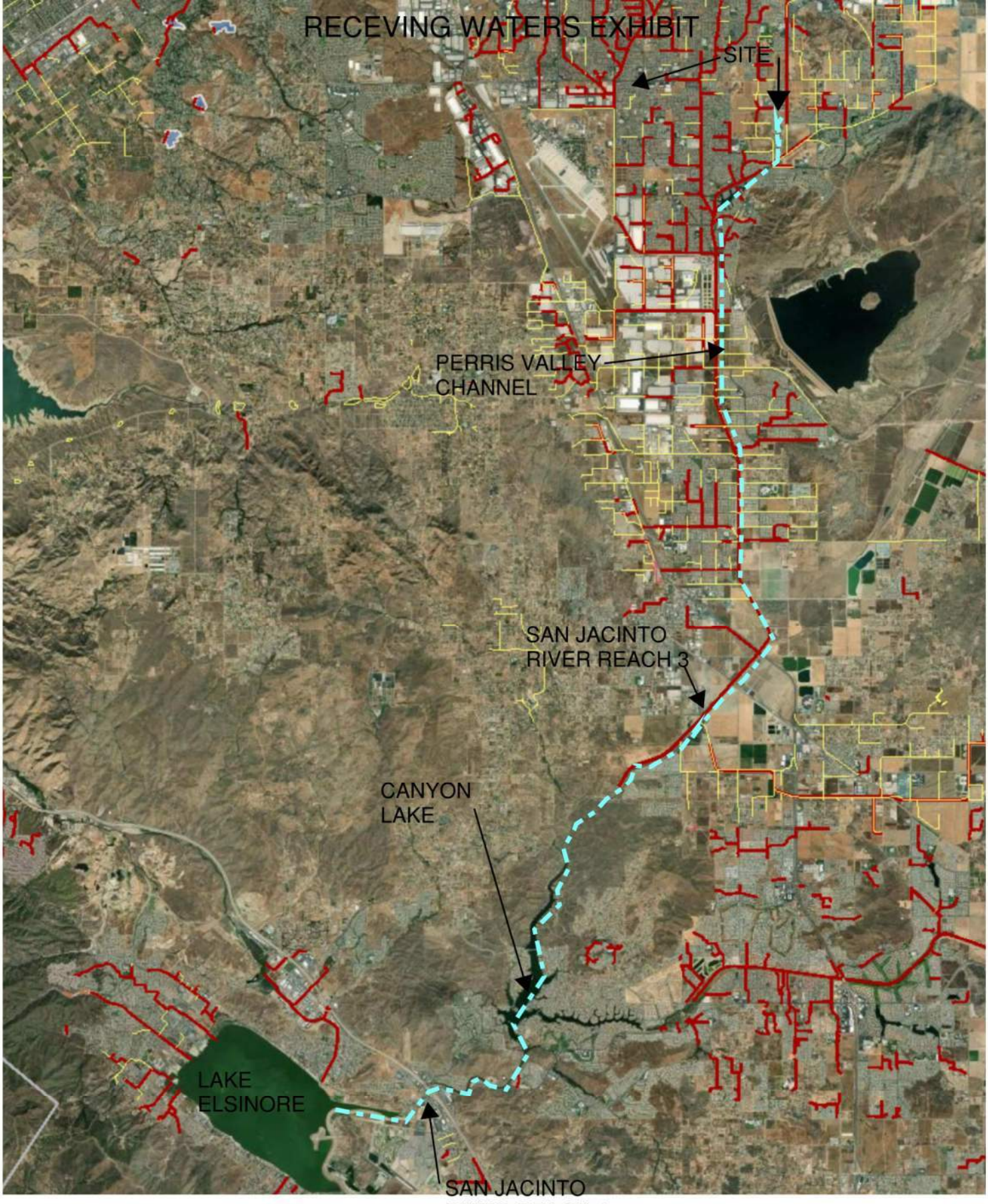
Appendix 1: Maps

Location Map, WQMP BMP Map and Receiving Waters Map

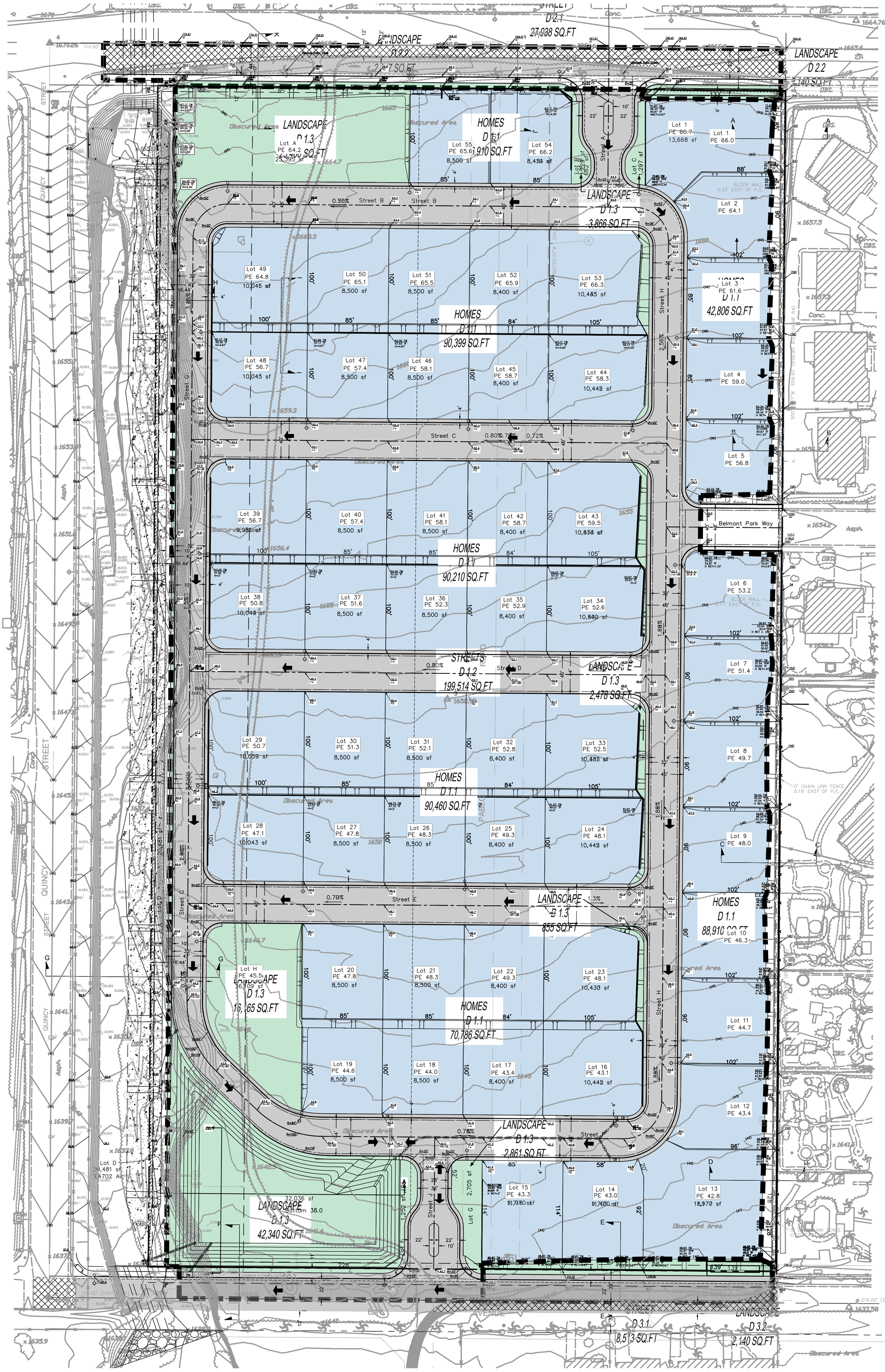


VICINITY MAP

N.T.S.


RECEVING WATERS EXHIBIT
SITE
PERRIS VALLEY
CHANNEL
SAN JACINTO
RIVER REACH 3
CANYON
LAKE
LAKE
ELSINORE
SAN JACINTO
RIVER REACH 1

BMP MAP
COTTONWOOD



LEGEND

- HOMES
- STREET
- LANDSCAPE/BASIN
- DMA BOUNDARY
- PROP. STORM DRAIN
- DRAINAGE PATH

0 50 150
25 100 200
SCALE: 1" = 50'

BMP DATA				
DMA	DMA CLASSIFICATION	NAME	SURFACE TYPE	AREA (SF)
1.1	D	HOMES	ROOF/LANDSCAPE 65% IMPERVIOUS	490,481
1.2	D	STREETS	ASPHALT/CONCRETE	199,514
1.3	D	LANDSCAPING	ORNAMENTAL LANDSCAPING	93,965
			TOTAL	783,960

BMP MAP
COTTONWOOD
PREPARATION DATE: JANUARY 2022
REVISION DATE: DECEMBER 2022
PLANS PREPARED BY:

adkan ENGINEERS
Civil Engineering • Surveying • Planning
6879 Airport Drive, Riverside, CA 92504
Tel:(951) 688-0241 • Fax:(951) 688-0599

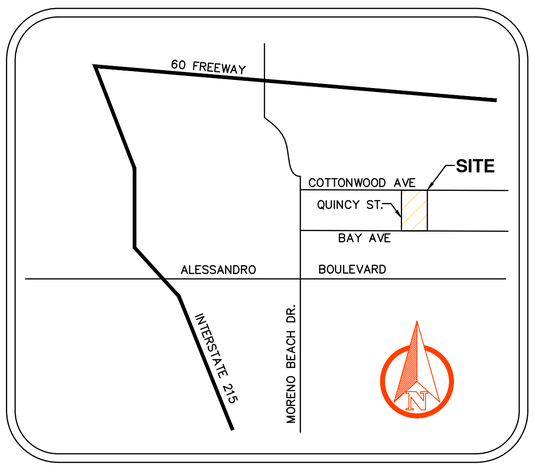
PLOT DATE: 12/9/2022 1:44 PM

U:\PROJECTS\BEERS\10183\WQMP\APPENDIX 1\BMP MAP.DWG

Appendix 2:Construction Plans

Grading and Drainage Plans

PEN22-0013 TTM 38264
City of Moreno Valley



VICINITY MAP
N.T.S.

LEGAL DESCRIPTION:

THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE CITY OF MORENO VALLEY, IN THE COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:
LOT 1 OF TRACT NO. 21078–R IN THE COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS PER MAP ON FILE IN BOOK 163, PAGE 46 OF MAPS, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

APN 478–250–001

GENERAL PLAN/ZONING/LANDUSE

EXISTING GENERAL PLAN DESIGNATION: R3
PROPOSED GENERAL PLAN DESIGNATION: R3

EXISTING ZONING: R3
PROPOSED ZONING: R3 – PUD
EXISTING LANDUSE: Vacant
PROPOSED LANDUSE: Single Family Residential

PROJECT NOTES

PROJECT SIZE: 20.01 Ac. Gross
18.36 Ac. Net
55 RESIDENTIAL LOTS
DENSITY: 3 du/Ac net
MINIMUM LOT AREA: 8,300 SF
MINIMUM LOT DEPTH: 100'
MINIMUM LOT WIDTH: 80'
LOT SIZE: AS SHOWN ON SHEET C–2
DEVELOPER RESERVES THE RIGHT TO FILE MULTIPLE FINAL MAPS
ALL ONSITE STREETS ARE PRIVATE
TOPOGRAPHY SOURCE: Aerial Topographic Mapping
PROJECT IS NOT GATED
PORTION OF THE PROPERTY IS ZONE A ALONG QUINCY STREET CHANNEL
BALANCE OF PROPERTY ZONE X

DEVELOPER

Passco Pacifica LLC
333 City Boulevard West, 17th Floor
Orange, CA 92866
ATT: Oscar Graham
714–609–7257

OWNER

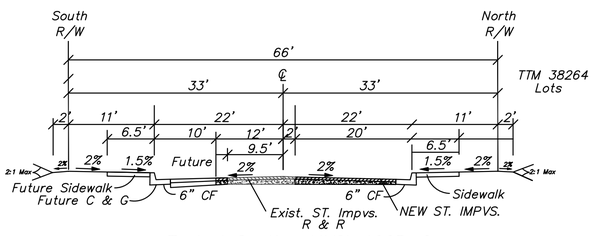
Passco Pacifica LLC
333 City Boulevard West, 17th Floor
Orange, CA 92866
ATT: Oscar Graham
714–609–7257

UTILITY PURVEYORS

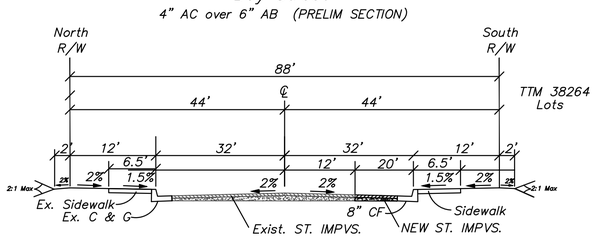
WATER:	*EASTERN MUNICIPAL WATER DISTRICT*
SEWER:	*EASTERN MUNICIPAL WATER DISTRICT*
GAS:	*SOUTHERN CALIFORNIA GAS COMPANY*
ELECTRICITY:	*SOUTHERN CALIFORNIA EDISON*
TELEPHONE:	*AT&T*
SCHOOL:	*MORENO VALLEY UNIFIED SCHOOL DISTRICT*
CATV:	*SPECTRUM*

SOILS ENGINEER

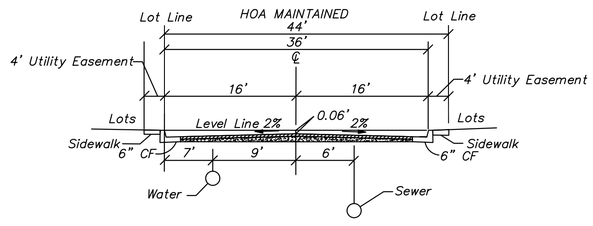
SOIL EXPLORATION COMPANY, INC.
7535 JURUPA AVENUE, UNIT C
Riverside, CA 92504
(951) 688–7200 *Cut: 32,458 cy's*
Project No. 21125–01 *Fill: 43,225 cy's*
Dated: May 3, 2021 *Import: 10,767 cy's*



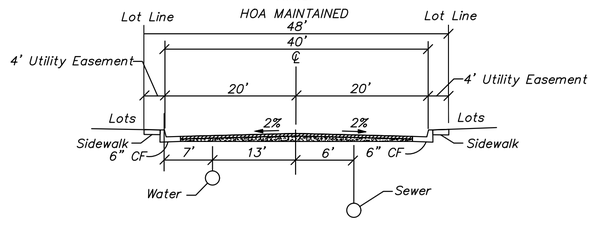
Typical Section MVSI–106B–0
Bay Street
4" AC over 6" AB (PRELIM SECTION)



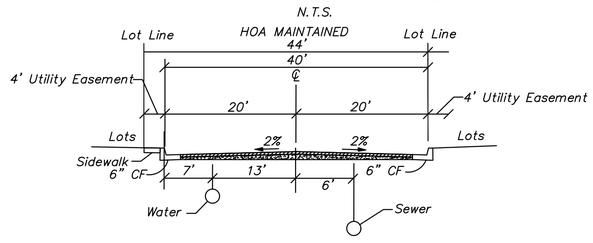
Typical Section MVSI–105A–0
Cottonwood Avenue
4" AC over 6" AB (PRELIM SECTION)



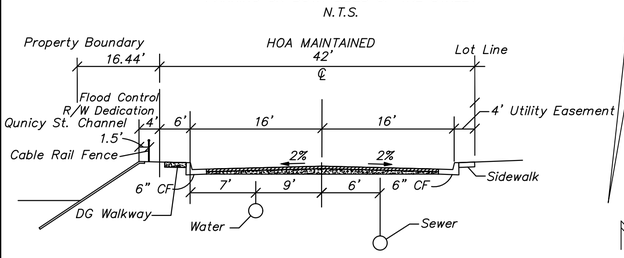
TYPICAL SECTION – PRIVATE STREET H
PARKING ON ONE SIDE OF THE STREET
N.T.S.



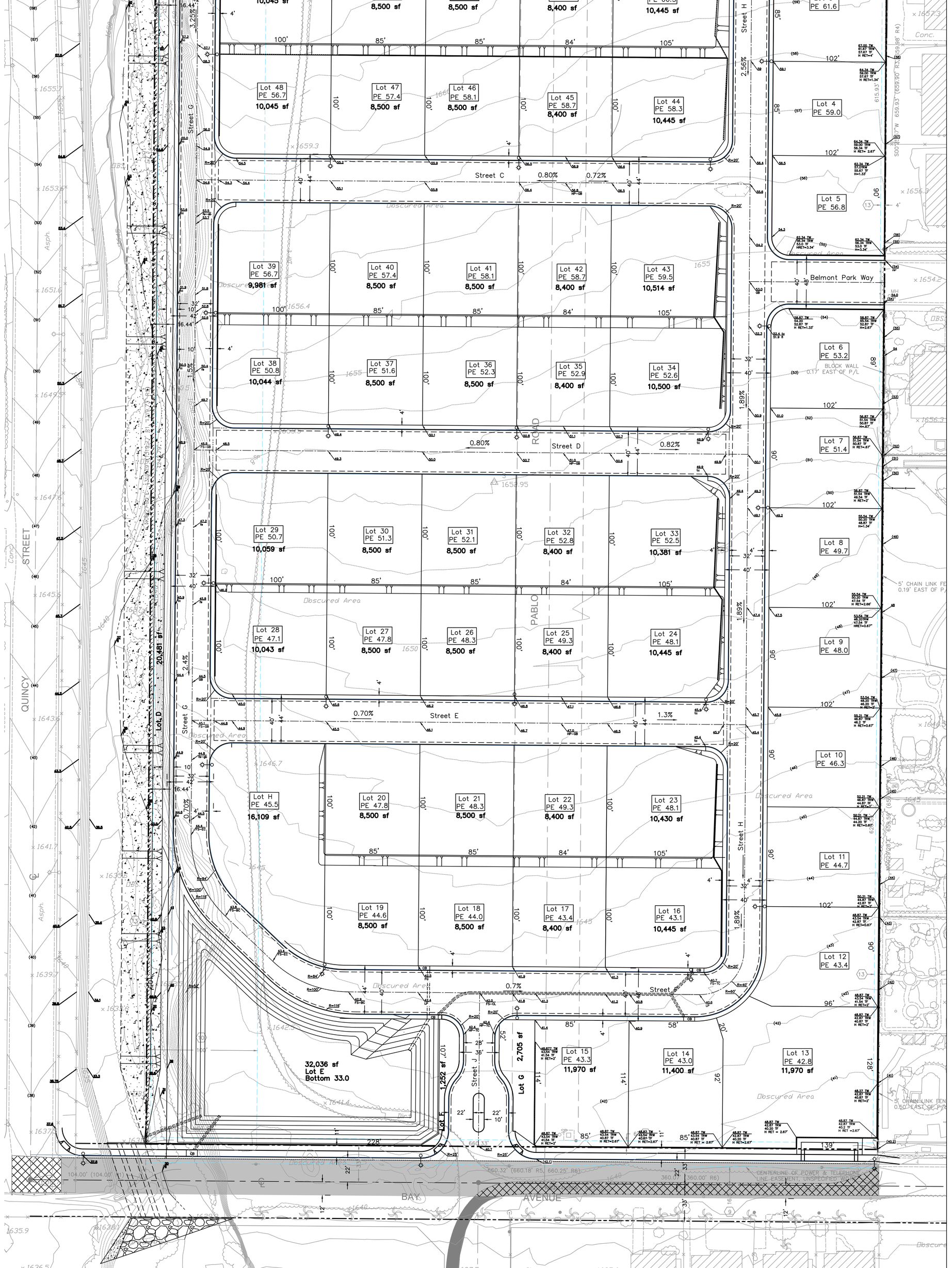
TYPICAL SECTION – PRIVATE STREETS B & F
PARKING ON BOTH SIDES OF THE STREET
N.T.S.



TYPICAL SECTION – PRIVATE STREETS C, D & E
PARKING ON BOTH SIDES OF THE STREET
N.T.S.



TYPICAL SECTION – PRIVATE STREET G
PARKING ALLOWED ON ONE SIDE OF THE STREET
N.T.S.



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

REGISTERED PROFESSIONAL ENGINEER
ROBERT MARK BEERS
No. 39405
Exp. 12–31–23
CIVIL
STATE OF CALIFORNIA

2022-12-08
Date

Robert M. Beers
Robert M. Beers R.C.E. 39405

PREPARED FOR:
Passco Pacifica LLC
333 City Boulevard West
17th Floor
Orange, CA 92866
PHONE: (714) 609–7257

TTM 38264
PEN22–0013

City of Moreno Valley
California

DATE Dec. 8, 2022
JOB NO.
DRAWN BY R.A.H.
CHECKED BY R.M.B.
SHEET C–1

Appendix 3:Soils Information

Geotechnical Study and Other Infiltration Testing Data

SOIL
EXPLORATION
COMPANY, INC.

Soil Engineering, Environmental Engineering, Materials Testing, Geology

May 3, 2021

Project No. 21125-01

TO: Bob Beers
8175 Limonite Ave.,
Jurupa Valley, CA 92509

SUBJECT: Soil Investigation and Liquefaction Evaluation Report, Proposed Residential Development Site, SEC of Cottonwood Avenue and Quincy Street: (APN 478-250-001), 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 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 eight 8" diameter borings, 25 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, maximum dry density/optimum moisture content 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.
- 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 and Cal/OSHA classification of soils.

Site Conditions

The 18.83 acres, rectangular shaped, relatively flat, vacant site is located on the southeast corner of Cottonwood Avenue and Quincy Street, in the City of Moreno Valley, Riverside County, California. Cottonwood Avenue is a paved road. Quincy Street is a paved road with curb and gutter. Existing houses are located on adjacent property to the east. Drainage channel is located on the west side along Quincy Street. Vegetation consists of dense weeds and palm trees along Cottonwood Avenue.

The approximate locations of the above and other features are shown on Exploratory Boring and Infiltration Test Location Map, Plate 1.

7535 Jurupa Ave., Unit C • Riverside, CA 92504 • Tel: (951) 688-7200 • Fax: (951) 688-7100
soilexploration@yahoo.com • www.soilexp.com

Proposed Development

We understand that the site is proposed for a single family 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

Eight exploratory borings were drilled on April 22, 2021, to a maximum depth of 50 feet below existing ground surface utilizing a CME-85 mobile drill rigs 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", "SP", "SP-SM", "SC" and "CL-ML"). The granular earth materials are generally loose to very dense. 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 valley 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, maximum dry density/optimum moisture content 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)
10N03W26k001S	2068.41	2/6/1959	0.38miles/NE	104.2

* WSE = Water Surface Elevation

Liquefaction Evaluation

The term liquefaction describes a phenomenon in which saturated, cohesionless or low-plasticity soils temporarily lose shear strength (liquefy) due to increased pore water pressures induced by strong, cyclic ground motions during an earthquake. Structures founded on or above potentially liquefiable soils may experience bearing capacity failures due to the temporary loss of foundation support, vertical settlements (both total and differential), and/or undergo lateral spreading. The factors known to influence liquefaction potential include soil type, relative density, grain size, confining pressure, depth to groundwater (i.e., less than 50 feet bgs), and the intensity and duration of the seismic ground shaking. Liquefaction is most prevalent in loose to medium dense, silty, sandy, and gravelly soils below the groundwater table.

Based on Riverside County GIS Map, the site is located within an area of moderate liquefaction potential (see Figure 3). Considering depth to groundwater (over 50 feet below ground surface), the potential for liquefaction at the site is very low.

Liquefaction Analysis/Dynamic Settlement: LiquefyPro

Liquefaction susceptibility using Standard Penetration Test data and laboratory Gain size test results were analyzed using LiquefyPro software (Version 5.5g). A predominant earthquake magnitude of 6.6 (USGS Interactive Deaggregation, 10% probability of exceedance in 50 years) was used. An associated ground acceleration of 0.658g (equivalent to two-thirds of PGAM), and a historic high depth to groundwater of 104 feet below the existing ground surface were used in our liquefaction evaluation. The software output is presented in Appendix E.

The main observations of the results are as follows:

Boring No.	Total settlement (inch)	Differential Settlement (inch)
B-3	1.7	0.851 to 1.124

- Onsite soils at the site in general have a Safety Factor of 5.0 against liquefaction.

Seismicity/Faulting

A computer search of all known Quarternary 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.

Secondary Seismic Hazards

Lateral Spreading

Lateral spreading is a phenomenon in which large blocks of intact, non-liquefied soil move downslope on a liquefied layer. Lateral spreading is often a regional event. For lateral spreading to occur, the liquefiable soil zone must be laterally continuous, unconstrained laterally, and free to move along sloping ground. Due to the low susceptibility for liquefaction, the potential for lateral spreading is considered very low.

Surface Rupture

The site is not located within a currently designated Alquist-Priolo earthquake fault zone. The potential for surface rupture on the subject site is considered low.

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 laboratory test results, the expansion potential of onsite near surface silty sands is very low (EI=0).

- 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 1.97 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 0.987g (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 recompacted 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 purpose 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 fills, 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.

Settlement and Shrinkage

The estimated total settlement of the structures supported on spread footings as recommended above is less than 1 inch. The differential settlement is estimated to less than ½ inch over a horizontal of 30 feet

Based on density tests performed, average 17 percent shrinkage may be considered on upper 5 feet of onsite soils.

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

On the basis of laboratory classification, we are of the opinion that the tentative new pavement design may be based on an R-value on the order of 50 (or better) corresponding to near surface soils. Considering this and based on typical traffic indices, the recommended pavement sections are outlined as follows:

Traffic Index (TI)	Asphalt Concrete (inches)	Aggregate Base (CAB) (inches)
5	2.5	3
6	3	4
7	4	4.5
8	5	5
9	6	5.5

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_o)	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_t)	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 1.97 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 0.987g. 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 the laboratory test results, the expansion potential of the near surface sandy soils is very low (EI=0).

Results of tests performed by Enviro - Chem, Inc. of Pomona, California on a select soil samples are summarized as below:

Sample Location	Sample Depth (ft)	PH	Resistivity (ohm-cm)	Sulfate Content (%)	Chloride Content (ppm)
B-6	0-2.0	7.84	9620	0.00158	30.0

Based on test results, soil indicates negligible soluble sulfate exposure (less than 0.1 percent water soluble sulfates by weight). Therefore, there is no restriction on cement type. Based on resistivity test results, soil is mildly to moderately corrosive and ferrous metals/pipes/reinforcement should be protected. Concrete, mix, placement and curing for concrete should comply with ACI guidelines. 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 C.

Temporary trench excavations deeper than 5 feet should be shored or sloped at 1.5:1 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.

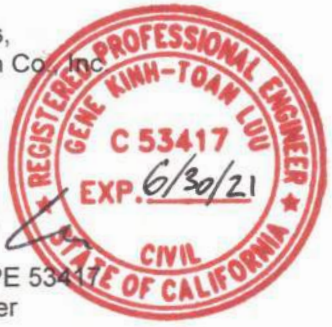
The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they are due to natural processes or the works of man on this or adjacent properties. In additions, changes in applicable or appropriate standards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



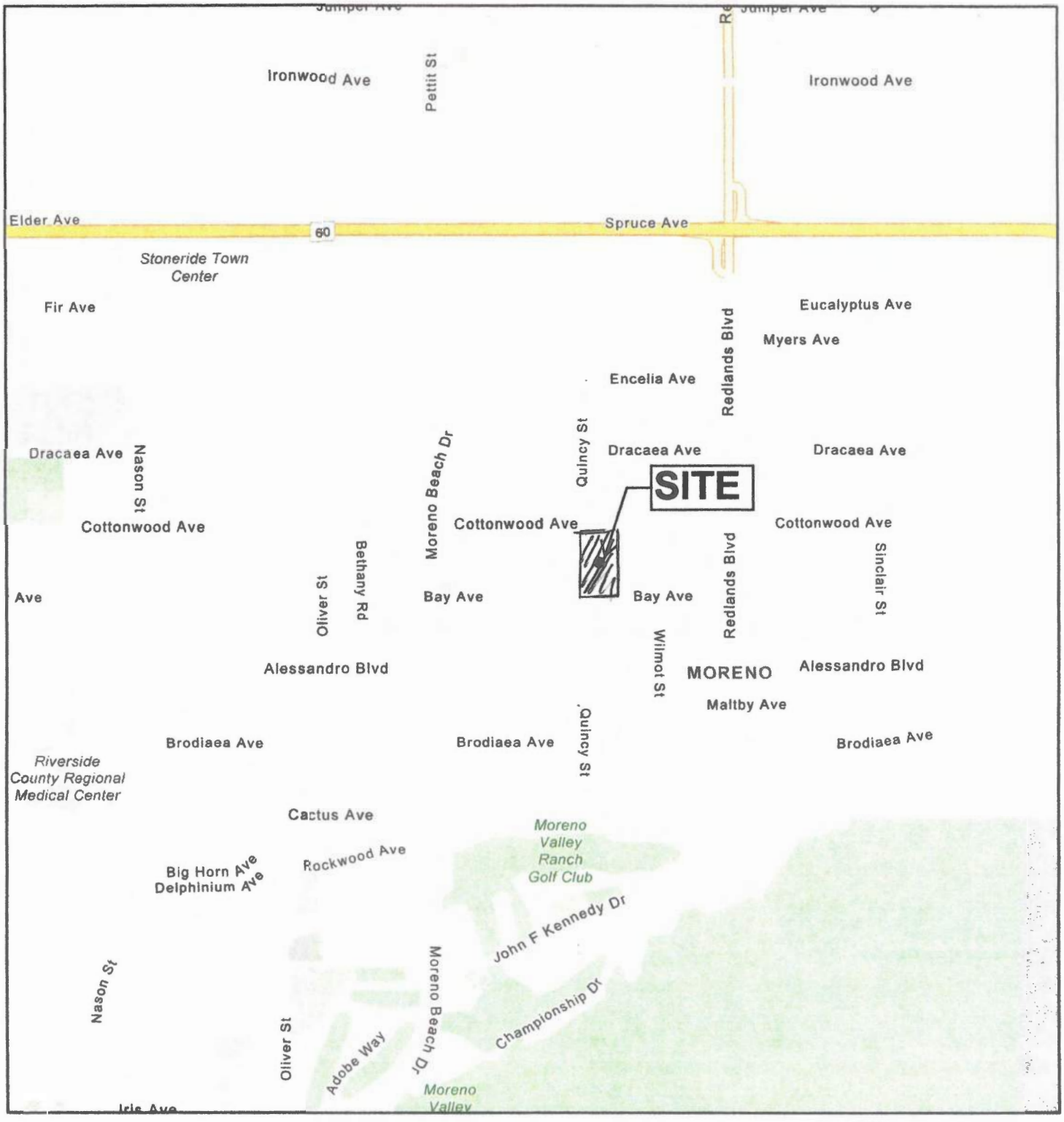
Gene K. Luu, PE 53417
Project Engineer

Distribution: [1] 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 Quaternary Faults Map
Plate 1	Exploratory Boring 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	Liquefaction Analysis Summary
Appendix G	Infiltration Test Procedure and Test Results

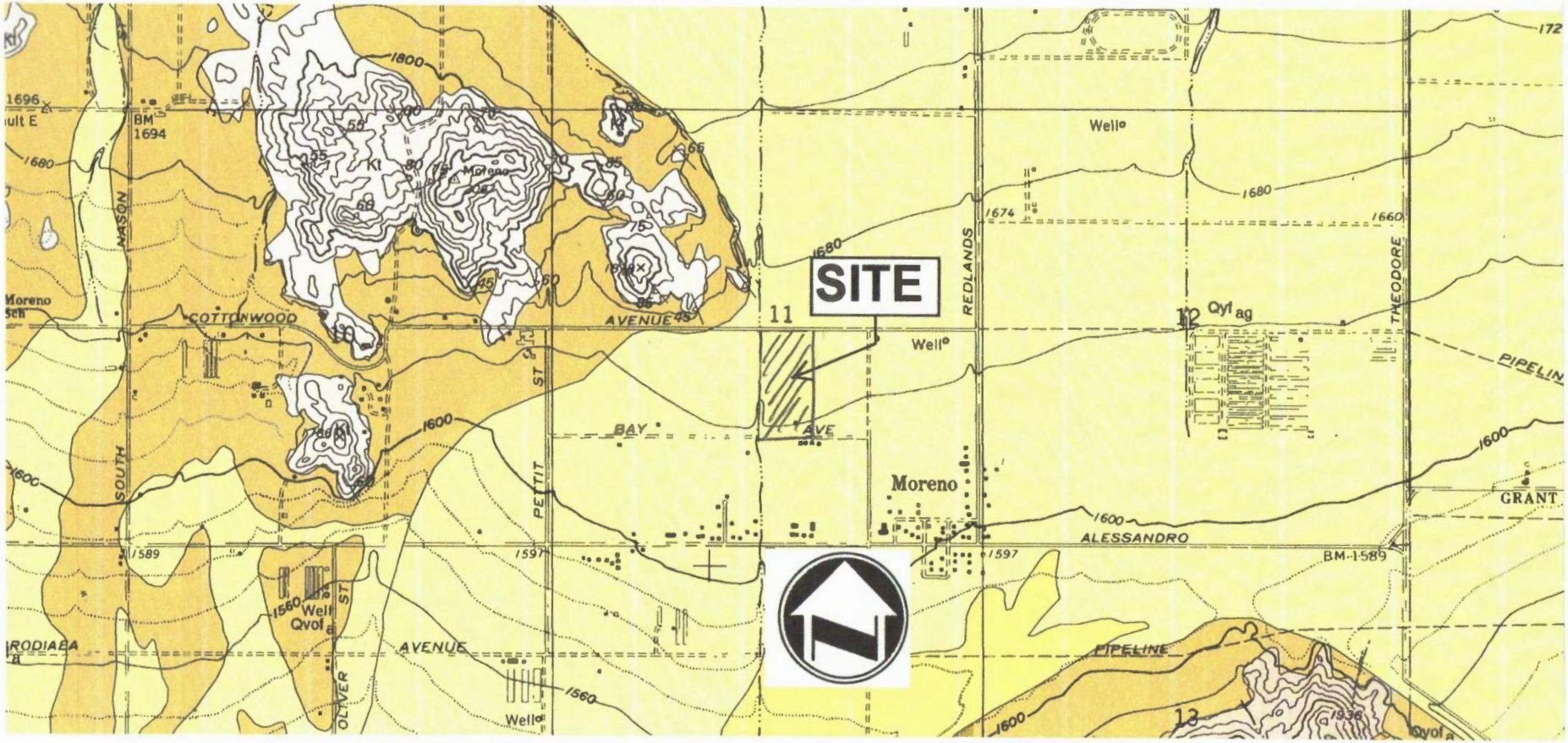
Site Location Map



0 0.25 0.5 1 mi

0 0.4 0.8 1.6 km

Figure 1



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

LEGEND:

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

a - arenaceous (very coarse sand through very fine sand)

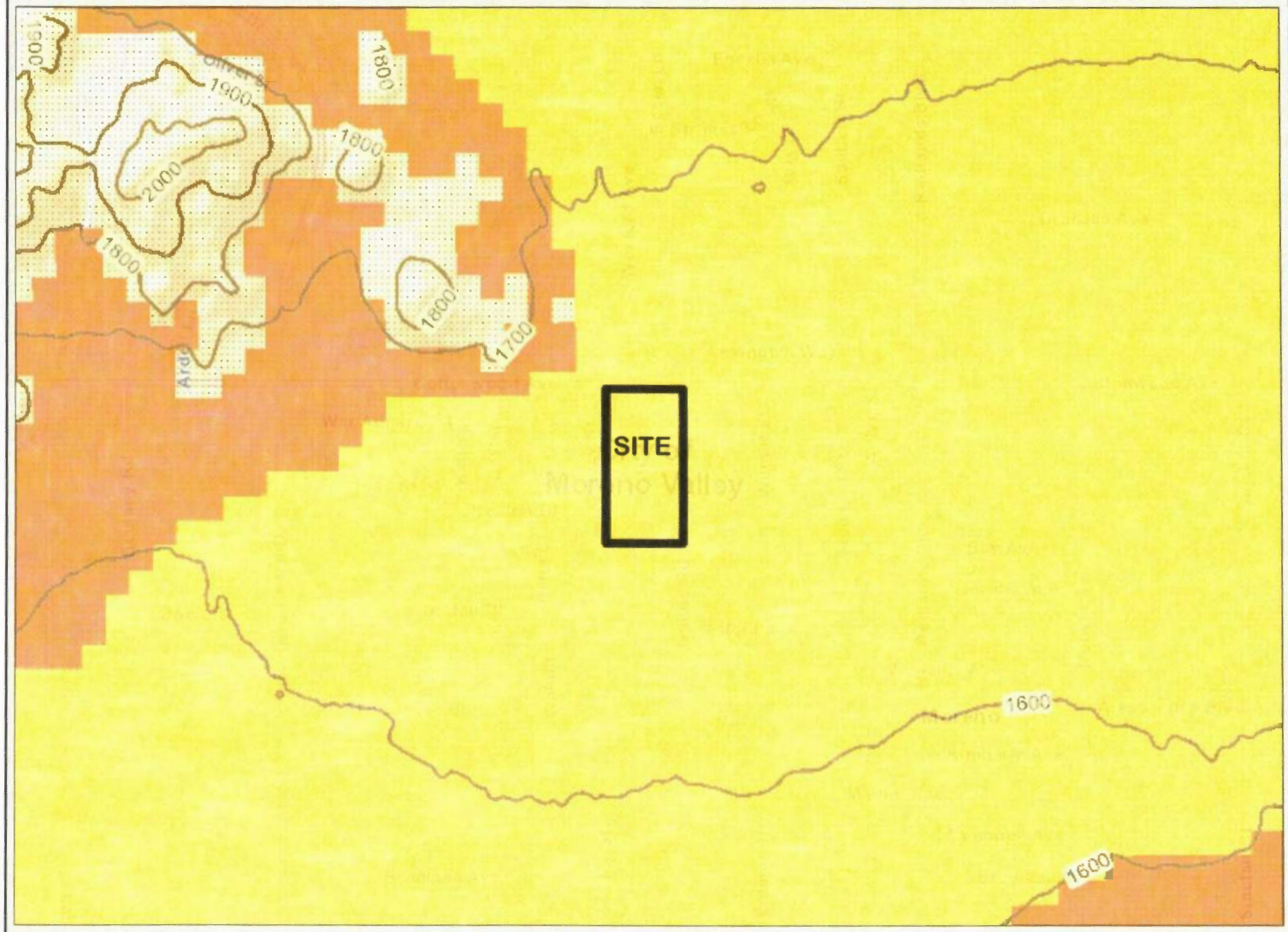
g - gravel (cobble through granule gravel)

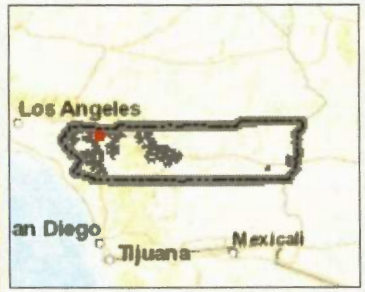
SEC of Cottonwood Ave and Quincy St.
City of Moreno Valley, California

Soil Exploration Co., Inc.
Project No.: 21125-01
Date: May 3, 2021

Figure: 2

Map My County Map





Legend

- Contours100 ft interval (with 1(
- 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
- Liquefaction
  - Other Susceptibility
  - High
  - Low
  - Moderate
  - Very High
  - Very low
- Blueline Streams
- City Areas
- World Street Map

RCIT

0 1,505 3,009 Feet

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.

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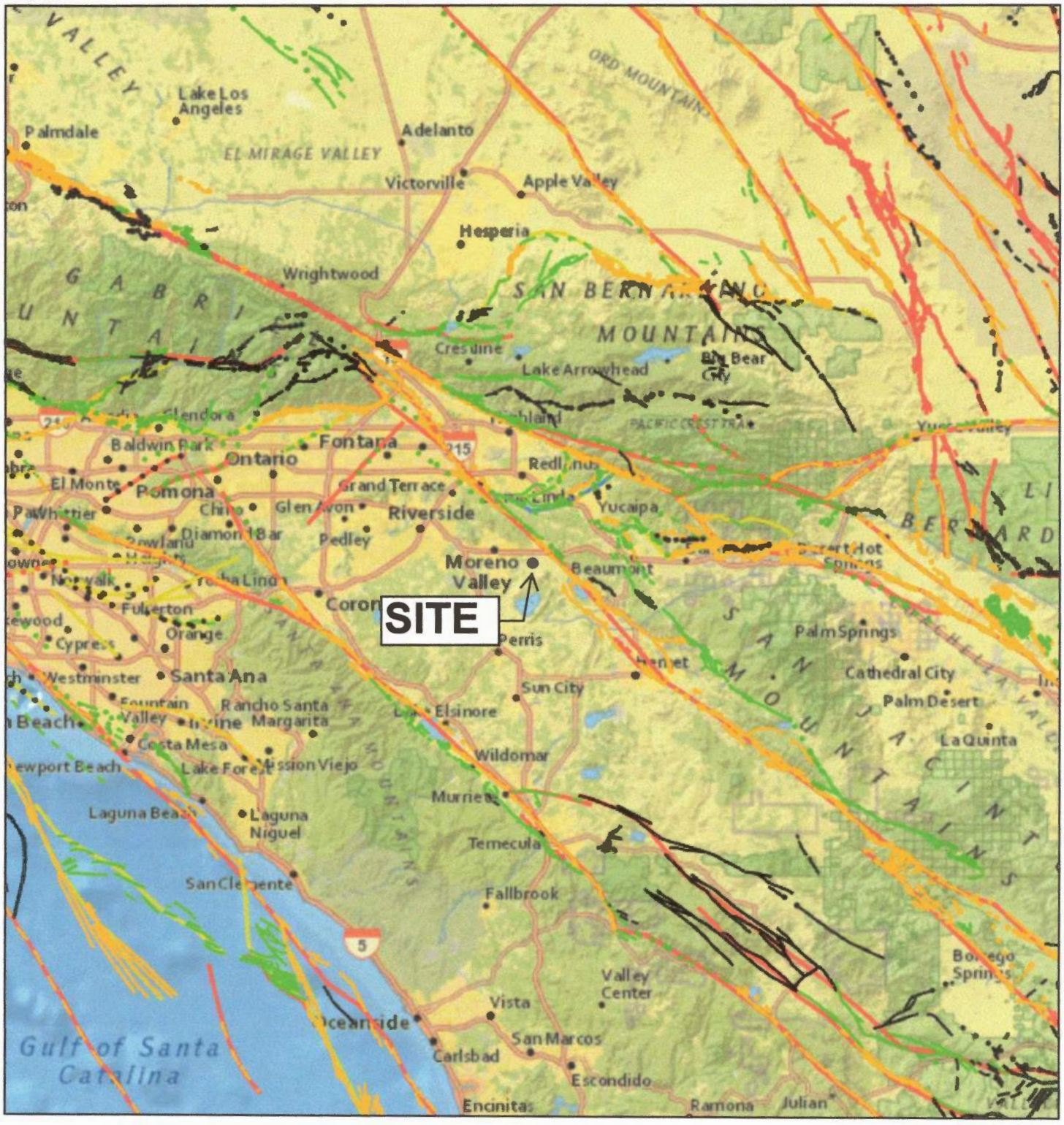
Notes

Figure 3

U.S. Geological Survey Quaternary Faults



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Fault Areas

- Class B
- historic
- late Quaternary
- latest Quaternary
- middle and late Quaternary

National Database

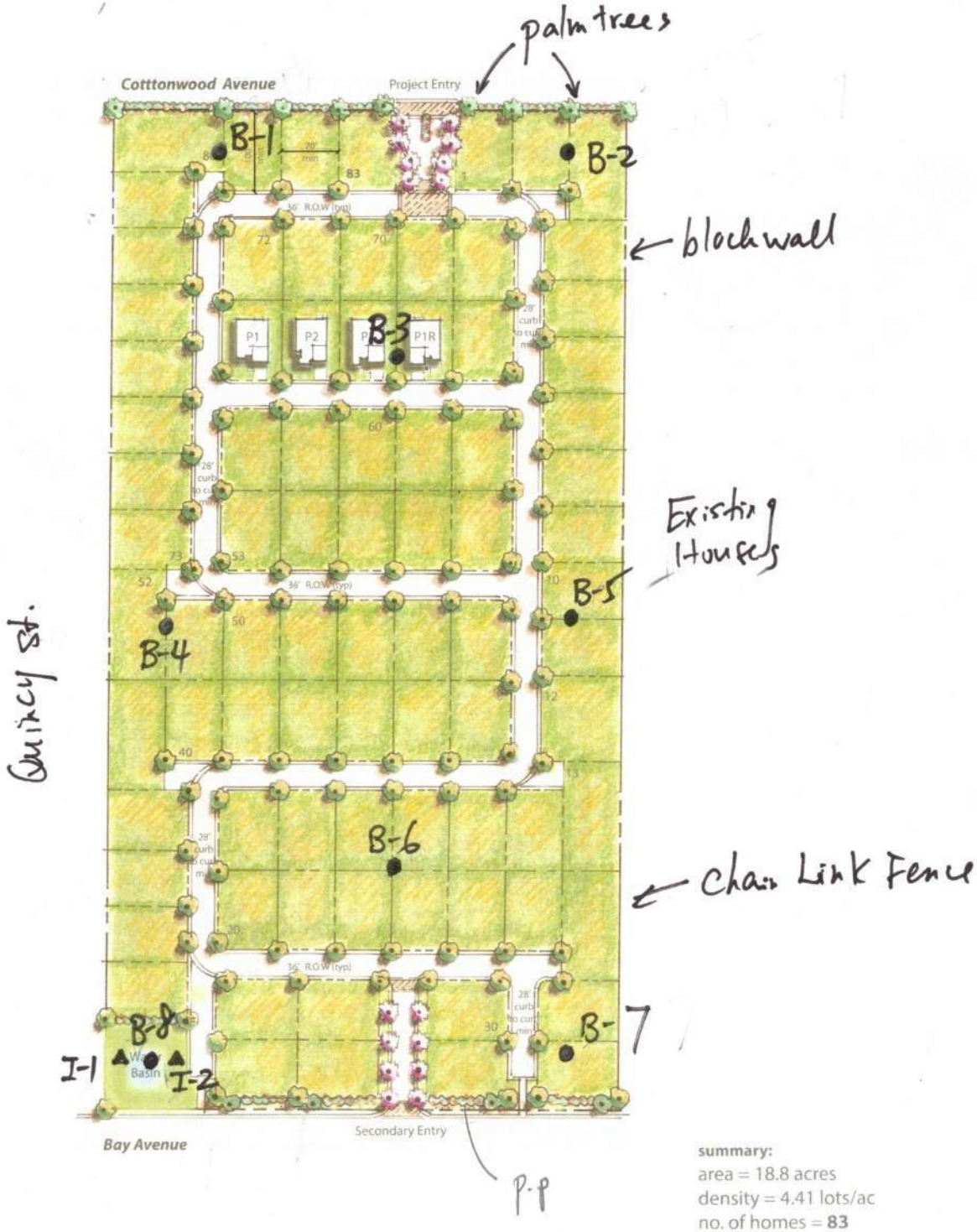
- Historic (< 150 years), well constrained location

0 5 10 20 mi

0 12.5 25 50 km

Figure 4

EXPLORATORY BORING & INFILTRATION TEST LOCATION MAP PLATE 1	
LEGEND B-1 • Approximate Location of Boring I-2 ▲ Approximate Location of Infiltration Test	
Soil Exploration Co., Inc.	
Project No. 21125-01-01	May 3, 2021



summary:
area = 18.8 acres
density = 4.41 lots/ac
no. of homes = **83**
70'x100' min. lot size

north
scale: 1" = 50' - 0"

COTTONWOOD Collection
Moreno Valley, CA
March 31, 2021
Conceptual Site Plan
IDEArc ARCHITECTURE + PLANNING
PACIFICA

	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 ½ 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

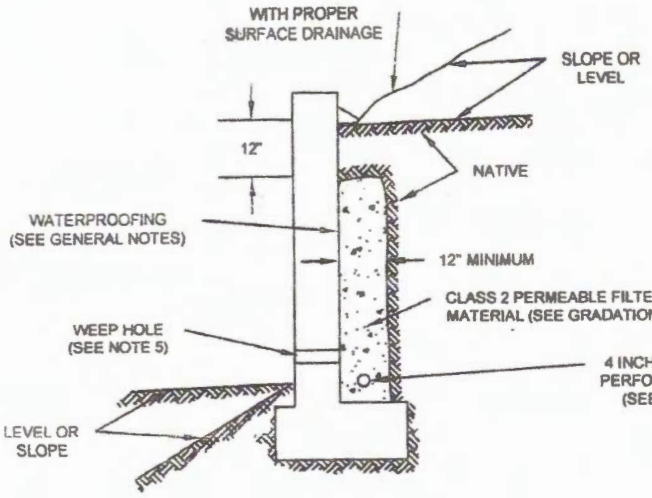
ONE- AND TWO-STORY RESIDENTIAL BUILDINGS

Soil Exploration Co. Inc.

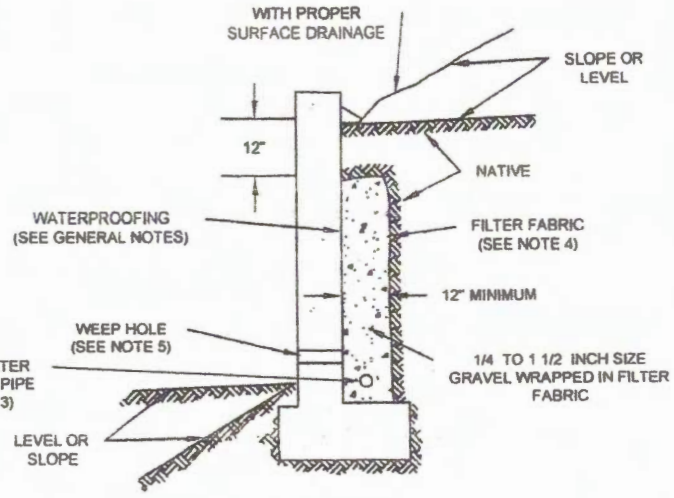
Plate: 2

SUBDRAIN OPTIONS AND BACKFILL WHEN NATIVE MATERIAL HAS EXPANSION INDEX ≤ 50

OPTION 1: PIPE SURROUNDED WITH CLASS 2 PERMEABLE MATERIAL



OPTION 2: GRAVEL WRAPPED IN FILTER FABRIC



Class 2 Filter Permeable Material Gradation
Per Caltrans Specifications

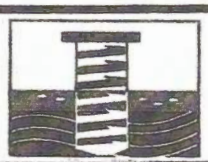
Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

GENERAL NOTES:

*Waterproofing should be provided where moisture nuisance problem through the wall is undesireable.
*Water proofing of the walls is not under the purview of the geotechnical engineer.
*All drains should have a gradient of 1 percent minimum.
*Outlet portion of the subdrain should have a 4-inch diamater solid pipe discharged into a suitable disposal area designed by the project engineer. The subdrain pipe should be accessible for maintenance (rodding).
*Other subdrain backfill options are subject to the review by the geotechnical engineer and modification of design parameters.

Notes:

1) Sand should have a sand equivalent of 30 or greater and may be densified by water jetting.
2) 1 Cu. ft. per ft. of 1/4 - to 1 1/2 -inch size gravel wrapped in filter fabric
3) Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785 Polyvinyl Chlorise plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down. Perforations should be 3/8 -inch in diameter placed at the ends of a 120-degree arc in two rows at 3-inch on center (staggered).
4) Filter Fabric should be Mirafi 140NC or approved equivalent.
5) Weephole should be 3-inch minimum diameter and provided at 10-foot maximum intervals. if exposure is permitted, weepholes should be located 12-inches above finished grade. If exposure is not permitted, such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk to be discharged through the curb face or equivalent should be provided. For a basement-type wall, a proper subdrain outlet system should be provided.
6) Retaining wall plans should be reviewed and approved by the geotechnical engineer.
7) Walls over six feet in height are subject to a special review by the geotechnical engineer and modifications to the above requirements.



RETAINING WALL BACKFILL AND SUBDRAIN DETAIL

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 Quaternary Faults.
- Riverside County, Low-impact development BMP design handbook, Appendix A-Infiltration Testing, June 2018.

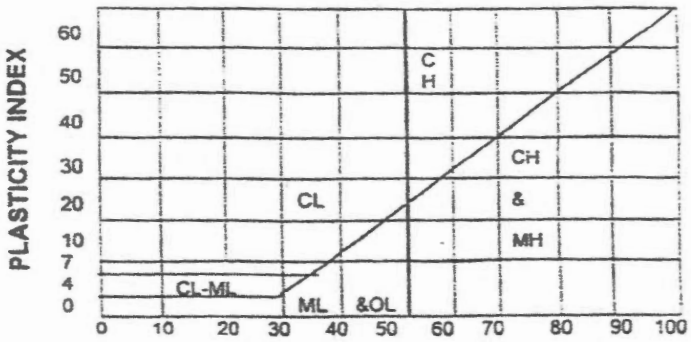
APPENDIX B

MAJOR DIVISIONS		SYMBOLS		TYPICAL NAMES
COARSE-GRAINED SOILS (More than ½ of soil < No. 200 sieve)	GRAVELS (More than ½ 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 ½ of coarse fraction < No. 4 sieve size)	SW		Well-graded sands or gravely sands, little or no fines
		SP		Poorly graded sands or gravelly sands, little or no fines
		SM		Silty sands, sand-salt mixtures
		SC		Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (More than ½ 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 diatonaceous 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	3" to No. 4	762 to 4.76
COARSE	3" TO ¾"	76.2 to 19.1
FINE	¾"to No. 4	19.1 to 4.76
SAND	No. 4 to 200	4.76 to 0.074
COARSE	No. 4 to 10	4.76 to 2.00
MEDIUM	No. 10 to 40	2.00 to 0.420
FINE	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: 4/22/21
Drilling Company: One Way Drilling
Hole Diameter: 8" Drive Weight: 140 lbs. Drop: 30"

Project No. 21125-01
Type of Rig: CME-85
Elevation: Existing Ground

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: GL SAMPLED BY: GL
1						SM	**SILTY SAND:** Light brown, fine to medium grained, dry, loose
2							
3			9/6/7	89.3	9.3		
4							
5							
6			4/9/13	98.9	4.8		Medium dense
7							
8							
9							
10							
11		X	4/3/3				Light greenish gray, dry, loose
12							
13							
14							
15							
16		X	5/6/7				Brown, dry, medium dense
17							
18							
19							
20							
21		X	9/10/13				Slightly moist, medium dense
22							
23							
24						ML	**SANDY SILT:** Light brown, slightly moist, dense
25		X	7/17/21				

TOTAL DEPTH = 25'
NO GROUNDWATER
NO CAVING
BORING BACKFILLED

GEOTECHNICAL BORING LOGS

Drill Hole No. B-2

Date: 4/22/21 | Project No. 21125-01
Drilling Company: One Way Drilling | Type of Rig: CME-85
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: GL SAMPLED BY: GL
1						SM	**SILTY SAND:** Light brown, fine to medium grained, dry, loose
2							
3		X	2/2/3		8.2		Slightly moist, loose
4							
5							
6		X	3/3/4		6.0		Dry, loose
7							
8							
9							
10							
11		X	3/4/5				
12							
13							
14							
15							
16		X	3/3/4				Brown, fine to medium grained, slightly moist, loose
17							
18							
19							
20							
21		X	6/8/10				Medium dense
22							
23							
24						CL-ML	**SILTY CLAY:** Gray, slightly moist, very stiff
25		X	7/11/13				

TOTAL DEPTH = 25'
NO GROUNDWATER
NO CAVING
BORING BACKFILLED

GEOTECHNICAL BORING LOGS

Drill Hole No. B-3

Date: 4/22/21
Drilling Company: One Way Drilling
Hole Diameter: 8" Drive Weight: 140 lbs. Drop: 30"

Project No. 21125-01
Type of Rig: CME-85
Elevation: Existing Ground

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: GL SAMPLED BY: GL
1						SM	**SILTY SAND:** Light brown, fine to medium grained, dry, loose
2							
3		X	2/2/3		8.2		
4							
5							
6		X	2/4/5		5.4		
7							
8							
9							
10							
11		X	4/4/5				
12							
13							
14							
15							
16		X	7/6/6		5.2		Dry, medium dense % passing # 200 sieve = 26
17							
18							
19							
20							
21		X	4/8/8				Brown, slightly moist
22							
23							
24							
25							

GEOTECHNICAL BORING LOGS

Drill Hole No. B-3

Date: 4/22/21 | Project No. 21125-01
Drilling Company: One Way Drilling | Type of Rig: CME-85
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: GL SAMPLED BY: GL
26		X	7/12/20		15.4	ML	**SANDY SILT:** Light brown, slightly moist, dense % passing # 200 sieve = 59
27							
28							
29							
30							
31		X	7/12/18		4.5	SM	**SILTY SAND:** Tan, fine to coarse grained, dry, dense % passing # 200 sieve = 7
32							
33							
34							
35							
36		X	4/9/12		2.2	SP	**SAND:** Pale brown, fine to coarse grained, dry, medium dense % passing # 200 sieve = 5
37							
38							
39							
40							
41		X	8/11/13			SM	**SILTY SAND:** Light brown, fine to medium grained, slightly moist, medium dense
42							
43							
44							
45							
46		X	3/5/6		11.2		% passing # 200 sieve = 48
47							
48							
49							
50		X	6/8/12				

TOTAL DEPTH = 50'
NO GROUNDWATER
NO CAVING
BORING BACKFILLED

GEOTECHNICAL BORING LOGS

Drill Hole No. B-4

Date: 4/22/21 **Project No.** 21125-01

Drilling Company: One Way Drilling **Type of Rig:** CME-85

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: GL SAMPLED BY: GL
1						SM	**SILTY SAND:** Light brown, fine to medium grained, dry, medium dense
2							
3		X	3/5/5		6.7		
4							
5							
6			4/4/7	99.8	4.6		Loose
7							
8							
9							
10							
11			5/6/9	99.8	3.0		Medium dense
12							
13							
14							
15							
16		X	2/4/4				Loose
17							
18							
19							
20							
21		X	7/9/12				Brown, medium dense
22							
23							
24							
25		X	8/12/17				Brown, fine to coarse grained, slightly moist, medium dense

TOTAL DEPTH = 25'
NO GROUNDWATER
NO CAVING
BORING BACKFILLED

Soil Exploration Co., Inc.

GEOTECHNICAL BORING LOGS

Drill Hole No. B-5

Date: 4/22/21
Drilling Company: One Way Drilling
Hole Diameter: 8" Drive Weight: 140 lbs. Drop: 30"

Project No. 21125-01
Type of Rig: CME-85
Elevation: Existing Ground

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: GL SAMPLED BY: GL
1						SM	**SILTY SAND:** Pale brown, fine to medium grained, dry, medium dense
2							
3			8/8/8	79.0	4.7		
4							
5							
6			2/3/4	98.9	6.7		Light brown, slightly moist, loose
7							
8							
9							
10							
11			3/4/7				Pale yellow, dry, medium dense
12							
13							
14							
15							
16			2/3/4				Brown, slightly moist, loose
17							
18							
19							
20							
21			5/8/12				Medium dense
22							
23							
24							
25			5/11/18				

TOTAL DEPTH = 25'
NO GROUNDWATER
NO CAVING
BORING BACKFILLED

GEOTECHNICAL BORING LOGS

Drill Hole No. B-6

Date: 4/22/21 **Project No.** 21125-01
Drilling Company: One Way Drilling **Type of Rig:** CME-85
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: GL SAMPLED BY: GL
1						SM	**SILTY SAND:** Light brown, fine to medium grained with gravel, dry, medium dense
2							
3		X	4/6/6		2.8		
4							
5							
6		X	3/3/4		2.9		Pale yellow, dry, loose, trace of gravel
7							% passing # 200 sieve = 16
8							
9							
10							
11		X	5/9/10		2.5	SP-SM	**SAND WITH SILT:** Pale yellow, fine to coarse grained, dry, medium dense
12							% passing # 200 sieve = 8
13							
14							
15							
16		X	6/6/7				
17						SM	**SILTY SAND:** Brown, fine to medium grained, slightly moist, medium dense
18							
19							
20							
21		X	4/8/10		11.2		% passing # 200 sieve = 35
22							
23							
24							
25							

GEOTECHNICAL BORING LOGS

Drill Hole No. B-6

Date: 4/22/21 | Project No. 21125-01

Drilling Company: One Way Drilling | Type of Rig: CME-85

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: GL SAMPLED BY: GL
26		X	10/20/30			SM	**SILTY SAND:** Brown, fine to medium grained, slightly moist, very dense
27							
28							
29							
30							
31		X	12/17/22				Light brown, slightly moist, dense
32							
33							
34							
35							
36		X	7/10/15		10.0		Light brown, fine to medium grained, medium dense
37							% passing # 200 sieve = 17
38							
39							
40							
41		X	13/18/13				Light brown, dense
42							
43							
44							
45							
46							
47							
48							
49							
50							

TOTAL DEPTH = 50'
NO GROUNDWATER
NO CAVING
BORING BACKFILLED

GEOTECHNICAL BORING LOGS

Drill Hole No. B-7

Date: 4/22/21 **Project No.** 21125-01
Drilling Company: One Way Drilling **Type of Rig:** CME-85
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: GL SAMPLED BY: GL
1						SM	**SILTY SAND:** Light brown, fine to medium grained, dry, loose
2							
3		X	2/3/4		7.2		
4							
5							
6		X	4/4/5		4.9		
7							
8							
9							
10							
11		X	2/2/2				Pale yellow, dry, loose
12							
13							
14							
15							
16		X	3/5/5				Pale yellow, dry, medium dense
17							
18							
19							
20							
21		X	4/7/12				Brown, moist, medium dense
22							
23							
24						SC	**SANDY CLAY:** Brown sandy clay, moist, very stiff
25		X	5/11/20				

TOTAL DEPTH = 25'
NO GROUNDWATER
NO CAVING
BORING BACKFILLED

GEOTECHNICAL BORING LOGS

Drill Hole No. B-8

Date: 4/22/21 **Project No.** 21125-01

Drilling Company: One Way Drilling **Type of Rig:** CME-85

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: GL SAMPLED BY: GL
1						SM	**SILTY SAND:** Light brown, fine to medium grained, dry, loose
2							
3		X	7/2/3		6.9		
4							
5							
6			3/5/5	94.4	6.1		
7							
8							
9							
10							
11			4/7/8	101.7	4.1		Pale yellow, dry, medium dense
12							
13							
14							
15							
16		X	3/3/5				Brown, loose
17							
18							
19							
20							
21		X	10/13/15				Medium dense
22							
23							
24							
25		X	15/39/50/ 5"				Very dense

TOTAL DEPTH = 25'
NO GROUNDWATER
NO CAVING
BORING BACKFILLED

APPENDIX C

LABORATORY TEST RESULTS

Maximum Density Tests: The maximum dry density and optimum moisture content of representative samples were determined using the guidelines of ASTM D 1557. The test results are presented in the table below.

Sample Location	Material Description	Maximum Dry Density (PCF)	Optimum Moisture Content (%)
B-3@0-5 feet	Silty sand	128.0	9.0

LABORATORY TEST RESULTS

Sieve Analysis Test Data

SIEVE SIZE	B-3 @ 15' % PASSING	B-3 @ 25' % PASSING	B-3 @ 30' % PASSING	B-3 @ 35' % PASSING
3/8"	100	100	100	100
No. 4	99	99	97	95
No. 8	93	95	89	79
No. 16	85	90	67	56
No. 30	75	86	59	31
No. 50	59	81	38	16
No. 100	41	72	18	9
No. 200	26	59	7	5
SIEVE ANALYSIS TEST DATA				

SIEVE SIZE	B-3 @ 45' % PASSING	B-6 @ 5' % PASSING	B-6 @ 10' % PASSING	B-6 @ 20' % PASSING
3/8"	100	100	100	100
No. 4	99	88	96	96
No. 8	96	82	89	88
No. 16	93	74	77	79
No. 30	89	61	56	71
No. 50	81	42	32	62
No. 100	65	26	21	49
No. 200	48	16	8	35
SIEVE ANALYSIS TEST DATA				

SIEVE SIZE	B-6 @ 35' % PASSING
3/8"	100
No. 4	98
No. 8	88
No. 16	72
No. 30	58
No. 50	44
No. 100	28
No. 200	17
SIEVE ANALYSIS TEST DATA	

Enviro – Chem, Inc.
1214 E. Lexington Avenue, Pomona, CA 91766 Tel (909) 590-5905 Fax (909) 590-5907

LABORATORY REPORT

CUSTOMER: **Soil Exploration Company**
7535 Jurupa Ave., Suite C
Riverside, CA 92504
Tel:(909)374-5429 E-Mail: SoilExploration@yahoo.com

PROJECT: **Bob Beers / 21125-01**
MATRIX:SOIL DATE RECEIVED:04/23/21
SAMPLING DATE:04/22/21 DATE ANALYZED:04/23&27/21
REPORT TO:Mr. GENE K. LUU DATE REPORTED:04/28/21

SAMPLE I.D.: **B-6 @ 0-2'** LAB I.D.: 210423-1

PARAMETER	SAMPLE RESULT	UNIT	PQL	DF	TEST METHOD
RESISTIVITY	9620	OHMS-CM	100000*	--	CALTRANS
SULFATE	15.8	mg/Kg	10	1	EPA 9038
CHLORIDE	30.0	mg/Kg	10	1	EPA 9253
pH	7.84	pH/UNIT	--	--	EPA 9045C

COMMENTS
DF = DILUTION FACTOR
PQL = PRACTICAL QUANTITATION LIMIT
ACTUAL DETECTION LIMIT = DF X PQL
ND = NON-DETECTED OR BELOW THE ACTUAL DETECTION LIMIT
mg/Kg = MILLIGRAM PER KILOGRAM = PPM
OHMS-CM = OHMS-CENTIMETER
RESISTIVITY = 1/CONDUCTIVITY
* = HIGH LIMIT
pH ANALYSIS CONDUCTED ON 1:1 SOIL/DEIONIZED WATER EXTRACTION

DATA REVIEWED AND APPROVED BY: _____
CAL-DHS ELAP CERTIFICATE No.: 1555

APPENDIX D

U.S. Geological Survey - Earthquake Hazards Program

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)	Length (km)
1.97	San Jacinto;SBV+SJV+A	CA	n/a	90	V	strike slip	0	16	134
1.97	San Jacinto;SJV+A+CC	CA	n/a	90	V	strike slip	0	16	136
1.97	San Jacinto;SJV	CA	18	90	V	strike slip	0	16	43
1.97	San Jacinto;SBV+SJV+A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15	241
1.97	San Jacinto;SJV+A+CC+B	CA	n/a	90	V	strike slip	0.1	15	170
1.97	San Jacinto;SBV+SJV+A+CC+B	CA	n/a	90	V	strike slip	0.1	15	215
1.97	San Jacinto;SBV+SJV+A+CC	CA	n/a	90	V	strike slip	0	16	181
1.97	San Jacinto;SBV+SJV+A+C	CA	n/a	90	V	strike slip	0	17	181
1.97	San Jacinto;SBV+SJV	CA	n/a	90	V	strike slip	0	16	88
1.97	San Jacinto;SJV+A+C	CA	n/a	90	V	strike slip	0	17	136
1.97	San Jacinto;SJV+A	CA	n/a	90	V	strike slip	0	17	89
1.97	San Jacinto;SJV+A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15	196
3.87	San Jacinto;A	CA	9	90	V	strike slip	0	17	71
3.87	San Jacinto;A+CC+B	CA	n/a	90	V	strike slip	0.1	15	152
3.87	San Jacinto;A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15	178
3.87	San Jacinto;A+C	CA	n/a	90	V	strike slip	0	17	118
3.87	San Jacinto;A+CC	CA	n/a	90	V	strike slip	0	16	118

7.75	San Jacinto;SBV	CA	6	90	V	strike slip	0	16	45
12.95	S. San Andreas;CC+BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	86		strike slip	0.1	13	449
12.95	S. San Andreas;CC+BB+NM+SM+NSB+SSB+BG	CA	n/a	85		strike slip	0	14	380
12.95	S. San Andreas;CC+BB+NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0	14	322
12.95	S. San Andreas;CH+CC+BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	86		strike slip	0.1	13	512
12.95	S. San Andreas;SSB+BG	CA	n/a	71		strike slip	0	13	101
12.95	S. San Andreas;NSB+SSB+BG+CO	CA	n/a	79		strike slip	0.2	12	206
12.95	S. San Andreas;NM+SM+NSB+SSB+BG+CO	CA	n/a	84		strike slip	0.1	13	340
12.95	S. San Andreas;BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	85		strike slip	0.1	13	390
12.95	S. San Andreas;BB+NM+SM+NSB+SSB+BG	CA	n/a	84		strike slip	0	14	321
12.95	S. San Andreas;BB+NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0	14	263
12.95	S. San Andreas;SSB+BG+CO	CA	n/a	77		strike slip	0.2	12	170
12.95	S. San Andreas;SSB	CA	16	90	V	strike slip	0	13	43
12.95	S. San Andreas;SM+NSB+SSB+BG+CO	CA	n/a	83		strike slip	0.1	13	303
12.95	S. San Andreas;SM+NSB+SSB+BG	CA	n/a	81		strike slip	0	13	234
12.95	S. San Andreas;SM+NSB+SSB	CA	n/a	90	V	strike slip	0	13	176
12.95	S. San Andreas;PK+CH+CC+BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	86		strike slip	0.1	13	548
12.95	S. San Andreas;PK+CH+CC+BB+NM+SM+NSB+SSB+BG	CA	n/a	86		strike slip	0.1	13	479
12.95	S. San Andreas;PK+CH+CC+BB+NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0.1	13	421
12.95	S. San Andreas;NSB+SSB+BG	CA	n/a	75		strike slip	0	14	136
12.95	S. San Andreas;NSB+SSB	CA	n/a	90	V	strike slip	0	13	79
12.95	S. San Andreas;NM+SM+NSB+SSB+BG	CA	n/a	83		strike	0	14	271

						slip			
12.95	S. San Andreas;NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0	13	213
12.95	S. San Andreas;CH+CC+BB+NM+SM+NSB+SSB+BG	CA	n/a	86		strike slip	0	14	442
12.95	S. San Andreas;CH+CC+BB+NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0	14	384
16.02	S. San Andreas;CH+CC+BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0	14	341
16.02	S. San Andreas;NSB	CA	22	90	V	strike slip	0	13	35
16.02	S. San Andreas;PK+CH+CC+BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0.1	13	377
16.02	S. San Andreas;BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0	14	220
16.02	S. San Andreas;SM+NSB	CA	n/a	90	V	strike slip	0	13	133
16.02	S. San Andreas;NM+SM+NSB	CA	n/a	90	V	strike slip	0	13	170
16.02	S. San Andreas;CC+BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0	14	279
20.31	Elsinore;W+GI+T+J+CM	CA	n/a	84	NE	strike slip	0	16	241
20.31	Elsinore;W+GI+T	CA	n/a	84	NE	strike slip	0	14	124
20.31	Elsinore;GI+T	CA	5	90	V	strike slip	0	14	78
20.31	Elsinore;GI+T+J	CA	n/a	86	NE	strike slip	0	17	153
20.31	Elsinore;GI+T+J+CM	CA	n/a	86	NE	strike slip	0	16	195
20.31	Elsinore;GI	CA	5	90	V	strike slip	0	13	37
20.31	Elsinore;W+GI	CA	n/a	81	NE	strike slip	0	14	83
20.31	Elsinore;W+GI+T+J	CA	n/a	84	NE	strike slip	0	16	199
20.91	S. San Andreas;BG	CA	n/a	58		strike slip	0	13	56
20.91	S. San Andreas;BG+CO	CA	n/a	72		strike slip	0.3	12	125
21.74	Elsinore;T+J	CA	n/a	86	NE	strike slip	0	17	127

21.74	Elsinore;T	CA	5	90	V	strike slip	0	14	52
21.74	Elsinore;T+J+CM	CA	n/a	85	NE	strike slip	0	16	169
23.86	Cucamonga	CA	5	45	N	thrust	0	8	28
24.09	Chino, alt 2	CA	1	65	SW	strike slip	0	14	29
24.82	Cleghorn	CA	3	90	V	strike slip	0	16	25
25.35	Elsinore;W	CA	2.5	75	NE	strike slip	0	14	46
25.39	Chino, alt 1	CA	1	50	SW	strike slip	0	9	24
27.03	Pinto Mtn	CA	2.5	90	V	strike slip	0	16	74
27.84	North Frontal (West)	CA	1	49	S	reverse	0	16	50
32.96	San Jose	CA	0.5	74	NW	strike slip	0	15	20
34.17	Helendale-So Lockhart	CA	0.6	90	V	strike slip	0	13	114
34.98	S. San Andreas;CC+BB+NM+SM	CA	n/a	90	V	strike slip	0	14	243
34.98	S. San Andreas;NM+SM	CA	n/a	90	V	strike slip	0	14	134
34.98	S. San Andreas;SM	CA	29	90	V	strike slip	0	13	98
34.98	S. San Andreas;PK+CH+CC+BB+NM+SM	CA	n/a	90	V	strike slip	0.1	13	342
34.98	S. San Andreas;BB+NM+SM	CA	n/a	90	V	strike slip	0	14	184
34.98	S. San Andreas;CH+CC+BB+NM+SM	CA	n/a	90	V	strike slip	0	14	306
35.35	North Frontal (East)	CA	0.5	41	S	thrust	0	16	27
35.85	Sierra Madre	CA	2	53	N	reverse	0	14	57
35.85	Sierra Madre Connected	CA	2	51		reverse	0	14	76
36.98	San Joaquin Hills	CA	0.5	23	SW	thrust	2	13	27
40.48	Puente Hills (Coyote Hills)	CA	0.7	26	N	thrust	2.8	15	17
41.09	Elsinore;J+CM	CA	3	84	NE	strike slip	0	17	118
41.09	Elsinore;J	CA	3	84	NE	strike	0	19	75

						slip			
41.92	Lenwood-Lockhart-Old Woman Springs	CA	0.9	90	V	strike slip	0	13	145
44.15	Burnt Mtn	CA	0.6	67	W	strike slip	0	16	21
44.82	Clamshell-Sawpit	CA	0.5	50	NW	reverse	0	14	16
45.76	Landers	CA	0.6	90	V	strike slip	0	15	95
46.23	Eureka Peak	CA	0.6	90	V	strike slip	0	15	19
46.36	Newport-Inglewood (Offshore)	CA	1.5	90	V	strike slip	0	10	66
46.36	Newport Inglewood Connected alt 2	CA	1.3	90	V	strike slip	0	11	208
46.36	Newport Inglewood Connected alt 1	CA	1.3	89		strike slip	0	11	208
47.51	San Jacinto;CC+B	CA	n/a	90	V	strike slip	0.2	14	77
47.51	San Jacinto;CC	CA	4	90	V	strike slip	0	16	43
47.51	San Jacinto;CC+B+SM	CA	n/a	90	V	strike slip	0.2	14	103
47.90	San Jacinto;C	CA	14	90	V	strike slip	0	17	47
48.21	Johnson Valley (No)	CA	0.6	90	V	strike slip	0	16	35
49.08	Puente Hills (Santa Fe Springs)	CA	0.7	29	N	thrust	2.8	15	11
49.22	Newport-Inglewood, alt 1	CA	1	88		strike slip	0	15	65

CBC (2019) Seismic Parameters

The CBC 2019 update is tabulated as follows:

2019 CBC – SEISMIC PARAMETERS		
Site Coordinates	**Latitude**	**Longitude**
	33.9228	**-117.1645**
Mapped Spectral Response Acceleration	S_s = 2.102	S_1 = 0.843
Site Coefficients (Class "D")	F_a = 1.0	F_v = 1.7
Maximum Considered Earthquake (MCE) Spectral Response Acceleration	S_{MS} = 2.102	S_{M1} = 1.433
Design Spectral Response Acceleration Parameters	S_{DS} = 1.402	S_{D1} = 0.955
Seismic Design Category	E	
Peak Ground Acceleration (PGA)	0.897	
Site amplification factor at PGA	1.1	
Site modified peak ground acceleration (PGAM)	0.987	

- Earthquake.usgs.gov/research/hazmaps/design
- 2019 California Building Code, California Code of Regulations, Title 24, Part 2, Volume 2 of 2, Section 1613, Earthquake Loads

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 D1557-09.

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 sheepsfoot 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 D1557-09 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

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LIQUEFACTION ANALYSIS SUMMARY

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Input File Name: UNTITLED
Title: PROJECT NAME:Bob Beers
Subtitle: Proj No. 21125-01

Surface Elev.=Existing Ground
Hole No.=B-3
Depth of Hole= 50.00 ft
Water Table during Earthquake= 104.00 ft
Water Table during In-Situ Testing= 104.00 ft
Max. Acceleration= 0.66 g
Earthquake Magnitude= 6.60

Input Data:
Surface Elev.=Existing Ground
Hole No.=B-3
Depth of Hole=50.00 ft
Water Table during Earthquake= 104.00 ft
Water Table during In-Situ Testing= 104.00 ft
Max. Acceleration=0.66 g
Earthquake Magnitude=6.60

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, Ce = 1.25
7. Borehole Diameter, Cb= 1
8. Sampling Method, Cs= 1
9. User request factor of safety (apply to CSR) , User= 1
   Plot one CSR curve (fs1=1)
10. Use Curve Smoothing: Yes*
* Recommended Options

In-Situ Test Data:

Depth	SPT	gamma	Fines

ft		pcf	%
0.00	5.00	120.00	26.00
5.00	9.00	120.00	26.00
10.00	9.00	120.00	26.00
15.00	12.00	120.00	26.00
20.00	16.00	120.00	26.00
25.00	32.00	120.00	59.00
30.00	30.00	120.00	7.00
35.00	21.00	120.00	5.00
40.00	24.00	120.00	48.00
45.00	11.00	120.00	48.00
50.00	20.00	120.00	48.00

Output Results:

Settlement of Saturated Sands=0.00 in.
Settlement of Unsaturated Sands=1.70 in.
Total Settlement of Saturated and Unsaturated Sands=1.70 in.
Differential Settlement=0.851 to 1.124 in.

Depth ft	CRRm	CSRfs	F.S.	S_sat. in.	S_dry in.	S_all in.
0.00	0.20	0.43	5.00	0.00	1.70	1.70
5.00	0.31	0.42	5.00	0.00	1.65	1.65
10.00	0.27	0.42	5.00	0.00	1.39	1.39
15.00	0.32	0.41	5.00	0.00	1.18	1.18
20.00	0.37	0.41	5.00	0.00	0.94	0.94
25.00	2.77	0.40	5.00	0.00	0.88	0.88
30.00	0.48	0.40	5.00	0.00	0.83	0.83
35.00	0.26	0.38	5.00	0.00	0.59	0.59
40.00	0.45	0.36	5.00	0.00	0.39	0.39
45.00	0.20	0.35	5.00	0.00	0.22	0.22
50.00	0.30	0.33	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.

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1 atm (atmosphere) = 1 tsf (ton/ft2)
CRRm Cyclic resistance ratio from soils
CSRsf Cyclic stress ratio induced by a given earthquake (with user request factor of safety)
F.S. Factor of Safety against liquefaction, F.S.=CRRm/CSRsf
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 G

Infiltration Test (Percolation Test Procedure)

The percolation test data from I-1 and I-2 was used to estimate infiltration rates using the Porchet Inverse Borehole Method, in accordance with Riverside County, Low-impact development BMP design handbook, Appendix A-Infiltration Testing, June 2018.

Two 9-inch diameter, 6 feet deep test holes (I-1 and I-2) were performed at the suggested area. To mitigate any possible caving or sloughing of the test hole, a 6-inch diameter perforated PVC pipe was placed in the hole. The bottom of the test hole was covered with 2 inches of gravel.

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

Tabulated Test Results/Boring Percolation Test Procedure)

Test No.	Depth of Test (feet)	Earth Material	Measured Infiltration Rate (in/hr)
I-1	6	Silty Sand ("SM")	4.07
I-2	6	Silty Sand ("SM")	3.57

- We recommend that a suitable factor of safety should be applied to the rate in design of the system
- The distance between the infiltration facility and the adjacent private property, any building and walls shall be a minimum of 10 feet
- Based on the test results, the measured infiltration rate obtained from the field is more than 1.6 inches per hour. Therefore, soils are considered feasible for infiltration.

Percolation Test Data Sheet

Project:	Bob Beers	Project No:	21125-01	Date:	5/4/21
Test Hole No:	I-1	Tested By:	Ed		
Depth of Test Hole, D_T:	6'	USCS Soil Classification:	SM		
Test Hole Dimensions (inches)			Length	Width	
Diameter (if round)=	9"	Sides (if rectangular)=			

Sandy Soil Criteria Test*

Trial No.	Start Time	Stop Time	Time Interval, (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or Equal to 6"? (y/n)
1	8:15:25	8:40:25	25	48	59.25	11.25	Y
2	8:42:16	9:07:16	25	48	58.5	10.5	Y

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Other wise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25".

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.)	Percolation Rate (min./in.)
1	9:15:01	9:25:01	10	48	55.875	7.875	1.27
2	9:26:54	9:36:54	10	48	55.5	7.5	1.33
3	9:40:00	9:50:00	10	48	55.125	7.125	1.40
4	9:51:13	10:01:13	10	48	54.875	6.875	1.45
5	10:03:14	10:13:14	10	48	54.875	6.875	1.45
6	10:14:26	10:24:26	10	48	54.875	6.875	1.45
7							
8							
9							
10							
11							
12							
13							
14							
15							

COMMENTS:

$H_o = D_T - D_o = 72 - 48 = 24$

$H_f = D_T - D_f = 72 - 54.875 = 17.125$

$H_{avg} = (H_o + H_f)/2 = 20.5625$

$I_t = \frac{4.5 \times 60 \times 6.875}{10(4.5 + 2620.5625)} = 4.07$ in/hr

Table 5 – Sample Test Data Form for Percolation Test

Percolation Test Data Sheet

Project:	Bob Beers	Project No:	21125-01	Date:	5/4/21
Test Hole No:	I-2	Tested By:	TB		
Depth of Test Hole, D_T:	6'	USCS Soil Classification:	SM		
Test Hole Dimensions (inches)			Length	Width	
Diameter (if round)=	9"	Sides (if rectangular)=			

Sandy Soil Criteria Test*

Trial No.	Start Time	Stop Time	Time Interval, (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or Equal to 6"? (y/n)
1	8:20:21	8:45:21	25	48	60.875	12.875	Y
2	8:46:12	9:11:12	25	48	60.25	12.25	Y

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Other wise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25".

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.)	Percolation Rate (min./in.)
1	9:12:19	9:22:19	10	48	55.5	7.5	1.33
2	9:23:14	9:33:14	10	48	55.125	7.125	1.40
3	9:34:50	9:44:50	10	48	54.875	6.875	1.45
4	9:45:12	9:55:12	10	48	54.5	6.5	1.54
5	9:58:01	10:08:01	10	48	54.125	6.125	1.63
6	10:09:36	10:19:36	10	48	54.125	6.125	1.63
7	10:21:22	10:31:22	10	48	54.125	6.125	1.63
8							
9							
10							
11							
12							
13							
14							
15							

COMMENTS:

$I_o = D_T - D_o = 72 - 48 = 24$

$I_f = D_T - D_f = 72 - 54.125 = 17.875$

$I_{ave} = I_o + I_f / 2 = 20.9375$

$I_f = \frac{45 \times 60 \times 6.125}{10(45 + 2(20.9375))} = 3.57$ in/hr

Table 5 – Sample Test Data Form for Percolation Test

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

“Not Applicable”

Appendix 6:BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation

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: 9/7/2022

Designed by: Jose Contreras — Case No:

Company Project Number/Name:

BMP Identification

BMP NAME / ID: Basin

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}= 0.65 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 Imperivous 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-1.1	*490481*	*Mixed Surface Types*	*0.5*	*0.34*	*166395.7*			
D-1.2	*199514*	*Concrete or Asphalt*	*1*	*0.89*	*177966.5*			
D-1.3	*93965*	*Ornamental Landscaping*	*0.1*	*0.11*	*10379.2*			
	783960	**Total**			**354741.4**	**0.65**	**19215.2**	**19216**

Notes:

Infiltration Basin - Design Procedure (Rev. 03-2012)	BMP ID	Legend:	Required Entries / Calculated Cells
Company Name: Adkan Engineers			Date: 9/7/2022
Designed by: Jose Contreras			County/City Case No.:

Design Volume

a) Tributary area (BMP subarea)	A_T =	18	acres
b) Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	19,216	ft^3

Maximum Depth

a) Infiltration rate	I =	3.57	in/hr
b) Factor of Safety (See Table 1, Appendix A: "Infiltration Testing" from this BMP Handbook)	FS =	3	
c) Calculate D_1 $D_1 = \frac{I\ (in/hr) \times 72\ hrs}{12\ (in/ft) \times FS}$	D_1 =	7.1	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 Depth to impermeable layer - (5 ft + freeboard)	D_2 =	9.0	ft
h) D_{MAX} is the smaller value of D_1 and D_2 but shall not exceed 5 feet	D_{MAX} =	7.1	ft

Basin Geometry

a) Basin side slopes (no steeper than 4:1)	z =	4	:1
b) Proposed basin depth (excluding freeboard)	d_B =	2.5	ft
c) Minimum bottom surface area of basin ($A_S = V_{BMP}/d_B$)	A_S =	7686	ft^2
d) Proposed Design Surface Area	A_D =	15,594	ft^2

Forebay

a) Forebay volume (minimum 0.5% V_{BMP})	Volume =	96	ft^3
b) Forebay depth (height of berm/splashwall. 1 foot min.)	Depth =	1	ft
c) Forebay surface area (minimum)	Area =	96	ft^2
d) Full height notch-type weir	Width (W) =	36.0	in

Notes: Dmax error is showing 7.1 feet, however, proposed basin depth excluding freeboard is 2.5 feet.

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	11/22/2022
Designed by	Jose Contreras	Case No	
Company Project Number/Name			

BMP Identification

BMP NAME / ID: Cottonwood Avenue

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}= 0.65 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 Imperivous 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-2.1	*27938*	*Concrete or Asphalt*	*1*	*0.89*	*24920.7*			
D-2.2	*4387*	*Ornamental Landscaping*	*0.1*	*0.11*	*484.6*			
	32325	***Total***			**25405.3**	**0.65**	***1376.1***	***1377***

Notes:

Infiltration Basin - Design Procedure (Rev. 03-2012)	BMP ID	Legend:	Required Entries / Calculated Cells
Company Name: Adkan Engineers			Date: 12/9/2022
Designed by: Jose Contreras			County/City Case No.:

Design Volume

a) Tributary area (BMP subarea)	A_T =	0.74	acres
b) Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	1,377	ft^3

Maximum Depth

a) Infiltration rate	I =	3.57	in/hr
b) Factor of Safety (See Table 1, Appendix A: "Infiltration Testing" from this BMP Handbook)	FS =	3	
c) Calculate D_1 $D_1 = \frac{I\ (in/hr) \times 72\ hrs}{12\ (in/ft) \times FS}$	D_1 =	7.1	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 Depth to impermeable layer - (5 ft + freeboard)	D_2 =	9.0	ft
h) D_{MAX} is the smaller value of D_1 and D_2 but shall not exceed 5 feet	D_{MAX} =	7.1	ft

Basin Geometry

a) Basin side slopes (no steeper than 4:1)	z =	4	:1
b) Proposed basin depth (excluding freeboard)	d_B =	1.5	ft
c) Minimum bottom surface area of basin ($A_S = V_{BMP}/d_B$)	A_S =	918	ft^2
d) Proposed Design Surface Area	A_D =	936	ft^2

Forebay

a) Forebay volume (minimum 0.5% V_{BMP})	Volume =	7	ft^3
b) Forebay depth (height of berm/splashwall. 1 foot min.)	Depth =	1	ft
c) Forebay surface area (minimum)	Area =	7	ft^2
d) Full height notch-type weir	Width (W) =	36.0	in

Notes: Dmax error is showing 7.1 feet, however, proposed basin depth excluding freeboard is 1.5 feet.

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	11/22/2022
Designed by	Jose Contreras	Case No	
Company Project Number/Name			

BMP Identification

BMP NAME / ID: Bay Avenue

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}= 0.65 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 Imperivous 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-2.1	*8513*	*Concrete or Asphalt*	*1*	*0.89*	*7593.6*			
D-2.2	*4796*	*Ornamental Landscaping*	*0.1*	*0.11*	*529.8*			
	13309	***Total***			**8123.4**	**0.65**	***440***	***440***

Notes:

Infiltration Basin - Design Procedure (Rev. 03-2012)	BMP ID	Legend:	Required Entries / Calculated Cells
Company Name: Adkan Engineers			Date: 12/9/2022
Designed by: Jose Contreras			County/City Case No.:

Design Volume

a) Tributary area (BMP subarea)	A_T =	0.31	acres
b) Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	440	ft^3

Maximum Depth

a) Infiltration rate	I =	3.57	in/hr
b) Factor of Safety (See Table 1, Appendix A: "Infiltration Testing" from this BMP Handbook)	FS =	3	
c) Calculate D_1 $D_1 = \frac{I\ (in/hr) \times 72\ hrs}{12\ (in/ft) \times FS}$	D_1 =	7.1	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 Depth to impermeable layer - (5 ft + freeboard)	D_2 =	9.0	ft
h) D_{MAX} is the smaller value of D_1 and D_2 but shall not exceed 5 feet	D_{MAX} =	7.1	ft

Basin Geometry

a) Basin side slopes (no steeper than 4:1)	z =	4	:1
b) Proposed basin depth (excluding freeboard)	d_B =	1.25	ft
c) Minimum bottom surface area of basin ($A_S = V_{BMP}/d_B$)	A_S =	352	ft^2
d) Proposed Design Surface Area	A_D =	358	ft^2

Forebay

a) Forebay volume (minimum 0.5% V_{BMP})	Volume =	2	ft^3
b) Forebay depth (height of berm/splashwall. 1 foot min.)	Depth =	1	ft
c) Forebay surface area (minimum)	Area =	2	ft^2
d) Full height notch-type weir	Width (W) =	36.0	in

Notes: Dmax error is showing 7.1 feet, however, proposed basin depth excluding freeboard is 1.5 feet.

Appendix 7:Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern

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

Study date 09/07/22 File: EX2242.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 5006

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

Drainage Area = 18.00(Ac.) = 0.028 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 18.00(Ac.) = 0.028 Sq. Mi.
Length along longest watercourse = 1248.00(Ft.)
Length along longest watercourse measured to centroid = 624.00(Ft.)
Length along longest watercourse = 0.236 Mi.
Length along longest watercourse measured to centroid = 0.118 Mi.
Difference in elevation = 36.00(Ft.)
Slope along watercourse = 152.3077 Ft./Mi.
Average Manning's 'N' = 0.030
Lag time = 0.071 Hr.
Lag time = 4.27 Min.
25% of lag time = 1.07 Min.
40% of lag time = 1.71 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
18.00	1.80	32.40

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
18.00	4.50	81.00

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 1.800(In)
Area Averaged 100-Year Rainfall = 4.500(In)

Point rain (area averaged) = 1.800(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 1.800(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
18.000	69.00	0.000

Total Area Entered = 18.00(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
69.0	49.8	0.574	0.000	0.574	1.000	0.574
					Sum (F) =	0.574

Area averaged mean soil loss (F) (In/Hr) = 0.574
Minimum soil loss rate ((In/Hr)) = 0.287
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.900

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)	Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)

1	0.083	117.131	24.362	4.419
2	0.167	234.263	48.793	8.851
3	0.250	351.394	13.567	2.461
4	0.333	468.526	6.173	1.120
5	0.417	585.657	3.446	0.625
6	0.500	702.789	2.028	0.368
7	0.583	819.920	1.632	0.296
			Sum = 100.000	Sum= 18.141

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.07	0.014	(1.017)	0.013	0.001
2	0.17	0.07	0.014	(1.014)	0.013	0.001
3	0.25	0.07	0.014	(1.010)	0.013	0.001
4	0.33	0.10	0.022	(1.006)	0.019	0.002
5	0.42	0.10	0.022	(1.002)	0.019	0.002
6	0.50	0.10	0.022	(0.998)	0.019	0.002
7	0.58	0.10	0.022	(0.994)	0.019	0.002
8	0.67	0.10	0.022	(0.990)	0.019	0.002
9	0.75	0.10	0.022	(0.986)	0.019	0.002
10	0.83	0.13	0.029	(0.982)	0.026	0.003
11	0.92	0.13	0.029	(0.978)	0.026	0.003
12	1.00	0.13	0.029	(0.975)	0.026	0.003
13	1.08	0.10	0.022	(0.971)	0.019	0.002
14	1.17	0.10	0.022	(0.967)	0.019	0.002
15	1.25	0.10	0.022	(0.963)	0.019	0.002
16	1.33	0.10	0.022	(0.959)	0.019	0.002
17	1.42	0.10	0.022	(0.955)	0.019	0.002
18	1.50	0.10	0.022	(0.952)	0.019	0.002
19	1.58	0.10	0.022	(0.948)	0.019	0.002
20	1.67	0.10	0.022	(0.944)	0.019	0.002
21	1.75	0.10	0.022	(0.940)	0.019	0.002
22	1.83	0.13	0.029	(0.936)	0.026	0.003
23	1.92	0.13	0.029	(0.933)	0.026	0.003
24	2.00	0.13	0.029	(0.929)	0.026	0.003
25	2.08	0.13	0.029	(0.925)	0.026	0.003
26	2.17	0.13	0.029	(0.921)	0.026	0.003
27	2.25	0.13	0.029	(0.918)	0.026	0.003
28	2.33	0.13	0.029	(0.914)	0.026	0.003
29	2.42	0.13	0.029	(0.910)	0.026	0.003
30	2.50	0.13	0.029	(0.906)	0.026	0.003
31	2.58	0.17	0.036	(0.903)	0.032	0.004
32	2.67	0.17	0.036	(0.899)	0.032	0.004
33	2.75	0.17	0.036	(0.895)	0.032	0.004
34	2.83	0.17	0.036	(0.892)	0.032	0.004
35	2.92	0.17	0.036	(0.888)	0.032	0.004
36	3.00	0.17	0.036	(0.884)	0.032	0.004
37	3.08	0.17	0.036	(0.881)	0.032	0.004
38	3.17	0.17	0.036	(0.877)	0.032	0.004
39	3.25	0.17	0.036	(0.873)	0.032	0.004
40	3.33	0.17	0.036	(0.870)	0.032	0.004
41	3.42	0.17	0.036	(0.866)	0.032	0.004
42	3.50	0.17	0.036	(0.862)	0.032	0.004
43	3.58	0.17	0.036	(0.859)	0.032	0.004
44	3.67	0.17	0.036	(0.855)	0.032	0.004
45	3.75	0.17	0.036	(0.852)	0.032	0.004
46	3.83	0.20	0.043	(0.848)	0.039	0.004
47	3.92	0.20	0.043	(0.844)	0.039	0.004
48	4.00	0.20	0.043	(0.841)	0.039	0.004
49	4.08	0.20	0.043	(0.837)	0.039	0.004
50	4.17	0.20	0.043	(0.834)	0.039	0.004
51	4.25	0.20	0.043	(0.830)	0.039	0.004
52	4.33	0.23	0.050	(0.827)	0.045	0.005
53	4.42	0.23	0.050	(0.823)	0.045	0.005
54	4.50	0.23	0.050	(0.820)	0.045	0.005
55	4.58	0.23	0.050	(0.816)	0.045	0.005
56	4.67	0.23	0.050	(0.813)	0.045	0.005
57	4.75	0.23	0.050	(0.809)	0.045	0.005
58	4.83	0.27	0.058	(0.806)	0.052	0.006
59	4.92	0.27	0.058	(0.802)	0.052	0.006
60	5.00	0.27	0.058	(0.799)	0.052	0.006
61	5.08	0.20	0.043	(0.795)	0.039	0.004
62	5.17	0.20	0.043	(0.792)	0.039	0.004
63	5.25	0.20	0.043	(0.788)	0.039	0.004
64	5.33	0.23	0.050	(0.785)	0.045	0.005
65	5.42	0.23	0.050	(0.781)	0.045	0.005
66	5.50	0.23	0.050	(0.778)	0.045	0.005
67	5.58	0.27	0.058	(0.775)	0.052	0.006
68	5.67	0.27	0.058	(0.771)	0.052	0.006
69	5.75	0.27	0.058	(0.768)	0.052	0.006

70	5.83	0.27	0.058	(0.764)	0.052	0.006
71	5.92	0.27	0.058	(0.761)	0.052	0.006
72	6.00	0.27	0.058	(0.758)	0.052	0.006
73	6.08	0.30	0.065	(0.754)	0.058	0.006
74	6.17	0.30	0.065	(0.751)	0.058	0.006
75	6.25	0.30	0.065	(0.748)	0.058	0.006
76	6.33	0.30	0.065	(0.744)	0.058	0.006
77	6.42	0.30	0.065	(0.741)	0.058	0.006
78	6.50	0.30	0.065	(0.738)	0.058	0.006
79	6.58	0.33	0.072	(0.734)	0.065	0.007
80	6.67	0.33	0.072	(0.731)	0.065	0.007
81	6.75	0.33	0.072	(0.728)	0.065	0.007
82	6.83	0.33	0.072	(0.724)	0.065	0.007
83	6.92	0.33	0.072	(0.721)	0.065	0.007
84	7.00	0.33	0.072	(0.718)	0.065	0.007
85	7.08	0.33	0.072	(0.715)	0.065	0.007
86	7.17	0.33	0.072	(0.711)	0.065	0.007
87	7.25	0.33	0.072	(0.708)	0.065	0.007
88	7.33	0.37	0.079	(0.705)	0.071	0.008
89	7.42	0.37	0.079	(0.702)	0.071	0.008
90	7.50	0.37	0.079	(0.698)	0.071	0.008
91	7.58	0.40	0.086	(0.695)	0.078	0.009
92	7.67	0.40	0.086	(0.692)	0.078	0.009
93	7.75	0.40	0.086	(0.689)	0.078	0.009
94	7.83	0.43	0.094	(0.686)	0.084	0.009
95	7.92	0.43	0.094	(0.682)	0.084	0.009
96	8.00	0.43	0.094	(0.679)	0.084	0.009
97	8.08	0.50	0.108	(0.676)	0.097	0.011
98	8.17	0.50	0.108	(0.673)	0.097	0.011
99	8.25	0.50	0.108	(0.670)	0.097	0.011
100	8.33	0.50	0.108	(0.667)	0.097	0.011
101	8.42	0.50	0.108	(0.664)	0.097	0.011
102	8.50	0.50	0.108	(0.660)	0.097	0.011
103	8.58	0.53	0.115	(0.657)	0.104	0.012
104	8.67	0.53	0.115	(0.654)	0.104	0.012
105	8.75	0.53	0.115	(0.651)	0.104	0.012
106	8.83	0.57	0.122	(0.648)	0.110	0.012
107	8.92	0.57	0.122	(0.645)	0.110	0.012
108	9.00	0.57	0.122	(0.642)	0.110	0.012
109	9.08	0.63	0.137	(0.639)	0.123	0.014
110	9.17	0.63	0.137	(0.636)	0.123	0.014
111	9.25	0.63	0.137	(0.633)	0.123	0.014
112	9.33	0.67	0.144	(0.630)	0.130	0.014
113	9.42	0.67	0.144	(0.627)	0.130	0.014
114	9.50	0.67	0.144	(0.624)	0.130	0.014
115	9.58	0.70	0.151	(0.621)	0.136	0.015
116	9.67	0.70	0.151	(0.618)	0.136	0.015
117	9.75	0.70	0.151	(0.615)	0.136	0.015
118	9.83	0.73	0.158	(0.612)	0.143	0.016
119	9.92	0.73	0.158	(0.609)	0.143	0.016
120	10.00	0.73	0.158	(0.606)	0.143	0.016
121	10.08	0.50	0.108	(0.603)	0.097	0.011
122	10.17	0.50	0.108	(0.600)	0.097	0.011
123	10.25	0.50	0.108	(0.597)	0.097	0.011
124	10.33	0.50	0.108	(0.594)	0.097	0.011
125	10.42	0.50	0.108	(0.592)	0.097	0.011
126	10.50	0.50	0.108	(0.589)	0.097	0.011
127	10.58	0.67	0.144	(0.586)	0.130	0.014
128	10.67	0.67	0.144	(0.583)	0.130	0.014
129	10.75	0.67	0.144	(0.580)	0.130	0.014
130	10.83	0.67	0.144	(0.577)	0.130	0.014
131	10.92	0.67	0.144	(0.574)	0.130	0.014
132	11.00	0.67	0.144	(0.572)	0.130	0.014
133	11.08	0.63	0.137	(0.569)	0.123	0.014
134	11.17	0.63	0.137	(0.566)	0.123	0.014
135	11.25	0.63	0.137	(0.563)	0.123	0.014
136	11.33	0.63	0.137	(0.560)	0.123	0.014
137	11.42	0.63	0.137	(0.558)	0.123	0.014
138	11.50	0.63	0.137	(0.555)	0.123	0.014
139	11.58	0.57	0.122	(0.552)	0.110	0.012
140	11.67	0.57	0.122	(0.549)	0.110	0.012
141	11.75	0.57	0.122	(0.547)	0.110	0.012
142	11.83	0.60	0.130	(0.544)	0.117	0.013
143	11.92	0.60	0.130	(0.541)	0.117	0.013
144	12.00	0.60	0.130	(0.538)	0.117	0.013
145	12.08	0.83	0.180	(0.536)	0.162	0.018
146	12.17	0.83	0.180	(0.533)	0.162	0.018
147	12.25	0.83	0.180	(0.530)	0.162	0.018
148	12.33	0.87	0.187	(0.528)	0.168	0.019
149	12.42	0.87	0.187	(0.525)	0.168	0.019
150	12.50	0.87	0.187	(0.522)	0.168	0.019
151	12.58	0.93	0.202	(0.520)	0.181	0.020
152	12.67	0.93	0.202	(0.517)	0.181	0.020
153	12.75	0.93	0.202	(0.515)	0.181	0.020
154	12.83	0.97	0.209	(0.512)	0.188	0.021
155	12.92	0.97	0.209	(0.509)	0.188	0.021

156	13.00	0.97	0.209	(0.507)	0.188	0.021
157	13.08	1.13	0.245	(0.504)	0.220	0.024
158	13.17	1.13	0.245	(0.502)	0.220	0.024
159	13.25	1.13	0.245	(0.499)	0.220	0.024
160	13.33	1.13	0.245	(0.497)	0.220	0.024
161	13.42	1.13	0.245	(0.494)	0.220	0.024
162	13.50	1.13	0.245	(0.492)	0.220	0.024
163	13.58	0.77	0.166	(0.489)	0.149	0.017
164	13.67	0.77	0.166	(0.487)	0.149	0.017
165	13.75	0.77	0.166	(0.484)	0.149	0.017
166	13.83	0.77	0.166	(0.482)	0.149	0.017
167	13.92	0.77	0.166	(0.479)	0.149	0.017
168	14.00	0.77	0.166	(0.477)	0.149	0.017
169	14.08	0.90	0.194	(0.474)	0.175	0.019
170	14.17	0.90	0.194	(0.472)	0.175	0.019
171	14.25	0.90	0.194	(0.469)	0.175	0.019
172	14.33	0.87	0.187	(0.467)	0.168	0.019
173	14.42	0.87	0.187	(0.465)	0.168	0.019
174	14.50	0.87	0.187	(0.462)	0.168	0.019
175	14.58	0.87	0.187	(0.460)	0.168	0.019
176	14.67	0.87	0.187	(0.458)	0.168	0.019
177	14.75	0.87	0.187	(0.455)	0.168	0.019
178	14.83	0.83	0.180	(0.453)	0.162	0.018
179	14.92	0.83	0.180	(0.451)	0.162	0.018
180	15.00	0.83	0.180	(0.448)	0.162	0.018
181	15.08	0.80	0.173	(0.446)	0.156	0.017
182	15.17	0.80	0.173	(0.444)	0.156	0.017
183	15.25	0.80	0.173	(0.441)	0.156	0.017
184	15.33	0.77	0.166	(0.439)	0.149	0.017
185	15.42	0.77	0.166	(0.437)	0.149	0.017
186	15.50	0.77	0.166	(0.435)	0.149	0.017
187	15.58	0.63	0.137	(0.432)	0.123	0.014
188	15.67	0.63	0.137	(0.430)	0.123	0.014
189	15.75	0.63	0.137	(0.428)	0.123	0.014
190	15.83	0.63	0.137	(0.426)	0.123	0.014
191	15.92	0.63	0.137	(0.424)	0.123	0.014
192	16.00	0.63	0.137	(0.421)	0.123	0.014
193	16.08	0.13	0.029	(0.419)	0.026	0.003
194	16.17	0.13	0.029	(0.417)	0.026	0.003
195	16.25	0.13	0.029	(0.415)	0.026	0.003
196	16.33	0.13	0.029	(0.413)	0.026	0.003
197	16.42	0.13	0.029	(0.411)	0.026	0.003
198	16.50	0.13	0.029	(0.409)	0.026	0.003
199	16.58	0.10	0.022	(0.407)	0.019	0.002
200	16.67	0.10	0.022	(0.405)	0.019	0.002
201	16.75	0.10	0.022	(0.403)	0.019	0.002
202	16.83	0.10	0.022	(0.401)	0.019	0.002
203	16.92	0.10	0.022	(0.398)	0.019	0.002
204	17.00	0.10	0.022	(0.396)	0.019	0.002
205	17.08	0.17	0.036	(0.394)	0.032	0.004
206	17.17	0.17	0.036	(0.392)	0.032	0.004
207	17.25	0.17	0.036	(0.390)	0.032	0.004
208	17.33	0.17	0.036	(0.389)	0.032	0.004
209	17.42	0.17	0.036	(0.387)	0.032	0.004
210	17.50	0.17	0.036	(0.385)	0.032	0.004
211	17.58	0.17	0.036	(0.383)	0.032	0.004
212	17.67	0.17	0.036	(0.381)	0.032	0.004
213	17.75	0.17	0.036	(0.379)	0.032	0.004
214	17.83	0.13	0.029	(0.377)	0.026	0.003
215	17.92	0.13	0.029	(0.375)	0.026	0.003
216	18.00	0.13	0.029	(0.373)	0.026	0.003
217	18.08	0.13	0.029	(0.371)	0.026	0.003
218	18.17	0.13	0.029	(0.370)	0.026	0.003
219	18.25	0.13	0.029	(0.368)	0.026	0.003
220	18.33	0.13	0.029	(0.366)	0.026	0.003
221	18.42	0.13	0.029	(0.364)	0.026	0.003
222	18.50	0.13	0.029	(0.363)	0.026	0.003
223	18.58	0.10	0.022	(0.361)	0.019	0.002
224	18.67	0.10	0.022	(0.359)	0.019	0.002
225	18.75	0.10	0.022	(0.357)	0.019	0.002
226	18.83	0.07	0.014	(0.356)	0.013	0.001
227	18.92	0.07	0.014	(0.354)	0.013	0.001
228	19.00	0.07	0.014	(0.352)	0.013	0.001
229	19.08	0.10	0.022	(0.351)	0.019	0.002
230	19.17	0.10	0.022	(0.349)	0.019	0.002
231	19.25	0.10	0.022	(0.347)	0.019	0.002
232	19.33	0.13	0.029	(0.346)	0.026	0.003
233	19.42	0.13	0.029	(0.344)	0.026	0.003
234	19.50	0.13	0.029	(0.342)	0.026	0.003
235	19.58	0.10	0.022	(0.341)	0.019	0.002
236	19.67	0.10	0.022	(0.339)	0.019	0.002
237	19.75	0.10	0.022	(0.338)	0.019	0.002
238	19.83	0.07	0.014	(0.336)	0.013	0.001
239	19.92	0.07	0.014	(0.335)	0.013	0.001
240	20.00	0.07	0.014	(0.333)	0.013	0.001
241	20.08	0.10	0.022	(0.332)	0.019	0.002

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242  20.17     0.10      0.022       (  0.330)       0.019        0.002
243  20.25     0.10      0.022       (  0.329)       0.019        0.002
244  20.33     0.10      0.022       (  0.328)       0.019        0.002
245  20.42     0.10      0.022       (  0.326)       0.019        0.002
246  20.50     0.10      0.022       (  0.325)       0.019        0.002
247  20.58     0.10      0.022       (  0.323)       0.019        0.002
248  20.67     0.10      0.022       (  0.322)       0.019        0.002
249  20.75     0.10      0.022       (  0.321)       0.019        0.002
250  20.83     0.07      0.014       (  0.319)       0.013        0.001
251  20.92     0.07      0.014       (  0.318)       0.013        0.001
252  21.00     0.07      0.014       (  0.317)       0.013        0.001
253  21.08     0.10      0.022       (  0.316)       0.019        0.002
254  21.17     0.10      0.022       (  0.314)       0.019        0.002
255  21.25     0.10      0.022       (  0.313)       0.019        0.002
256  21.33     0.07      0.014       (  0.312)       0.013        0.001
257  21.42     0.07      0.014       (  0.311)       0.013        0.001
258  21.50     0.07      0.014       (  0.310)       0.013        0.001
259  21.58     0.10      0.022       (  0.308)       0.019        0.002
260  21.67     0.10      0.022       (  0.307)       0.019        0.002
261  21.75     0.10      0.022       (  0.306)       0.019        0.002
262  21.83     0.07      0.014       (  0.305)       0.013        0.001
263  21.92     0.07      0.014       (  0.304)       0.013        0.001
264  22.00     0.07      0.014       (  0.303)       0.013        0.001
265  22.08     0.10      0.022       (  0.302)       0.019        0.002
266  22.17     0.10      0.022       (  0.301)       0.019        0.002
267  22.25     0.10      0.022       (  0.300)       0.019        0.002
268  22.33     0.07      0.014       (  0.299)       0.013        0.001
269  22.42     0.07      0.014       (  0.298)       0.013        0.001
270  22.50     0.07      0.014       (  0.297)       0.013        0.001
271  22.58     0.07      0.014       (  0.297)       0.013        0.001
272  22.67     0.07      0.014       (  0.296)       0.013        0.001
273  22.75     0.07      0.014       (  0.295)       0.013        0.001
274  22.83     0.07      0.014       (  0.294)       0.013        0.001
275  22.92     0.07      0.014       (  0.293)       0.013        0.001
276  23.00     0.07      0.014       (  0.293)       0.013        0.001
277  23.08     0.07      0.014       (  0.292)       0.013        0.001
278  23.17     0.07      0.014       (  0.291)       0.013        0.001
279  23.25     0.07      0.014       (  0.291)       0.013        0.001
280  23.33     0.07      0.014       (  0.290)       0.013        0.001
281  23.42     0.07      0.014       (  0.290)       0.013        0.001
282  23.50     0.07      0.014       (  0.289)       0.013        0.001
283  23.58     0.07      0.014       (  0.289)       0.013        0.001
284  23.67     0.07      0.014       (  0.288)       0.013        0.001
285  23.75     0.07      0.014       (  0.288)       0.013        0.001
286  23.83     0.07      0.014       (  0.287)       0.013        0.001
287  23.92     0.07      0.014       (  0.287)       0.013        0.001
288  24.00     0.07      0.014       (  0.287)       0.013        0.001
               (Loss Rate Not Used)
    Sum =     100.0                                  Sum =     2.2
      Flood volume = Effective rainfall      0.18(In)
       times area      18.0(Ac.)/[(In)/(Ft.)] =       0.3(Ac.Ft)
      Total soil loss =      1.62(In)
      Total soil loss =     2.430(Ac.Ft)
      Total rainfall =      1.80(In)
      Flood volume =       11760.8 Cubic Feet
      Total soil loss =      105847.1 Cubic Feet
      ---------------------------------------------------------------------
       Peak flow rate of this hydrograph =      0.443(CFS)
      ---------------------------------------------------------------------
      +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                        24 - H O U R    S T O R M
                     R u n o f f      H y d r o g r a p h
      ---------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals ((CFS))

      ---------------------------------------------------------------------
 Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
 ---------------------------------------------------------------------------
   0+ 5       0.0000      0.01  Q          |         |         |         |
   0+10       0.0002      0.02  Q          |         |         |         |
   0+15       0.0003      0.02  Q          |         |         |         |
   0+20       0.0005      0.03  Q          |         |         |         |
   0+25       0.0008      0.03  Q          |         |         |         |
   0+30       0.0010      0.04  Q          |         |         |         |
   0+35       0.0013      0.04  Q          |         |         |         |
   0+40       0.0015      0.04  Q          |         |         |         |
   0+45       0.0018      0.04  Q          |         |         |         |
   0+50       0.0021      0.04  Q          |         |         |         |
   0+55       0.0024      0.05  Q          |         |         |         |
   1+ 0       0.0028      0.05  Q          |         |         |         |
   1+ 5       0.0031      0.05  Q          |         |         |         |
   1+10       0.0034      0.04  Q          |         |         |         |
   1+15       0.0037      0.04  Q          |         |         |         |
   1+20       0.0040      0.04  Q          |         |         |         |
   1+25       0.0042      0.04  Q          |         |         |         |
   1+30       0.0045      0.04  Q          |         |         |         |
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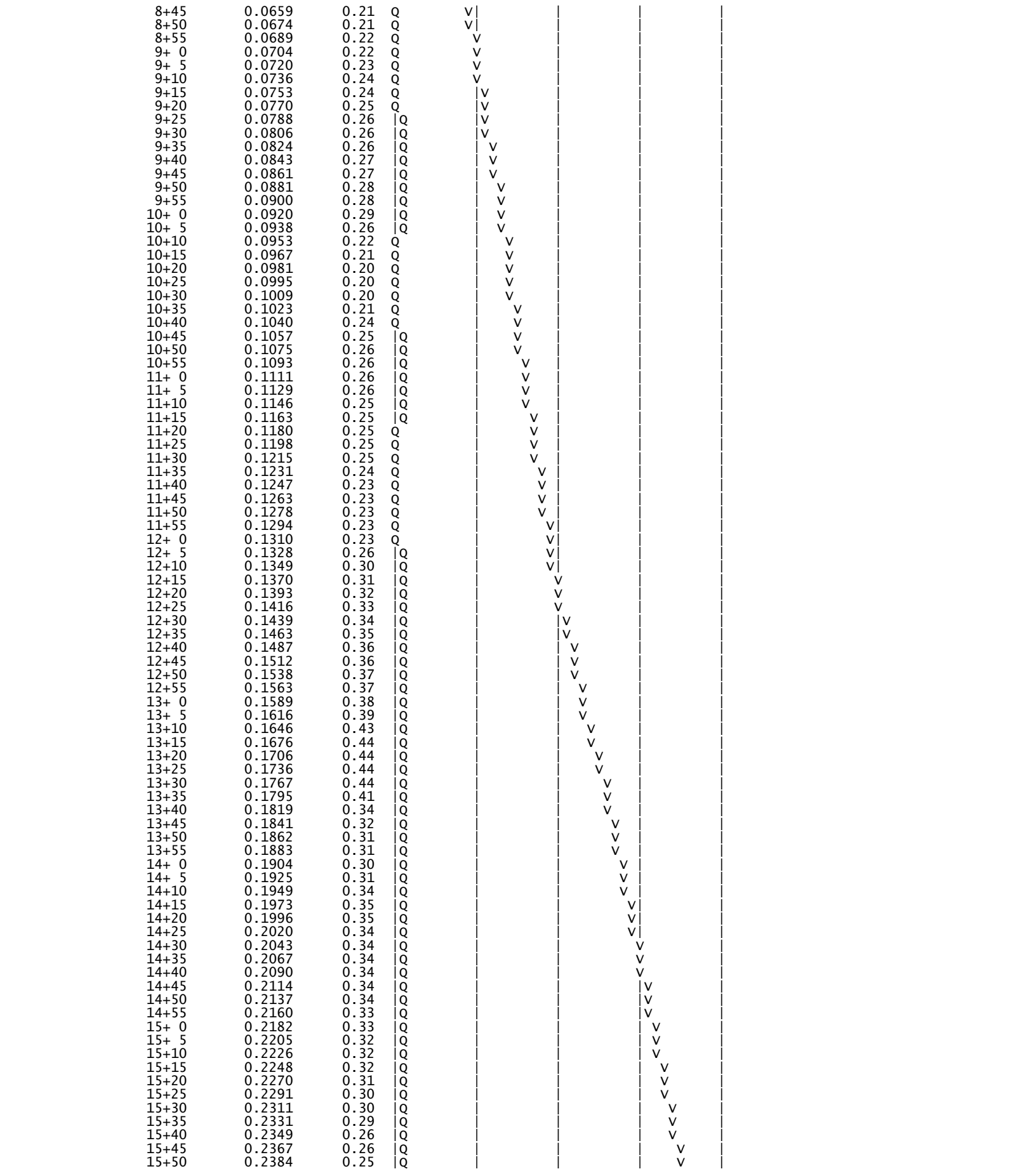
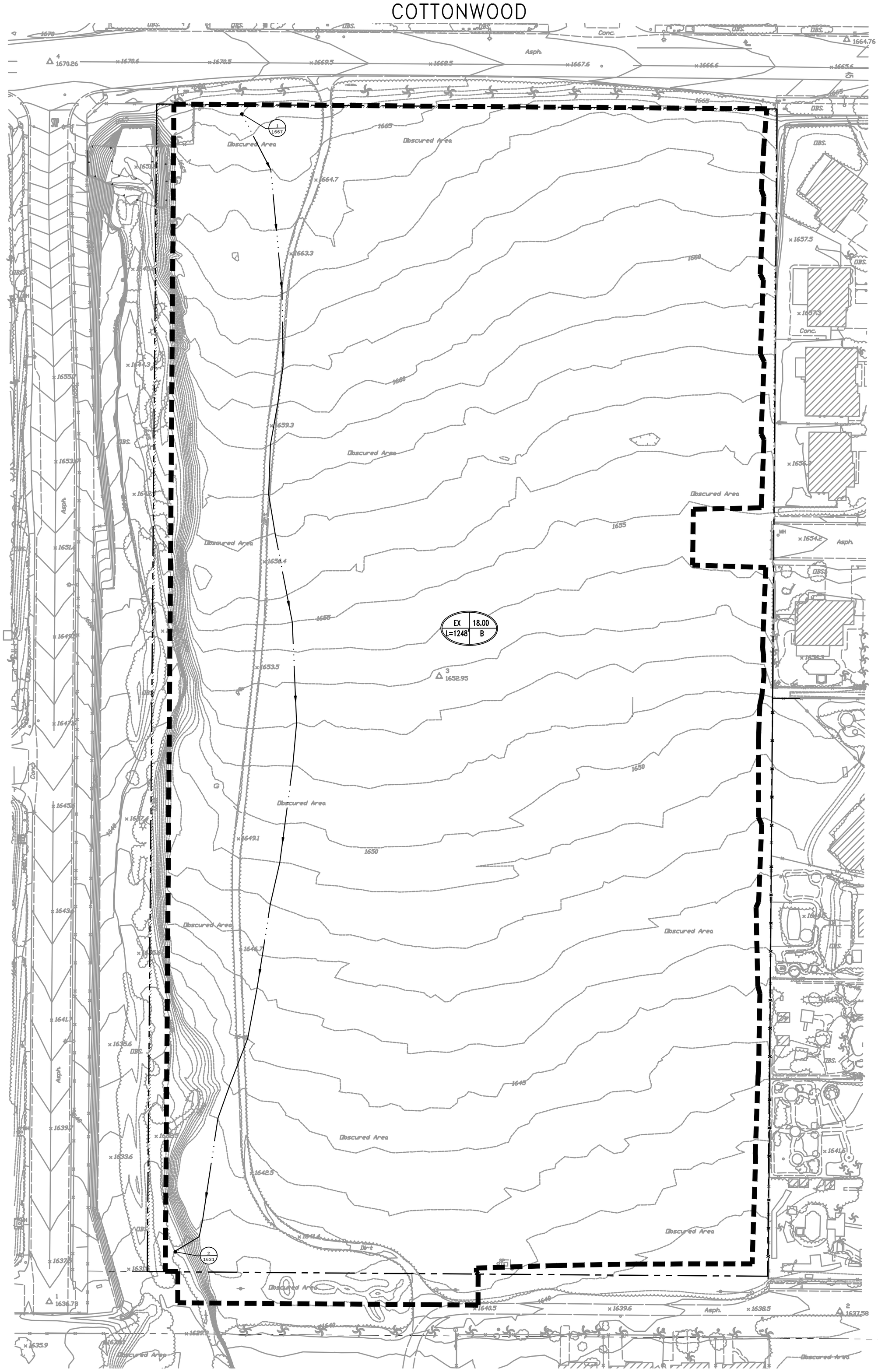
1+35	0.0048	0.04	Q	|	|	|	|
1+40	0.0051	0.04	Q	|	|	|	|
1+45	0.0053	0.04	Q	|	|	|	|
1+50	0.0056	0.04	Q	|	|	|	|
1+55	0.0060	0.05	Q	|	|	|	|
2+ 0	0.0063	0.05	Q	|	|	|	|
2+ 5	0.0067	0.05	Q	|	|	|	|
2+10	0.0070	0.05	QV	|	|	|	|
2+15	0.0074	0.05	QV	|	|	|	|
2+20	0.0077	0.05	QV	|	|	|	|
2+25	0.0081	0.05	QV	|	|	|	|
2+30	0.0084	0.05	QV	|	|	|	|
2+35	0.0088	0.06	QV	|	|	|	|
2+40	0.0093	0.06	QV	|	|	|	|
2+45	0.0097	0.06	QV	|	|	|	|
2+50	0.0101	0.06	QV	|	|	|	|
2+55	0.0106	0.06	QV	|	|	|	|
3+ 0	0.0110	0.07	QV	|	|	|	|
3+ 5	0.0115	0.07	QV	|	|	|	|
3+10	0.0119	0.07	QV	|	|	|	|
3+15	0.0124	0.07	QV	|	|	|	|
3+20	0.0128	0.07	QV	|	|	|	|
3+25	0.0133	0.07	QV	|	|	|	|
3+30	0.0137	0.07	Q V	|	|	|	|
3+35	0.0142	0.07	Q V	|	|	|	|
3+40	0.0146	0.07	Q V	|	|	|	|
3+45	0.0151	0.07	Q V	|	|	|	|
3+50	0.0156	0.07	Q V	|	|	|	|
3+55	0.0161	0.07	Q V	|	|	|	|
4+ 0	0.0166	0.08	Q V	|	|	|	|
4+ 5	0.0171	0.08	Q V	|	|	|	|
4+10	0.0177	0.08	Q V	|	|	|	|
4+15	0.0182	0.08	Q V	|	|	|	|
4+20	0.0188	0.08	Q V	|	|	|	|
4+25	0.0194	0.09	Q V	|	|	|	|
4+30	0.0200	0.09	Q V	|	|	|	|
4+35	0.0206	0.09	Q V	|	|	|	|
4+40	0.0212	0.09	Q V	|	|	|	|
4+45	0.0219	0.09	Q V	|	|	|	|
4+50	0.0225	0.09	Q V	|	|	|	|
4+55	0.0232	0.10	Q V	|	|	|	|
5+ 0	0.0239	0.10	Q V	|	|	|	|
5+ 5	0.0246	0.10	Q V	|	|	|	|
5+10	0.0252	0.08	Q V	|	|	|	|
5+15	0.0257	0.08	Q V	|	|	|	|
5+20	0.0263	0.08	Q V	|	|	|	|
5+25	0.0269	0.09	Q V	|	|	|	|
5+30	0.0276	0.09	Q V	|	|	|	|
5+35	0.0282	0.09	Q V	|	|	|	|
5+40	0.0289	0.10	Q V	|	|	|	|
5+45	0.0296	0.10	Q V	|	|	|	|
5+50	0.0303	0.10	Q V	|	|	|	|
5+55	0.0310	0.10	Q V	|	|	|	|
6+ 0	0.0317	0.10	Q V	|	|	|	|
6+ 5	0.0325	0.11	Q V	|	|	|	|
6+10	0.0333	0.11	Q V	|	|	|	|
6+15	0.0341	0.12	Q V	|	|	|	|
6+20	0.0349	0.12	Q V	|	|	|	|
6+25	0.0357	0.12	Q V	|	|	|	|
6+30	0.0365	0.12	Q V	|	|	|	|
6+35	0.0373	0.12	Q V	|	|	|	|
6+40	0.0382	0.13	Q V	|	|	|	|
6+45	0.0391	0.13	Q V	|	|	|	|
6+50	0.0400	0.13	Q V	|	|	|	|
6+55	0.0409	0.13	Q V	|	|	|	|
7+ 0	0.0418	0.13	Q V	|	|	|	|
7+ 5	0.0427	0.13	Q V	|	|	|	|
7+10	0.0436	0.13	Q V	|	|	|	|
7+15	0.0445	0.13	Q V	|	|	|	|
7+20	0.0454	0.13	Q V	|	|	|	|
7+25	0.0464	0.14	Q V	|	|	|	|
7+30	0.0473	0.14	Q V	|	|	|	|
7+35	0.0483	0.15	Q V	|	|	|	|
7+40	0.0494	0.15	Q V	|	|	|	|
7+45	0.0505	0.15	Q V	|	|	|	|
7+50	0.0516	0.16	Q V	|	|	|	|
7+55	0.0527	0.17	Q V	|	|	|	|
8+ 0	0.0539	0.17	Q V	|	|	|	|
8+ 5	0.0551	0.18	Q V	|	|	|	|
8+10	0.0564	0.19	Q V	|	|	|	|
8+15	0.0577	0.19	Q V	|	|	|	|
8+20	0.0590	0.19	Q V	|	|	|	|
8+25	0.0604	0.20	Q V	|	|	|	|
8+30	0.0617	0.20	Q V	|	|	|	|
8+35	0.0631	0.20	Q V	|	|	|	|
8+40	0.0645	0.21	Q V	|	|	|	|


8+45 0.0659 0.21
8+50 0.0674 0.21
8+55 0.0689 0.22
9+ 0 0.0704 0.22
9+ 5 0.0720 0.23
9+10 0.0736 0.24
9+15 0.0753 0.24
9+20 0.0770 0.25
9+25 0.0788 0.26
9+30 0.0806 0.26
9+35 0.0824 0.26
9+40 0.0843 0.27
9+45 0.0861 0.27
9+50 0.0881 0.28
9+55 0.0900 0.28
10+ 0 0.0920 0.29
10+ 5 0.0938 0.26
10+10 0.0953 0.22
10+15 0.0967 0.21
10+20 0.0981 0.20
10+25 0.0995 0.20
10+30 0.1009 0.20
10+35 0.1023 0.21
10+40 0.1040 0.24
10+45 0.1057 0.25
10+50 0.1075 0.26
10+55 0.1093 0.26
11+ 0 0.1111 0.26
11+ 5 0.1129 0.26
11+10 0.1146 0.25
11+15 0.1163 0.25
11+20 0.1180 0.25
11+25 0.1198 0.25
11+30 0.1215 0.25
11+35 0.1231 0.24
11+40 0.1247 0.23
11+45 0.1263 0.23
11+50 0.1278 0.23
11+55 0.1294 0.23
12+ 0 0.1310 0.23
12+ 5 0.1328 0.26
12+10 0.1349 0.30
12+15 0.1370 0.31
12+20 0.1393 0.32
12+25 0.1416 0.33
12+30 0.1439 0.34
12+35 0.1463 0.35
12+40 0.1487 0.36
12+45 0.1512 0.36
12+50 0.1538 0.37
12+55 0.1563 0.37
13+ 0 0.1589 0.38
13+ 5 0.1616 0.39
13+10 0.1646 0.43
13+15 0.1676 0.44
13+20 0.1706 0.44
13+25 0.1736 0.44
13+30 0.1767 0.44
13+35 0.1795 0.41
13+40 0.1819 0.34
13+45 0.1841 0.32
13+50 0.1862 0.31
13+55 0.1883 0.31
14+ 0 0.1904 0.30
14+ 5 0.1925 0.31
14+10 0.1949 0.34
14+15 0.1973 0.35
14+20 0.1996 0.35
14+25 0.2020 0.34
14+30 0.2043 0.34
14+35 0.2067 0.34
14+40 0.2090 0.34
14+45 0.2114 0.34
14+50 0.2137 0.34
14+55 0.2160 0.33
15+ 0 0.2182 0.33
15+ 5 0.2205 0.32
15+10 0.2226 0.32
15+15 0.2248 0.32
15+20 0.2270 0.31
15+25 0.2291 0.30
15+30 0.2311 0.30
15+35 0.2331 0.29
15+40 0.2349 0.26
15+45 0.2367 0.26
15+50 0.2384 0.25

```
15+55    0.2402    0.25  |Q      |       |       |    V    |
16+ 0    0.2419    0.25  Q       |       |       |    V    |
16+ 5    0.2433    0.20  Q       |       |       |     V   |
16+10    0.2440    0.10  Q       |       |       |     V   |
16+15    0.2445    0.08  Q       |       |       |     V   |
16+20    0.2450    0.07  Q       |       |       |     V   |
16+25    0.2454    0.06  Q       |       |       |     V   |
16+30    0.2458    0.06  Q       |       |       |     V   |
16+35    0.2461    0.05  Q       |       |       |     V   |
16+40    0.2464    0.04  Q       |       |       |     V   |
16+45    0.2467    0.04  Q       |       |       |     V   |
16+50    0.2470    0.04  Q       |       |       |     V   |
16+55    0.2472    0.04  Q       |       |       |     V   |
17+ 0    0.2475    0.04  Q       |       |       |     V   |
17+ 5    0.2478    0.05  Q       |       |       |     V   |
17+10    0.2482    0.06  Q       |       |       |     V   |
17+15    0.2486    0.06  Q       |       |       |     V   |
17+20    0.2491    0.06  Q       |       |       |     V   |
17+25    0.2495    0.06  Q       |       |       |     V   |
17+30    0.2500    0.06  Q       |       |       |      V  |
17+35    0.2504    0.07  Q       |       |       |      V  |
17+40    0.2509    0.07  Q       |       |       |      V  |
17+45    0.2513    0.07  Q       |       |       |      V  |
17+50    0.2518    0.06  Q       |       |       |      V  |
17+55    0.2521    0.06  Q       |       |       |      V  |
18+ 0    0.2525    0.05  Q       |       |       |      V  |
18+ 5    0.2529    0.05  Q       |       |       |      V  |
18+10    0.2532    0.05  Q       |       |       |      V  |
18+15    0.2536    0.05  Q       |       |       |      V  |
18+20    0.2540    0.05  Q       |       |       |      V  |
18+25    0.2543    0.05  Q       |       |       |      V  |
18+30    0.2547    0.05  Q       |       |       |      V  |
18+35    0.2550    0.05  Q       |       |       |      V  |
18+40    0.2553    0.04  Q       |       |       |      V  |
18+45    0.2556    0.04  Q       |       |       |      V  |
18+50    0.2558    0.04  Q       |       |       |      V  |
18+55    0.2561    0.03  Q       |       |       |      V  |
19+ 0    0.2562    0.03  Q       |       |       |      V  |
19+ 5    0.2565    0.03  Q       |       |       |      V  |
19+10    0.2567    0.04  Q       |       |       |       V |
19+15    0.2570    0.04  Q       |       |       |       V |
19+20    0.2573    0.04  Q       |       |       |       V |
19+25    0.2576    0.05  Q       |       |       |       V |
19+30    0.2579    0.05  Q       |       |       |       V |
19+35    0.2583    0.05  Q       |       |       |       V |
19+40    0.2586    0.04  Q       |       |       |       V |
19+45    0.2588    0.04  Q       |       |       |       V |
19+50    0.2591    0.04  Q       |       |       |       V |
19+55    0.2593    0.03  Q       |       |       |       V |
20+ 0    0.2595    0.03  Q       |       |       |       V |
20+ 5    0.2597    0.03  Q       |       |       |       V |
20+10    0.2599    0.04  Q       |       |       |       V |
20+15    0.2602    0.04  Q       |       |       |       V |
20+20    0.2605    0.04  Q       |       |       |       V |
20+25    0.2607    0.04  Q       |       |       |       V |
20+30    0.2610    0.04  Q       |       |       |       V |
20+35    0.2613    0.04  Q       |       |       |       V |
20+40    0.2615    0.04  Q       |       |       |       V |
20+45    0.2618    0.04  Q       |       |       |       V |
20+50    0.2621    0.04  Q       |       |       |       V |
20+55    0.2623    0.03  Q       |       |       |       V |
21+ 0    0.2625    0.03  Q       |       |       |       V |
21+ 5    0.2627    0.03  Q       |       |       |       V |
21+10    0.2629    0.04  Q       |       |       |       V |
21+15    0.2632    0.04  Q       |       |       |       V |
21+20    0.2634    0.04  Q       |       |       |        V|
21+25    0.2636    0.03  Q       |       |       |        V|
21+30    0.2638    0.03  Q       |       |       |        V|
21+35    0.2640    0.03  Q       |       |       |        V|
21+40    0.2643    0.04  Q       |       |       |        V|
21+45    0.2645    0.04  Q       |       |       |        V|
21+50    0.2648    0.04  Q       |       |       |        V|
21+55    0.2650    0.03  Q       |       |       |        V|
22+ 0    0.2652    0.03  Q       |       |       |        V|
22+ 5    0.2654    0.03  Q       |       |       |        V|
22+10    0.2656    0.04  Q       |       |       |        V|
22+15    0.2659    0.04  Q       |       |       |        V|
22+20    0.2661    0.04  Q       |       |       |        V|
22+25    0.2663    0.03  Q       |       |       |        V|
22+30    0.2665    0.03  Q       |       |       |        V|
22+35    0.2667    0.03  Q       |       |       |        V|
22+40    0.2669    0.03  Q       |       |       |        V|
22+45    0.2671    0.03  Q       |       |       |        V|
22+50    0.2672    0.03  Q       |       |       |        V|
22+55    0.2674    0.03  Q       |       |       |        V|
23+ 0    0.2676    0.03  Q       |       |       |        V|
```

```
   23+ 5       0.2678      0.03  Q          |          |          |         v|
   23+10       0.2680      0.03  Q          |          |          |         v|
   23+15       0.2681      0.03  Q          |          |          |         v|
   23+20       0.2683      0.03  Q          |          |          |         v|
   23+25       0.2685      0.03  Q          |          |          |         v|
   23+30       0.2687      0.03  Q          |          |          |         v|
   23+35       0.2689      0.03  Q          |          |          |         v|
   23+40       0.2690      0.03  Q          |          |          |         v|
   23+45       0.2692      0.03  Q          |          |          |         v|
   23+50       0.2694      0.03  Q          |          |          |         v|
   23+55       0.2696      0.03  Q          |          |          |         v|
   24+ 0       0.2698      0.03  Q          |          |          |         v|
   24+ 5       0.2699      0.02  Q          |          |          |         v|
   24+10       0.2699      0.01  Q          |          |          |         v|
   24+15       0.2700      0.00  Q          |          |          |         v|
   24+20       0.2700      0.00  Q          |          |          |         v|
   24+25       0.2700      0.00  Q          |          |          |         v|
   24+30       0.2700      0.00  Q          |          |          |          v
-------------------------------------------------------------------------------
```

PRE DEVELOPMENT UNIT HYDROGRAPH MAP
COTTONWOOD



SCALE: 1" = 50'

POST DEVELOPMENT
UNIT HYDROGRAPH
COTTONWOOD

PREPARATION DATE: DECEMBER 2021
REVISION DATE: SEPTEMBER 2022
PLANS PREPARED BY:

adkan ENGINEERS
Civil Engineering • Surveying • Planning
6879 Airport Drive, Riverside, CA 92504
Tel:(951) 688-0241 • Fax:(951) 688-0599

PLOT DATE: 9/7/2022 1:12 PM

U:\PROJECTS\BEERS\10183\HYDROLOGY\PRE DEVELOPMENT UNIT HYDROGRAPH.DWG

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

Study date 09/07/22 File: PRO2242.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 5006

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

Drainage Area = 18.00(Ac.) = 0.028 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 18.00(Ac.) = 0.028 Sq. Mi.
Length along longest watercourse = 1689.00(Ft.)
Length along longest watercourse measured to centroid = 845.00(Ft.)
Length along longest watercourse = 0.320 Mi.
Length along longest watercourse measured to centroid = 0.160 Mi.
Difference in elevation = 34.50(Ft.)
Slope along watercourse = 107.8508 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time = 0.048 Hr.
Lag time = 2.87 Min.
25% of lag time = 0.72 Min.
40% of lag time = 1.15 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
18.00	1.80	32.40

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
18.00	4.50	81.00

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 1.800(In)
Area Averaged 100-Year Rainfall = 4.500(In)

Point rain (area averaged) = 1.800(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 1.800(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
18.000	56.00	0.500

Total Area Entered = 18.00(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	36.0	0.706	0.500	0.388	1.000	0.388
					Sum (F) =	0.388

Area averaged mean soil loss (F) (In/Hr) = 0.388
Minimum soil loss rate ((In/Hr)) = 0.194
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)	Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)

1	0.083	174.281	38.576	6.998
2	0.167	348.562	45.201	8.200
3	0.250	522.843	9.932	1.802
4	0.333	697.123	4.129	0.749
5	0.417	871.404	2.163	0.392
			Sum = 100.000 Sum=	18.141

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.07	0.014	(0.688)	0.007	0.007
2	0.17	0.07	0.014	(0.686)	0.007	0.007
3	0.25	0.07	0.014	(0.683)	0.007	0.007
4	0.33	0.10	0.022	(0.680)	0.011	0.011
5	0.42	0.10	0.022	(0.678)	0.011	0.011
6	0.50	0.10	0.022	(0.675)	0.011	0.011
7	0.58	0.10	0.022	(0.672)	0.011	0.011
8	0.67	0.10	0.022	(0.670)	0.011	0.011
9	0.75	0.10	0.022	(0.667)	0.011	0.011
10	0.83	0.13	0.029	(0.665)	0.014	0.014
11	0.92	0.13	0.029	(0.662)	0.014	0.014
12	1.00	0.13	0.029	(0.659)	0.014	0.014
13	1.08	0.10	0.022	(0.657)	0.011	0.011
14	1.17	0.10	0.022	(0.654)	0.011	0.011
15	1.25	0.10	0.022	(0.652)	0.011	0.011
16	1.33	0.10	0.022	(0.649)	0.011	0.011
17	1.42	0.10	0.022	(0.646)	0.011	0.011
18	1.50	0.10	0.022	(0.644)	0.011	0.011
19	1.58	0.10	0.022	(0.641)	0.011	0.011
20	1.67	0.10	0.022	(0.639)	0.011	0.011
21	1.75	0.10	0.022	(0.636)	0.011	0.011
22	1.83	0.13	0.029	(0.634)	0.014	0.014
23	1.92	0.13	0.029	(0.631)	0.014	0.014
24	2.00	0.13	0.029	(0.628)	0.014	0.014
25	2.08	0.13	0.029	(0.626)	0.014	0.014
26	2.17	0.13	0.029	(0.623)	0.014	0.014
27	2.25	0.13	0.029	(0.621)	0.014	0.014
28	2.33	0.13	0.029	(0.618)	0.014	0.014
29	2.42	0.13	0.029	(0.616)	0.014	0.014
30	2.50	0.13	0.029	(0.613)	0.014	0.014
31	2.58	0.17	0.036	(0.611)	0.018	0.018
32	2.67	0.17	0.036	(0.608)	0.018	0.018
33	2.75	0.17	0.036	(0.606)	0.018	0.018
34	2.83	0.17	0.036	(0.603)	0.018	0.018
35	2.92	0.17	0.036	(0.601)	0.018	0.018
36	3.00	0.17	0.036	(0.598)	0.018	0.018
37	3.08	0.17	0.036	(0.596)	0.018	0.018
38	3.17	0.17	0.036	(0.593)	0.018	0.018
39	3.25	0.17	0.036	(0.591)	0.018	0.018
40	3.33	0.17	0.036	(0.588)	0.018	0.018
41	3.42	0.17	0.036	(0.586)	0.018	0.018
42	3.50	0.17	0.036	(0.583)	0.018	0.018
43	3.58	0.17	0.036	(0.581)	0.018	0.018
44	3.67	0.17	0.036	(0.579)	0.018	0.018
45	3.75	0.17	0.036	(0.576)	0.018	0.018
46	3.83	0.20	0.043	(0.574)	0.022	0.022
47	3.92	0.20	0.043	(0.571)	0.022	0.022
48	4.00	0.20	0.043	(0.569)	0.022	0.022
49	4.08	0.20	0.043	(0.566)	0.022	0.022
50	4.17	0.20	0.043	(0.564)	0.022	0.022
51	4.25	0.20	0.043	(0.562)	0.022	0.022
52	4.33	0.23	0.050	(0.559)	0.025	0.025
53	4.42	0.23	0.050	(0.557)	0.025	0.025
54	4.50	0.23	0.050	(0.555)	0.025	0.025
55	4.58	0.23	0.050	(0.552)	0.025	0.025
56	4.67	0.23	0.050	(0.550)	0.025	0.025
57	4.75	0.23	0.050	(0.547)	0.025	0.025
58	4.83	0.27	0.058	(0.545)	0.029	0.029
59	4.92	0.27	0.058	(0.543)	0.029	0.029
60	5.00	0.27	0.058	(0.540)	0.029	0.029
61	5.08	0.20	0.043	(0.538)	0.022	0.022
62	5.17	0.20	0.043	(0.536)	0.022	0.022
63	5.25	0.20	0.043	(0.533)	0.022	0.022
64	5.33	0.23	0.050	(0.531)	0.025	0.025
65	5.42	0.23	0.050	(0.529)	0.025	0.025
66	5.50	0.23	0.050	(0.526)	0.025	0.025
67	5.58	0.27	0.058	(0.524)	0.029	0.029
68	5.67	0.27	0.058	(0.522)	0.029	0.029
69	5.75	0.27	0.058	(0.519)	0.029	0.029
70	5.83	0.27	0.058	(0.517)	0.029	0.029
71	5.92	0.27	0.058	(0.515)	0.029	0.029

72	6.00	0.27	0.058	(0.513)	0.029	0.029
73	6.08	0.30	0.065	(0.510)	0.032	0.032
74	6.17	0.30	0.065	(0.508)	0.032	0.032
75	6.25	0.30	0.065	(0.506)	0.032	0.032
76	6.33	0.30	0.065	(0.503)	0.032	0.032
77	6.42	0.30	0.065	(0.501)	0.032	0.032
78	6.50	0.30	0.065	(0.499)	0.032	0.032
79	6.58	0.33	0.072	(0.497)	0.036	0.036
80	6.67	0.33	0.072	(0.494)	0.036	0.036
81	6.75	0.33	0.072	(0.492)	0.036	0.036
82	6.83	0.33	0.072	(0.490)	0.036	0.036
83	6.92	0.33	0.072	(0.488)	0.036	0.036
84	7.00	0.33	0.072	(0.486)	0.036	0.036
85	7.08	0.33	0.072	(0.483)	0.036	0.036
86	7.17	0.33	0.072	(0.481)	0.036	0.036
87	7.25	0.33	0.072	(0.479)	0.036	0.036
88	7.33	0.37	0.079	(0.477)	0.040	0.040
89	7.42	0.37	0.079	(0.475)	0.040	0.040
90	7.50	0.37	0.079	(0.472)	0.040	0.040
91	7.58	0.40	0.086	(0.470)	0.043	0.043
92	7.67	0.40	0.086	(0.468)	0.043	0.043
93	7.75	0.40	0.086	(0.466)	0.043	0.043
94	7.83	0.43	0.094	(0.464)	0.047	0.047
95	7.92	0.43	0.094	(0.462)	0.047	0.047
96	8.00	0.43	0.094	(0.460)	0.047	0.047
97	8.08	0.50	0.108	(0.457)	0.054	0.054
98	8.17	0.50	0.108	(0.455)	0.054	0.054
99	8.25	0.50	0.108	(0.453)	0.054	0.054
100	8.33	0.50	0.108	(0.451)	0.054	0.054
101	8.42	0.50	0.108	(0.449)	0.054	0.054
102	8.50	0.50	0.108	(0.447)	0.054	0.054
103	8.58	0.53	0.115	(0.445)	0.058	0.058
104	8.67	0.53	0.115	(0.443)	0.058	0.058
105	8.75	0.53	0.115	(0.441)	0.058	0.058
106	8.83	0.57	0.122	(0.438)	0.061	0.061
107	8.92	0.57	0.122	(0.436)	0.061	0.061
108	9.00	0.57	0.122	(0.434)	0.061	0.061
109	9.08	0.63	0.137	(0.432)	0.068	0.068
110	9.17	0.63	0.137	(0.430)	0.068	0.068
111	9.25	0.63	0.137	(0.428)	0.068	0.068
112	9.33	0.67	0.144	(0.426)	0.072	0.072
113	9.42	0.67	0.144	(0.424)	0.072	0.072
114	9.50	0.67	0.144	(0.422)	0.072	0.072
115	9.58	0.70	0.151	(0.420)	0.076	0.076
116	9.67	0.70	0.151	(0.418)	0.076	0.076
117	9.75	0.70	0.151	(0.416)	0.076	0.076
118	9.83	0.73	0.158	(0.414)	0.079	0.079
119	9.92	0.73	0.158	(0.412)	0.079	0.079
120	10.00	0.73	0.158	(0.410)	0.079	0.079
121	10.08	0.50	0.108	(0.408)	0.054	0.054
122	10.17	0.50	0.108	(0.406)	0.054	0.054
123	10.25	0.50	0.108	(0.404)	0.054	0.054
124	10.33	0.50	0.108	(0.402)	0.054	0.054
125	10.42	0.50	0.108	(0.400)	0.054	0.054
126	10.50	0.50	0.108	(0.398)	0.054	0.054
127	10.58	0.67	0.144	(0.396)	0.072	0.072
128	10.67	0.67	0.144	(0.394)	0.072	0.072
129	10.75	0.67	0.144	(0.392)	0.072	0.072
130	10.83	0.67	0.144	(0.391)	0.072	0.072
131	10.92	0.67	0.144	(0.389)	0.072	0.072
132	11.00	0.67	0.144	(0.387)	0.072	0.072
133	11.08	0.63	0.137	(0.385)	0.068	0.068
134	11.17	0.63	0.137	(0.383)	0.068	0.068
135	11.25	0.63	0.137	(0.381)	0.068	0.068
136	11.33	0.63	0.137	(0.379)	0.068	0.068
137	11.42	0.63	0.137	(0.377)	0.068	0.068
138	11.50	0.63	0.137	(0.375)	0.068	0.068
139	11.58	0.57	0.122	(0.374)	0.061	0.061
140	11.67	0.57	0.122	(0.372)	0.061	0.061
141	11.75	0.57	0.122	(0.370)	0.061	0.061
142	11.83	0.60	0.130	(0.368)	0.065	0.065
143	11.92	0.60	0.130	(0.366)	0.065	0.065
144	12.00	0.60	0.130	(0.364)	0.065	0.065
145	12.08	0.83	0.180	(0.362)	0.090	0.090
146	12.17	0.83	0.180	(0.361)	0.090	0.090
147	12.25	0.83	0.180	(0.359)	0.090	0.090
148	12.33	0.87	0.187	(0.357)	0.094	0.094
149	12.42	0.87	0.187	(0.355)	0.094	0.094
150	12.50	0.87	0.187	(0.353)	0.094	0.094
151	12.58	0.93	0.202	(0.352)	0.101	0.101
152	12.67	0.93	0.202	(0.350)	0.101	0.101
153	12.75	0.93	0.202	(0.348)	0.101	0.101
154	12.83	0.97	0.209	(0.346)	0.104	0.104
155	12.92	0.97	0.209	(0.345)	0.104	0.104
156	13.00	0.97	0.209	(0.343)	0.104	0.104
157	13.08	1.13	0.245	(0.341)	0.122	0.122

158	13.17	1.13	0.245	(0.339)	0.122	0.122
159	13.25	1.13	0.245	(0.338)	0.122	0.122
160	13.33	1.13	0.245	(0.336)	0.122	0.122
161	13.42	1.13	0.245	(0.334)	0.122	0.122
162	13.50	1.13	0.245	(0.333)	0.122	0.122
163	13.58	0.77	0.166	(0.331)	0.083	0.083
164	13.67	0.77	0.166	(0.329)	0.083	0.083
165	13.75	0.77	0.166	(0.328)	0.083	0.083
166	13.83	0.77	0.166	(0.326)	0.083	0.083
167	13.92	0.77	0.166	(0.324)	0.083	0.083
168	14.00	0.77	0.166	(0.323)	0.083	0.083
169	14.08	0.90	0.194	(0.321)	0.097	0.097
170	14.17	0.90	0.194	(0.319)	0.097	0.097
171	14.25	0.90	0.194	(0.318)	0.097	0.097
172	14.33	0.87	0.187	(0.316)	0.094	0.094
173	14.42	0.87	0.187	(0.314)	0.094	0.094
174	14.50	0.87	0.187	(0.313)	0.094	0.094
175	14.58	0.87	0.187	(0.311)	0.094	0.094
176	14.67	0.87	0.187	(0.310)	0.094	0.094
177	14.75	0.87	0.187	(0.308)	0.094	0.094
178	14.83	0.83	0.180	(0.306)	0.090	0.090
179	14.92	0.83	0.180	(0.305)	0.090	0.090
180	15.00	0.83	0.180	(0.303)	0.090	0.090
181	15.08	0.80	0.173	(0.302)	0.086	0.086
182	15.17	0.80	0.173	(0.300)	0.086	0.086
183	15.25	0.80	0.173	(0.299)	0.086	0.086
184	15.33	0.77	0.166	(0.297)	0.083	0.083
185	15.42	0.77	0.166	(0.296)	0.083	0.083
186	15.50	0.77	0.166	(0.294)	0.083	0.083
187	15.58	0.63	0.137	(0.293)	0.068	0.068
188	15.67	0.63	0.137	(0.291)	0.068	0.068
189	15.75	0.63	0.137	(0.290)	0.068	0.068
190	15.83	0.63	0.137	(0.288)	0.068	0.068
191	15.92	0.63	0.137	(0.287)	0.068	0.068
192	16.00	0.63	0.137	(0.285)	0.068	0.068
193	16.08	0.13	0.029	(0.284)	0.014	0.014
194	16.17	0.13	0.029	(0.282)	0.014	0.014
195	16.25	0.13	0.029	(0.281)	0.014	0.014
196	16.33	0.13	0.029	(0.279)	0.014	0.014
197	16.42	0.13	0.029	(0.278)	0.014	0.014
198	16.50	0.13	0.029	(0.277)	0.014	0.014
199	16.58	0.10	0.022	(0.275)	0.011	0.011
200	16.67	0.10	0.022	(0.274)	0.011	0.011
201	16.75	0.10	0.022	(0.272)	0.011	0.011
202	16.83	0.10	0.022	(0.271)	0.011	0.011
203	16.92	0.10	0.022	(0.270)	0.011	0.011
204	17.00	0.10	0.022	(0.268)	0.011	0.011
205	17.08	0.17	0.036	(0.267)	0.018	0.018
206	17.17	0.17	0.036	(0.266)	0.018	0.018
207	17.25	0.17	0.036	(0.264)	0.018	0.018
208	17.33	0.17	0.036	(0.263)	0.018	0.018
209	17.42	0.17	0.036	(0.262)	0.018	0.018
210	17.50	0.17	0.036	(0.260)	0.018	0.018
211	17.58	0.17	0.036	(0.259)	0.018	0.018
212	17.67	0.17	0.036	(0.258)	0.018	0.018
213	17.75	0.17	0.036	(0.256)	0.018	0.018
214	17.83	0.13	0.029	(0.255)	0.014	0.014
215	17.92	0.13	0.029	(0.254)	0.014	0.014
216	18.00	0.13	0.029	(0.253)	0.014	0.014
217	18.08	0.13	0.029	(0.251)	0.014	0.014
218	18.17	0.13	0.029	(0.250)	0.014	0.014
219	18.25	0.13	0.029	(0.249)	0.014	0.014
220	18.33	0.13	0.029	(0.248)	0.014	0.014
221	18.42	0.13	0.029	(0.246)	0.014	0.014
222	18.50	0.13	0.029	(0.245)	0.014	0.014
223	18.58	0.10	0.022	(0.244)	0.011	0.011
224	18.67	0.10	0.022	(0.243)	0.011	0.011
225	18.75	0.10	0.022	(0.242)	0.011	0.011
226	18.83	0.07	0.014	(0.241)	0.007	0.007
227	18.92	0.07	0.014	(0.239)	0.007	0.007
228	19.00	0.07	0.014	(0.238)	0.007	0.007
229	19.08	0.10	0.022	(0.237)	0.011	0.011
230	19.17	0.10	0.022	(0.236)	0.011	0.011
231	19.25	0.10	0.022	(0.235)	0.011	0.011
232	19.33	0.13	0.029	(0.234)	0.014	0.014
233	19.42	0.13	0.029	(0.233)	0.014	0.014
234	19.50	0.13	0.029	(0.232)	0.014	0.014
235	19.58	0.10	0.022	(0.231)	0.011	0.011
236	19.67	0.10	0.022	(0.230)	0.011	0.011
237	19.75	0.10	0.022	(0.229)	0.011	0.011
238	19.83	0.07	0.014	(0.228)	0.007	0.007
239	19.92	0.07	0.014	(0.226)	0.007	0.007
240	20.00	0.07	0.014	(0.225)	0.007	0.007
241	20.08	0.10	0.022	(0.224)	0.011	0.011
242	20.17	0.10	0.022	(0.223)	0.011	0.011
243	20.25	0.10	0.022	(0.223)	0.011	0.011

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244  20.33     0.10      0.022       (  0.222)       0.011        0.011
245  20.42     0.10      0.022       (  0.221)       0.011        0.011
246  20.50     0.10      0.022       (  0.220)       0.011        0.011
247  20.58     0.10      0.022       (  0.219)       0.011        0.011
248  20.67     0.10      0.022       (  0.218)       0.011        0.011
249  20.75     0.10      0.022       (  0.217)       0.011        0.011
250  20.83     0.07      0.014       (  0.216)       0.007        0.007
251  20.92     0.07      0.014       (  0.215)       0.007        0.007
252  21.00     0.07      0.014       (  0.214)       0.007        0.007
253  21.08     0.10      0.022       (  0.213)       0.011        0.011
254  21.17     0.10      0.022       (  0.213)       0.011        0.011
255  21.25     0.10      0.022       (  0.212)       0.011        0.011
256  21.33     0.07      0.014       (  0.211)       0.007        0.007
257  21.42     0.07      0.014       (  0.210)       0.007        0.007
258  21.50     0.07      0.014       (  0.209)       0.007        0.007
259  21.58     0.10      0.022       (  0.209)       0.011        0.011
260  21.67     0.10      0.022       (  0.208)       0.011        0.011
261  21.75     0.10      0.022       (  0.207)       0.011        0.011
262  21.83     0.07      0.014       (  0.206)       0.007        0.007
263  21.92     0.07      0.014       (  0.206)       0.007        0.007
264  22.00     0.07      0.014       (  0.205)       0.007        0.007
265  22.08     0.10      0.022       (  0.204)       0.011        0.011
266  22.17     0.10      0.022       (  0.204)       0.011        0.011
267  22.25     0.10      0.022       (  0.203)       0.011        0.011
268  22.33     0.07      0.014       (  0.202)       0.007        0.007
269  22.42     0.07      0.014       (  0.202)       0.007        0.007
270  22.50     0.07      0.014       (  0.201)       0.007        0.007
271  22.58     0.07      0.014       (  0.201)       0.007        0.007
272  22.67     0.07      0.014       (  0.200)       0.007        0.007
273  22.75     0.07      0.014       (  0.199)       0.007        0.007
274  22.83     0.07      0.014       (  0.199)       0.007        0.007
275  22.92     0.07      0.014       (  0.198)       0.007        0.007
276  23.00     0.07      0.014       (  0.198)       0.007        0.007
277  23.08     0.07      0.014       (  0.198)       0.007        0.007
278  23.17     0.07      0.014       (  0.197)       0.007        0.007
279  23.25     0.07      0.014       (  0.197)       0.007        0.007
280  23.33     0.07      0.014       (  0.196)       0.007        0.007
281  23.42     0.07      0.014       (  0.196)       0.007        0.007
282  23.50     0.07      0.014       (  0.196)       0.007        0.007
283  23.58     0.07      0.014       (  0.195)       0.007        0.007
284  23.67     0.07      0.014       (  0.195)       0.007        0.007
285  23.75     0.07      0.014       (  0.195)       0.007        0.007
286  23.83     0.07      0.014       (  0.194)       0.007        0.007
287  23.92     0.07      0.014       (  0.194)       0.007        0.007
288  24.00     0.07      0.014       (  0.194)       0.007        0.007
              (Loss Rate Not Used)
    Sum =     100.0                                  Sum =    10.8
      Flood volume = Effective rainfall      0.90(In)
       times area      18.0(Ac.)/[(In)/(Ft.)] =       1.3(Ac.Ft)
      Total soil loss =      0.90(In)
      Total soil loss =     1.350(Ac.Ft)
      Total rainfall =      1.80(In)
      Flood volume =       58803.9 Cubic Feet
      Total soil loss =       58803.9 Cubic Feet
      ---------------------------------------------------------------------
       Peak flow rate of this hydrograph =      2.221(CFS)
      ---------------------------------------------------------------------
      +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                        24 - H O U R    S T O R M
                    R u n o f f      H y d r o g r a p h
      ---------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals ((CFS))

      ---------------------------------------------------------------------
 Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
 ---------------------------------------------------------------------------
   0+ 5       0.0003      0.05  Q          |         |         |         |
   0+10       0.0011      0.11  Q          |         |         |         |
   0+15       0.0019      0.12  Q          |         |         |         |
   0+20       0.0030      0.15  Q          |         |         |         |
   0+25       0.0043      0.19  Q          |         |         |         |
   0+30       0.0056      0.19  Q          |         |         |         |
   0+35       0.0069      0.19  Q          |         |         |         |
   0+40       0.0083      0.20  Q          |         |         |         |
   0+45       0.0096      0.20  Q          |         |         |         |
   0+50       0.0112      0.22  Q          |         |         |         |
   0+55       0.0129      0.25  VQ         |         |         |         |
   1+ 0       0.0147      0.26  VQ         |         |         |         |
   1+ 5       0.0163      0.23  Q          |         |         |         |
   1+10       0.0177      0.21  Q          |         |         |         |
   1+15       0.0191      0.20  Q          |         |         |         |
   1+20       0.0204      0.20  Q          |         |         |         |
   1+25       0.0218      0.20  Q          |         |         |         |
   1+30       0.0231      0.20  Q          |         |         |         |
   1+35       0.0245      0.20  Q          |         |         |         |
   1+40       0.0258      0.20  Q          |         |         |         |
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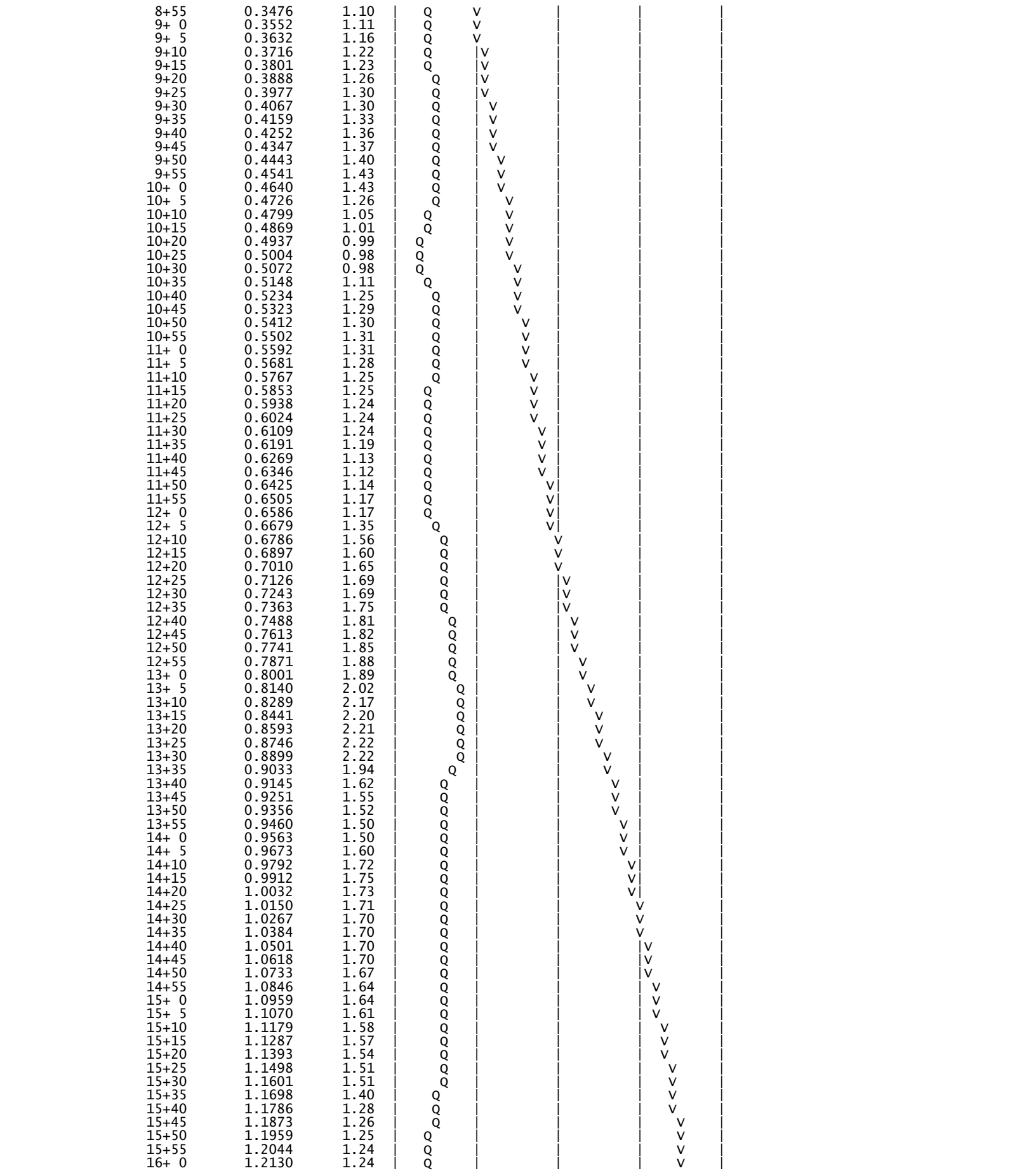
1+45	0.0272	0.20	Q	|	|	|	|
1+50	0.0287	0.22	Q	|	|	|	|
1+55	0.0304	0.25	VQ	|	|	|	|
2+ 0	0.0322	0.26	VQ	|	|	|	|
2+ 5	0.0340	0.26	|Q	|	|	|	|
2+10	0.0358	0.26	|Q	|	|	|	|
2+15	0.0376	0.26	|Q	|	|	|	|
2+20	0.0394	0.26	|Q	|	|	|	|
2+25	0.0412	0.26	|Q	|	|	|	|
2+30	0.0430	0.26	|Q	|	|	|	|
2+35	0.0450	0.29	|Q	|	|	|	|
2+40	0.0471	0.32	|Q	|	|	|	|
2+45	0.0494	0.32	|Q	|	|	|	|
2+50	0.0516	0.33	|Q	|	|	|	|
2+55	0.0539	0.33	|Q	|	|	|	|
3+ 0	0.0561	0.33	|Q	|	|	|	|
3+ 5	0.0584	0.33	|Q	|	|	|	|
3+10	0.0606	0.33	|Q	|	|	|	|
3+15	0.0629	0.33	|Q	|	|	|	|
3+20	0.0651	0.33	|Q	|	|	|	|
3+25	0.0674	0.33	|Q	|	|	|	|
3+30	0.0696	0.33	|QV	|	|	|	|
3+35	0.0719	0.33	|QV	|	|	|	|
3+40	0.0741	0.33	|QV	|	|	|	|
3+45	0.0764	0.33	|QV	|	|	|	|
3+50	0.0788	0.35	|QV	|	|	|	|
3+55	0.0814	0.38	|QV	|	|	|	|
4+ 0	0.0841	0.39	|QV	|	|	|	|
4+ 5	0.0868	0.39	|QV	|	|	|	|
4+10	0.0895	0.39	|QV	|	|	|	|
4+15	0.0922	0.39	|QV	|	|	|	|
4+20	0.0950	0.42	|QV	|	|	|	|
4+25	0.0981	0.45	|QV	|	|	|	|
4+30	0.1012	0.45	|QV	|	|	|	|
4+35	0.1044	0.46	|Q V	|	|	|	|
4+40	0.1075	0.46	|Q V	|	|	|	|
4+45	0.1107	0.46	|Q V	|	|	|	|
4+50	0.1140	0.48	|Q V	|	|	|	|
4+55	0.1175	0.51	| QV	|	|	|	|
5+ 0	0.1211	0.52	| QV	|	|	|	|
5+ 5	0.1243	0.47	|Q V	|	|	|	|
5+10	0.1272	0.41	|Q V	|	|	|	|
5+15	0.1300	0.40	|Q V	|	|	|	|
5+20	0.1328	0.42	|Q V	|	|	|	|
5+25	0.1359	0.45	|Q V	|	|	|	|
5+30	0.1390	0.45	|Q V	|	|	|	|
5+35	0.1424	0.48	|Q V	|	|	|	|
5+40	0.1459	0.51	| Q V	|	|	|	|
5+45	0.1495	0.52	| Q V	|	|	|	|
5+50	0.1530	0.52	| Q V	|	|	|	|
5+55	0.1566	0.52	| Q V	|	|	|	|
6+ 0	0.1602	0.52	| Q V	|	|	|	|
6+ 5	0.1640	0.55	| Q V	|	|	|	|
6+10	0.1680	0.58	| Q V	|	|	|	|
6+15	0.1720	0.58	| Q V	|	|	|	|
6+20	0.1761	0.59	| Q V	|	|	|	|
6+25	0.1801	0.59	| Q V	|	|	|	|
6+30	0.1842	0.59	| Q V	|	|	|	|
6+35	0.1884	0.61	| Q V	|	|	|	|
6+40	0.1928	0.64	| Q V	|	|	|	|
6+45	0.1973	0.65	| Q V	|	|	|	|
6+50	0.2018	0.65	| Q V	|	|	|	|
6+55	0.2063	0.65	| Q V	|	|	|	|
7+ 0	0.2108	0.65	| Q V	|	|	|	|
7+ 5	0.2153	0.65	| Q V	|	|	|	|
7+10	0.2198	0.65	| Q V	|	|	|	|
7+15	0.2243	0.65	| Q V	|	|	|	|
7+20	0.2289	0.68	| Q V	|	|	|	|
7+25	0.2338	0.71	| Q V	|	|	|	|
7+30	0.2387	0.71	| Q V	|	|	|	|
7+35	0.2439	0.74	| Q V	|	|	|	|
7+40	0.2492	0.77	| Q V	|	|	|	|
7+45	0.2546	0.78	| Q V	|	|	|	|
7+50	0.2601	0.81	| Q V	|	|	|	|
7+55	0.2659	0.84	| Q V	|	|	|	|
8+ 0	0.2717	0.85	| Q V	|	|	|	|
8+ 5	0.2779	0.90	| Q V	|	|	|	|
8+10	0.2845	0.96	| Q V	|	|	|	|
8+15	0.2912	0.97	| Q V	|	|	|	|
8+20	0.2979	0.98	| Q V	|	|	|	|
8+25	0.3047	0.98	| Q V|	|	|	|	|
8+30	0.3114	0.98	| Q V|	|	|	|	|
8+35	0.3184	1.01	| Q V|	|	|	|	|
8+40	0.3255	1.03	| Q V|	|	|	|	|
8+45	0.3326	1.04	| Q V|	|	|	|	|
8+50	0.3400	1.07	| Q V	|	|	|	|



8+55	0.3476	1.10	Q V
9+ 0	0.3552	1.11	Q V
9+ 5	0.3632	1.16	Q V
9+10	0.3716	1.22	Q V
9+15	0.3801	1.23	Q V
9+20	0.3888	1.26	Q V
9+25	0.3977	1.30	Q V
9+30	0.4067	1.30	Q V
9+35	0.4159	1.33	Q V
9+40	0.4252	1.36	Q V
9+45	0.4347	1.37	Q V
9+50	0.4443	1.40	Q V
9+55	0.4541	1.43	Q V
10+ 0	0.4640	1.43	Q V
10+ 5	0.4726	1.26	Q V
10+10	0.4799	1.05	Q V
10+15	0.4869	1.01	Q V
10+20	0.4937	0.99	Q V
10+25	0.5004	0.98	Q V
10+30	0.5072	0.98	Q V
10+35	0.5148	1.11	Q V
10+40	0.5234	1.25	Q V
10+45	0.5323	1.29	Q V
10+50	0.5412	1.30	Q V
10+55	0.5502	1.31	Q V
11+ 0	0.5592	1.31	Q V
11+ 5	0.5681	1.28	Q V
11+10	0.5767	1.25	Q V
11+15	0.5853	1.25	Q V
11+20	0.5938	1.24	Q V
11+25	0.6024	1.24	Q V
11+30	0.6109	1.24	Q V
11+35	0.6191	1.19	Q V
11+40	0.6269	1.13	Q V
11+45	0.6346	1.12	Q V
11+50	0.6425	1.14	Q V
11+55	0.6505	1.17	Q V
12+ 0	0.6586	1.17	Q V
12+ 5	0.6679	1.35	Q V
12+10	0.6786	1.56	Q V
12+15	0.6897	1.60	Q V
12+20	0.7010	1.65	Q V
12+25	0.7126	1.69	Q V
12+30	0.7243	1.69	Q V
12+35	0.7363	1.75	Q V
12+40	0.7488	1.81	Q V
12+45	0.7613	1.82	Q V
12+50	0.7741	1.85	Q V
12+55	0.7871	1.88	Q V
13+ 0	0.8001	1.89	Q V
13+ 5	0.8140	2.02	Q V
13+10	0.8289	2.17	Q V
13+15	0.8441	2.20	Q V
13+20	0.8593	2.21	Q V
13+25	0.8746	2.22	Q V
13+30	0.8899	2.22	Q V
13+35	0.9033	1.94	Q V
13+40	0.9145	1.62	Q V
13+45	0.9251	1.55	Q V
13+50	0.9356	1.52	Q V
13+55	0.9460	1.50	Q V
14+ 0	0.9563	1.50	Q V
14+ 5	0.9673	1.60	Q V
14+10	0.9792	1.72	Q V
14+15	0.9912	1.75	Q V
14+20	1.0032	1.73	Q V
14+25	1.0150	1.71	Q V
14+30	1.0267	1.70	Q V
14+35	1.0384	1.70	Q V
14+40	1.0501	1.70	Q V
14+45	1.0618	1.70	Q V
14+50	1.0733	1.67	Q V
14+55	1.0846	1.64	Q V
15+ 0	1.0959	1.64	Q V
15+ 5	1.1070	1.61	Q V
15+10	1.1179	1.58	Q V
15+15	1.1287	1.57	Q V
15+20	1.1393	1.54	Q V
15+25	1.1498	1.51	Q V
15+30	1.1601	1.51	Q V
15+35	1.1698	1.40	Q V
15+40	1.1786	1.28	Q V
15+45	1.1873	1.26	Q V
15+50	1.1959	1.25	Q V
15+55	1.2044	1.24	Q V
16+ 0	1.2130	1.24	Q V

16+ 5	1.2189	0.86	| Q	|	|	|	V |
16+10	1.2218	0.42	|Q	|	|	|	V |
16+15	1.2241	0.32	|Q	|	|	|	V |
16+20	1.2260	0.28	|Q	|	|	|	V |
16+25	1.2278	0.26	|Q	|	|	|	V |
16+30	1.2296	0.26	|Q	|	|	|	V |
16+35	1.2312	0.24	Q	|	|	|	V |
16+40	1.2327	0.21	Q	|	|	|	V |
16+45	1.2340	0.20	Q	|	|	|	V |
16+50	1.2354	0.20	Q	|	|	|	V |
16+55	1.2367	0.20	Q	|	|	|	V |
17+ 0	1.2381	0.20	Q	|	|	|	V |
17+ 5	1.2398	0.25	Q	|	|	|	V |
17+10	1.2419	0.31	|Q	|	|	|	V |
17+15	1.2441	0.32	|Q	|	|	|	V |
17+20	1.2463	0.32	|Q	|	|	|	V |
17+25	1.2486	0.33	|Q	|	|	|	V |
17+30	1.2508	0.33	|Q	|	|	|	V |
17+35	1.2531	0.33	|Q	|	|	|	V |
17+40	1.2553	0.33	|Q	|	|	|	V |
17+45	1.2576	0.33	|Q	|	|	|	V |
17+50	1.2596	0.30	|Q	|	|	|	V |
17+55	1.2615	0.27	|Q	|	|	|	V |
18+ 0	1.2633	0.27	|Q	|	|	|	V |
18+ 5	1.2652	0.26	|Q	|	|	|	V |
18+10	1.2670	0.26	|Q	|	|	|	V |
18+15	1.2688	0.26	|Q	|	|	|	V |
18+20	1.2706	0.26	|Q	|	|	|	V |
18+25	1.2724	0.26	|Q	|	|	|	V |
18+30	1.2742	0.26	|Q	|	|	|	V |
18+35	1.2758	0.24	Q	|	|	|	V |
18+40	1.2772	0.21	Q	|	|	|	V |
18+45	1.2786	0.20	Q	|	|	|	V |
18+50	1.2798	0.17	Q	|	|	|	V |
18+55	1.2807	0.14	Q	|	|	|	V |
19+ 0	1.2817	0.13	Q	|	|	|	V |
19+ 5	1.2828	0.16	Q	|	|	|	V |
19+10	1.2840	0.19	Q	|	|	|	V |
19+15	1.2854	0.19	Q	|	|	|	V |
19+20	1.2869	0.22	Q	|	|	|	V |
19+25	1.2886	0.25	|Q	|	|	|	V |
19+30	1.2904	0.26	|Q	|	|	|	V |
19+35	1.2920	0.23	Q	|	|	|	V |
19+40	1.2934	0.21	Q	|	|	|	V |
19+45	1.2948	0.20	Q	|	|	|	V |
19+50	1.2960	0.17	Q	|	|	|	V |
19+55	1.2969	0.14	Q	|	|	|	V |
20+ 0	1.2979	0.13	Q	|	|	|	V |
20+ 5	1.2990	0.16	Q	|	|	|	V |
20+10	1.3002	0.19	Q	|	|	|	V |
20+15	1.3016	0.19	Q	|	|	|	V |
20+20	1.3029	0.19	Q	|	|	|	V |
20+25	1.3042	0.20	Q	|	|	|	V |
20+30	1.3056	0.20	Q	|	|	|	V |
20+35	1.3069	0.20	Q	|	|	|	V |
20+40	1.3083	0.20	Q	|	|	|	V |
20+45	1.3096	0.20	Q	|	|	|	V |
20+50	1.3108	0.17	Q	|	|	|	V |
20+55	1.3118	0.14	Q	|	|	|	V |
21+ 0	1.3127	0.13	Q	|	|	|	V |
21+ 5	1.3138	0.16	Q	|	|	|	V |
21+10	1.3151	0.19	Q	|	|	|	V |
21+15	1.3164	0.19	Q	|	|	|	V|
21+20	1.3176	0.17	Q	|	|	|	V|
21+25	1.3185	0.14	Q	|	|	|	V|
21+30	1.3195	0.13	Q	|	|	|	V|
21+35	1.3206	0.16	Q	|	|	|	V|
21+40	1.3218	0.19	Q	|	|	|	V|
21+45	1.3232	0.19	Q	|	|	|	V|
21+50	1.3243	0.17	Q	|	|	|	V|
21+55	1.3253	0.14	Q	|	|	|	V|
22+ 0	1.3262	0.13	Q	|	|	|	V|
22+ 5	1.3273	0.16	Q	|	|	|	V|
22+10	1.3286	0.19	Q	|	|	|	V|
22+15	1.3299	0.19	Q	|	|	|	V|
22+20	1.3311	0.17	Q	|	|	|	V|
22+25	1.3320	0.14	Q	|	|	|	V|
22+30	1.3330	0.13	Q	|	|	|	V|
22+35	1.3339	0.13	Q	|	|	|	V|
22+40	1.3348	0.13	Q	|	|	|	V|
22+45	1.3357	0.13	Q	|	|	|	V|
22+50	1.3366	0.13	Q	|	|	|	V|
22+55	1.3375	0.13	Q	|	|	|	V|
23+ 0	1.3384	0.13	Q	|	|	|	V|
23+ 5	1.3393	0.13	Q	|	|	|	V|
23+10	1.3402	0.13	Q	|	|	|	V|

```
   23+15       1.3411      0.13  Q          |          |          |          v|
   23+20       1.3420      0.13  Q          |          |          |          v|
   23+25       1.3429      0.13  Q          |          |          |          v|
   23+30       1.3438      0.13  Q          |          |          |          v|
   23+35       1.3447      0.13  Q          |          |          |          v|
   23+40       1.3456      0.13  Q          |          |          |          v|
   23+45       1.3465      0.13  Q          |          |          |          v|
   23+50       1.3474      0.13  Q          |          |          |          v|
   23+55       1.3483      0.13  Q          |          |          |          v|
   24+ 0       1.3492      0.13  Q          |          |          |          v|
   24+ 5       1.3497      0.08  Q          |          |          |          v|
   24+10       1.3499      0.02  Q          |          |          |          v|
   24+15       1.3499      0.01  Q          |          |          |          v|
   24+20       1.3500      0.00  Q          |          |          |          v|
-------------------------------------------------------------------------------
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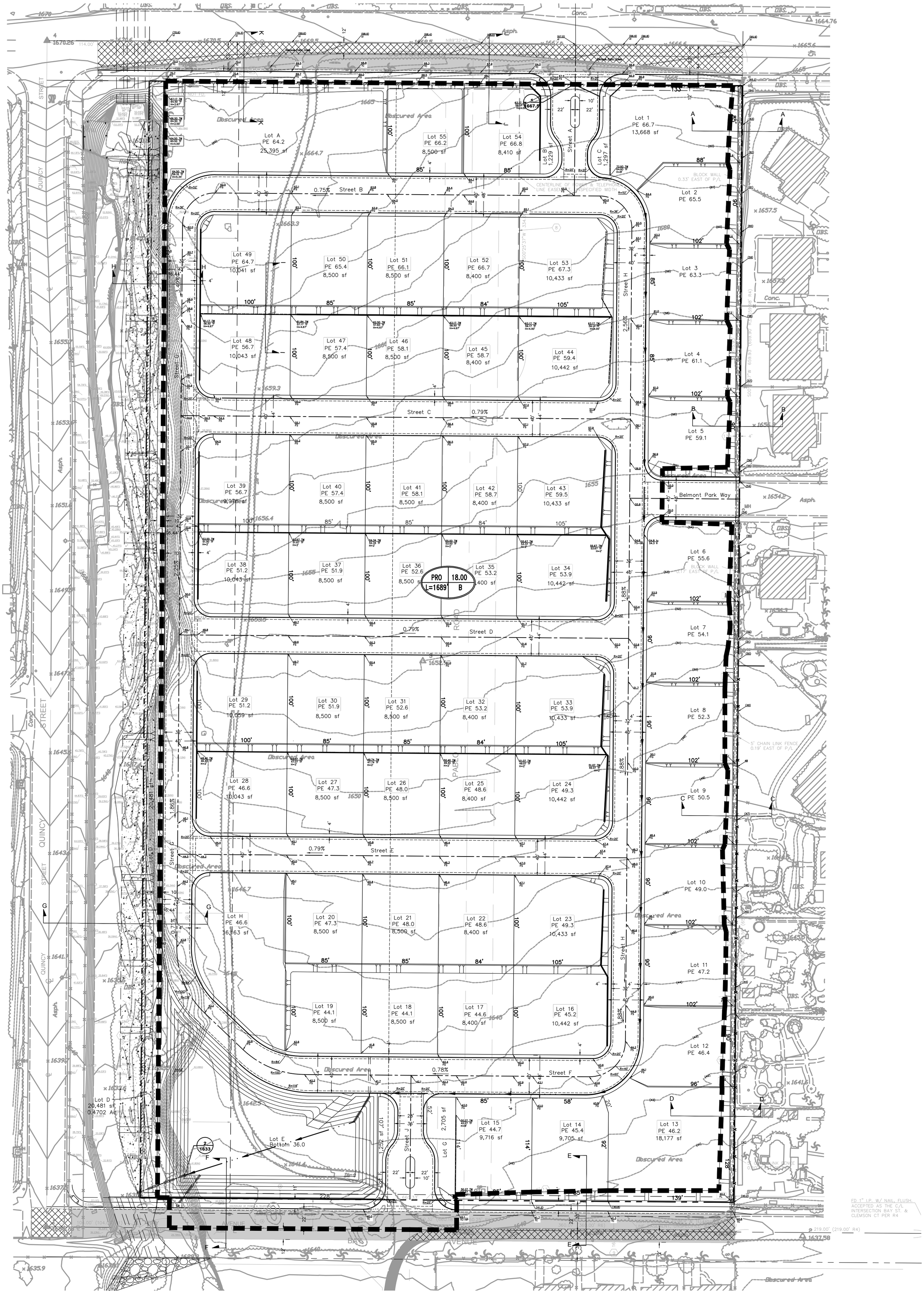
POST DEVELOPMENT UNIT HYDROGRAPH MAP
COTTONWOOD



0 50 150
25 100 200
SCALE: 1" = 50'

POST DEVELOPMENT
UNIT HYDROGRAPH
COTTONWOOD

PREPARATION DATE: DECEMBER 2021
REVISION DATE: SEPTEMBER 2022

PLANS PREPARED BY:

adkan ENGINEERS
Civil Engineering • Surveying • Planning
6879 Airport Drive, Riverside, CA 92504
Tel:(951) 688-0241 • Fax:(951) 688-0599

PLOT DATE: 9/7/2022 1:04 PM

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Basin Size and Flow Calculations

	BASIN PARAMETERS					OUTLET								
Basin Elevation	Depth	Area S.F.	Volume C.F.	Volume AC-FT	Effective Volume AC-FT	Q_1 Orrifice Plate (cfs)	Q_2 Orrifice Plate (cfs)	Q_3 Orrifice Plate (cfs)	Q_4 Orrifice Plate (cfs)	Q_5Orrifice Plate (cfs)	Q_6 Orrifice Plate (cfs)	Q_7Orrifice Plate (cfs)	Q Weir 1 (cfs)	Q Total (cfs)
1636.00	0.00	15,594.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1636.50	0.50	16,935.50	8,132.38	0.187	0.187	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1637.00	1.00	18,277.00	16,935.50	0.389	0.389	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1637.50	1.50	19,687.50	26,461.13	0.607	0.607	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1638.00	2.00	21,098.00	36,692.00	0.842	0.842	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1638.50	2.50	22,585.00	47,723.75	1.096	1.096	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1639.00	3.00	24,072.00	59,499.00	1.366	1.366	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1639.50	3.50	25,628.50	72,139.38	1.656	1.656	0.000	0.812	0.000	0.000	0.000	0.000	0.000	0.000	0.812
1640.00	4.00	27,185.00	85,558.00	1.964	1.964	0.000	1.407	0.000	0.000	0.000	0.000	0.000	0.000	1.407
1640.50	4.50	28,833.50	99,961.88	2.295	2.295	0.000	1.817	0.000	0.000	0.000	0.000	0.000	26.958	28.775
1641.00	5.00	30,482.00	115,190.00	2.644	2.644	0.000	2.150	0.000	0.000	0.000	0.000	0.000	90.983	93.132

SUPPORTING DESIGN PARAMETERS

Orifice Coefficient	0.66	Dia of Orrifice	0.00	7.50							0.00
Gravimetric Constant	32.2 ft/s^2	Eff Dia of Orrifice	0.0000	0.6250	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Number of Rows	1	Area of Orrifice	0.0000	0.3068	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Minimum Orrifice Plate Height		Number of Orrifeces	1	1	1	1	1	1	1	1	
Minimum Orrifice Plate Width		Centroid Elev	1636.2	1639.25						0	

.	Weir	Sharp Crest Weir Coefficient	3.33
		Length of Weir	32.00
		Elev. at Crest of Weir	1640.1
		VBMP Storage Elevation	1637.75

Orifice Equation

$Q=Cd(1/4\pi D2)\sqrt{2gh}$

Weir Equation

(Q/(Weir Length* Weir Coefficent))^(2/3)

Q100 Elevation Weir Calc		
2 - 4' X 4' Box Inlet Weir Calc		
Crest Wier Elev.	1640.10	
Q100	38.99	cfs
Weir Length	32	
Weir Coeff.	3.33	
H Weir	0.511571116	
Q100 Elevation	**1640.61**	

Q100 Elevation Weir Calc		
Basin Emergency Spillway Weir Calc		
Crest Wier Elev.	1640.65	
Q100	38.99	cfs
Weir Length	80	
Weir Coeff.	3.33	
H Weir	0.27772353	
Q100 Elevation	**1640.93**	

Storm Event	Existing Condition		Proposed Condition		Basin Mitigation Storage & Outflow		
	cfs	volume ac.ft.	cfs	volume ac.ft.	cfs	volume ac.ft.	Depth
2yr24hr	0.443	0.2700	2.221	1.3500	0.000	1.3430	2.96

FLOOD HYDROGRAPH ROUTING PROGRAM
Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2004
Study date: 11/23/22

Program License Serial Number 5006

********** HYDROGRAPH INFORMATION **********

From study/file name: PRO2242.rte
**********HYDROGRAPH DATA**********
Number of intervals = 292
Time interval = 5.0 (Min.)
Maximum/Peak flow rate = 2.221 (CFS)
Total volume = 1.350 (Ac.Ft)
Status of hydrographs being held in storage
Stream 1 Stream 2 Stream 3 Stream 4 Stream 5
Peak (CFS) 0.000 0.000 0.000 0.000 0.000
Vol (Ac.Ft) 0.000 0.000 0.000 0.000 0.000
****

++++++++++
Process from Point/Station 1.000 to Point/Station 1.000
**** RETARDING BASIN ROUTING ****

User entry of depth-outflow-storage data

Total number of inflow hydrograph intervals = 292
Hydrograph time unit = 5.000 (Min.)
Initial depth in storage basin = 0.00(Ft.)

Initial basin depth = 0.00 (Ft.)
Initial basin storage = 0.00 (Ac.Ft)
Initial basin outflow = 0.00 (CFS)

Depth vs. Storage and Depth vs. Discharge data:

Basin Depth (Ft.)	Storage (Ac.Ft)	Outflow (CFS)	(S-O*dt/2) (Ac.Ft)	(S+O*dt/2) (Ac.Ft)
0.000	0.000	0.000	0.000	0.000
0.500	0.187	0.001	0.187	0.187
1.000	0.389	0.002	0.389	0.389
1.500	0.607	0.003	0.607	0.607
2.000	0.842	0.004	0.842	0.842
2.500	1.096	0.005	1.096	1.096
3.000	1.366	0.006	1.366	1.366
3.500	1.656	0.812	1.653	1.659
4.000	1.964	1.407	1.959	1.969
4.500	2.295	28.775	2.196	2.394
5.000	2.644	93.132	2.323	2.965

Hydrograph Detention Basin Routing

Graph values: 'I'= unit inflow; 'O'=outflow at time shown

Time (Hours)	Inflow (CFS)	Outflow (CFS)	Storage (Ac.Ft)	.0	0.6	1.11	1.67	2.22 (Ft.) Depth
0.083	0.05	0.00	0.000	O	|	|	|	0.00
0.167	0.11	0.00	0.001	OI	|	|	|	0.00
0.250	0.12	0.00	0.002	OI	|	|	|	0.00
0.333	0.15	0.00	0.002	O I	|	|	|	0.01
0.417	0.19	0.00	0.004	O I	|	|	|	0.01
0.500	0.19	0.00	0.005	O I	|	|	|	0.01
0.583	0.19	0.00	0.006	O I	|	|	|	0.02
0.667	0.20	0.00	0.008	O I	|	|	|	0.02
0.750	0.20	0.00	0.009	O I	|	|	|	0.02
0.833	0.22	0.00	0.010	O I	|	|	|	0.03
0.917	0.25	0.00	0.012	O I	|	|	|	0.03
1.000	0.26	0.00	0.014	O I	|	|	|	0.04
1.083	0.23	0.00	0.015	O I	|	|	|	0.04
1.167	0.21	0.00	0.017	O I	|	|	|	0.05
1.250	0.20	0.00	0.018	O I	|	|	|	0.05
1.333	0.20	0.00	0.020	O I	|	|	|	0.05

1.417	0.20	0.00	0.021	o I	|	|	|	0.06
1.500	0.20	0.00	0.022	o I	|	|	|	0.06
1.583	0.20	0.00	0.024	o I	|	|	|	0.06
1.667	0.20	0.00	0.025	o I	|	|	|	0.07
1.750	0.20	0.00	0.027	o I	|	|	|	0.07
1.833	0.22	0.00	0.028	o I	|	|	|	0.07
1.917	0.25	0.00	0.030	o I	|	|	|	0.08
2.000	0.26	0.00	0.031	o I	|	|	|	0.08
2.083	0.26	0.00	0.033	o I	|	|	|	0.09
2.167	0.26	0.00	0.035	o I	|	|	|	0.09
2.250	0.26	0.00	0.037	o I	|	|	|	0.10
2.333	0.26	0.00	0.038	o I	|	|	|	0.10
2.417	0.26	0.00	0.040	o I	|	|	|	0.11
2.500	0.26	0.00	0.042	o I	|	|	|	0.11
2.583	0.29	0.00	0.044	o I	|	|	|	0.12
2.667	0.32	0.00	0.046	o I	|	|	|	0.12
2.750	0.32	0.00	0.048	o I	|	|	|	0.13
2.833	0.33	0.00	0.050	o I	|	|	|	0.13
2.917	0.33	0.00	0.053	o I	|	|	|	0.14
3.000	0.33	0.00	0.055	o I	|	|	|	0.15
3.083	0.33	0.00	0.057	o I	|	|	|	0.15
3.167	0.33	0.00	0.059	o I	|	|	|	0.16
3.250	0.33	0.00	0.062	o I	|	|	|	0.16
3.333	0.33	0.00	0.064	o I	|	|	|	0.17
3.417	0.33	0.00	0.066	o I	|	|	|	0.18
3.500	0.33	0.00	0.068	o I	|	|	|	0.18
3.583	0.33	0.00	0.071	o I	|	|	|	0.19
3.667	0.33	0.00	0.073	o I	|	|	|	0.20
3.750	0.33	0.00	0.075	o I	|	|	|	0.20
3.833	0.35	0.00	0.078	o I	|	|	|	0.21
3.917	0.38	0.00	0.080	o I	|	|	|	0.21
4.000	0.39	0.00	0.083	o I	|	|	|	0.22
4.083	0.39	0.00	0.085	o I	|	|	|	0.23
4.167	0.39	0.00	0.088	o I	|	|	|	0.24
4.250	0.39	0.00	0.091	o I	|	|	|	0.24
4.333	0.42	0.00	0.094	o I	|	|	|	0.25
4.417	0.45	0.00	0.097	o I	|	|	|	0.26
4.500	0.45	0.00	0.100	o I	|	|	|	0.27
4.583	0.46	0.00	0.103	o I	|	|	|	0.27
4.667	0.46	0.00	0.106	o I	|	|	|	0.28
4.750	0.46	0.00	0.109	o I	|	|	|	0.29
4.833	0.48	0.00	0.112	o I	|	|	|	0.30
4.917	0.51	0.00	0.116	o I	|	|	|	0.31
5.000	0.52	0.00	0.119	o I	|	|	|	0.32
5.083	0.47	0.00	0.123	o I	|	|	|	0.33
5.167	0.41	0.00	0.126	o I	|	|	|	0.34
5.250	0.40	0.00	0.128	o I	|	|	|	0.34
5.333	0.42	0.00	0.131	o I	|	|	|	0.35
5.417	0.45	0.00	0.134	o I	|	|	|	0.36
5.500	0.45	0.00	0.137	o I	|	|	|	0.37
5.583	0.48	0.00	0.141	o I	|	|	|	0.38
5.667	0.51	0.00	0.144	o I	|	|	|	0.38
5.750	0.52	0.00	0.148	o I	|	|	|	0.39
5.833	0.52	0.00	0.151	o I	|	|	|	0.40
5.917	0.52	0.00	0.155	o I	|	|	|	0.41
6.000	0.52	0.00	0.158	o I	|	|	|	0.42
6.083	0.55	0.00	0.162	o I	|	|	|	0.43
6.167	0.58	0.00	0.166	o I	|	|	|	0.44
6.250	0.58	0.00	0.170	o I	|	|	|	0.45
6.333	0.59	0.00	0.174	o I	|	|	|	0.46
6.417	0.59	0.00	0.178	o I	|	|	|	0.48
6.500	0.59	0.00	0.182	o I	|	|	|	0.49
6.583	0.61	0.00	0.186	o I	|	|	|	0.50
6.667	0.64	0.00	0.190	o I	|	|	|	0.51
6.750	0.65	0.00	0.195	o I	|	|	|	0.52
6.833	0.65	0.00	0.199	o I	|	|	|	0.53
6.917	0.65	0.00	0.204	o I	|	|	|	0.54
7.000	0.65	0.00	0.208	o I	|	|	|	0.55
7.083	0.65	0.00	0.213	o I	|	|	|	0.56
7.167	0.65	0.00	0.217	o I	|	|	|	0.57
7.250	0.65	0.00	0.222	o I	|	|	|	0.59
7.333	0.68	0.00	0.226	o I	|	|	|	0.60
7.417	0.71	0.00	0.231	o I	|	|	|	0.61
7.500	0.71	0.00	0.236	o I	|	|	|	0.62
7.583	0.74	0.00	0.241	o I	|	|	|	0.63
7.667	0.77	0.00	0.246	o I	|	|	|	0.65
7.750	0.78	0.00	0.252	o I	|	|	|	0.66
7.833	0.81	0.00	0.257	o I	|	|	|	0.67
7.917	0.84	0.00	0.263	o I	|	|	|	0.69
8.000	0.85	0.00	0.268	o I	|	|	|	0.70
8.083	0.90	0.00	0.274	o I	|	|	|	0.72
8.167	0.96	0.00	0.281	o I	|	|	|	0.73
8.250	0.97	0.00	0.287	o I	|	|	|	0.75
8.333	0.98	0.00	0.294	o I	|	|	|	0.77
8.417	0.98	0.00	0.301	o I	|	|	|	0.78
8.500	0.98	0.00	0.308	o I	|	|	|	0.80

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 8.583    1.01    0.00      0.314  o       |     I |       |       |     0.82
 8.667    1.03    0.00      0.321  o       |     I |       |       |     0.83
 8.750    1.04    0.00      0.329  o       |     I |       |       |     0.85
 8.833    1.07    0.00      0.336  o       |      I|       |       |     0.87
 8.917    1.10    0.00      0.343  o       |      I|       |       |     0.89
 9.000    1.11    0.00      0.351  o       |      I|       |       |     0.91
 9.083    1.16    0.00      0.359  o       |       I       |       |     0.93
 9.167    1.22    0.00      0.367  o       |       |I      |       |     0.95
 9.250    1.23    0.00      0.375  o       |       |I      |       |     0.97
 9.333    1.26    0.00      0.384  o       |       | I     |       |     0.99
 9.417    1.30    0.00      0.393  o       |       | I     |       |     1.01
 9.500    1.30    0.00      0.402  o       |       | I     |       |     1.03
 9.583    1.33    0.00      0.411  o       |       |  I    |       |     1.05
 9.667    1.36    0.00      0.420  o       |       |  I    |       |     1.07
 9.750    1.37    0.00      0.429  o       |       |  I    |       |     1.09
 9.833    1.40    0.00      0.439  o       |       |   I   |       |     1.11
 9.917    1.43    0.00      0.449  o       |       |   I   |       |     1.14
10.000    1.43    0.00      0.458  o       |       |   I   |       |     1.16
10.083    1.26    0.00      0.468  o       |       | I     |       |     1.18
10.167    1.05    0.00      0.476  o       |      I|       |       |     1.20
10.250    1.01    0.00      0.483  o       |     I |       |       |     1.21
10.333    0.99    0.00      0.490  o       |     I |       |       |     1.23
10.417    0.98    0.00      0.496  o       |     I |       |       |     1.25
10.500    0.98    0.00      0.503  o       |     I |       |       |     1.26
10.583    1.11    0.00      0.510  o       |      I|       |       |     1.28
10.667    1.25    0.00      0.518  o       |       | I     |       |     1.30
10.750    1.29    0.00      0.527  o       |       | I     |       |     1.32
10.833    1.30    0.00      0.536  o       |       | I     |       |     1.34
10.917    1.31    0.00      0.545  o       |       | I     |       |     1.36
11.000    1.31    0.00      0.554  o       |       | I     |       |     1.38
11.083    1.28    0.00      0.563  o       |       | I     |       |     1.40
11.167    1.25    0.00      0.571  o       |       | I     |       |     1.42
11.250    1.25    0.00      0.580  o       |       |I      |       |     1.44
11.333    1.24    0.00      0.589  o       |       |I      |       |     1.46
11.417    1.24    0.00      0.597  o       |       |I      |       |     1.48
11.500    1.24    0.00      0.606  o       |       |I      |       |     1.50
11.583    1.19    0.00      0.614  o       |       |I      |       |     1.51
11.667    1.13    0.00      0.622  o       |       I       |       |     1.53
11.750    1.12    0.00      0.630  o       |       I       |       |     1.55
11.833    1.14    0.00      0.637  o       |       I       |       |     1.56
11.917    1.17    0.00      0.645  o       |       I       |       |     1.58
12.000    1.17    0.00      0.653  o       |       I       |       |     1.60
12.083    1.35    0.00      0.662  o       |       |  I    |       |     1.62
12.167    1.56    0.00      0.672  o       |       |    I  |       |     1.64
12.250    1.60    0.00      0.683  o       |       |     I|       |     1.66
12.333    1.65    0.00      0.694  o       |       |     I|       |     1.69
12.417    1.69    0.00      0.706  o       |       |      I       |     1.71
12.500    1.69    0.00      0.717  o       |       |      I       |     1.73
12.583    1.75    0.00      0.729  o       |       |       I      |     1.76
12.667    1.81    0.00      0.741  o       |       |       | I    |     1.79
12.750    1.82    0.00      0.754  o       |       |       | I    |     1.81
12.833    1.85    0.00      0.766  o       |       |       | I    |     1.84
12.917    1.88    0.00      0.779  o       |       |       |  I   |     1.87
13.000    1.89    0.00      0.792  o       |       |       |  I   |     1.89
13.083    2.02    0.00      0.806  o       |       |       |    I |     1.92
13.167    2.17    0.00      0.820  o       |       |       |     I|     1.95
13.250    2.20    0.00      0.835  o       |       |       |     I|     1.99
13.333    2.21    0.00      0.850  o       |       |       |     I|     2.02
13.417    2.22    0.00      0.865  o       |       |       |      I     2.05
13.500    2.22    0.00      0.881  o       |       |       |      I     2.08
13.583    1.94    0.00      0.895  o       |       |       |   I  |     2.10
13.667    1.62    0.00      0.907  o       |       |     I|      |     2.13
13.750    1.55    0.00      0.918  o       |       |    I |      |     2.15
13.833    1.52    0.00      0.929  o       |       |   I  |      |     2.17
13.917    1.50    0.00      0.939  o       |       |   I  |      |     2.19
14.000    1.50    0.00      0.949  o       |       |   I  |      |     2.21
14.083    1.60    0.00      0.960  o       |       |     I|      |     2.23
14.167    1.72    0.00      0.971  o       |       |      I      |     2.25
14.250    1.75    0.00      0.983  o       |       |       |I    |     2.28
14.333    1.73    0.00      0.995  o       |       |       I     |     2.30
14.417    1.71    0.00      1.007  o       |       |       I     |     2.33
14.500    1.70    0.00      1.019  o       |       |       I     |     2.35
14.583    1.70    0.00      1.031  o       |       |       I     |     2.37
14.667    1.70    0.00      1.042  o       |       |       I     |     2.39
14.750    1.70    0.00      1.054  o       |       |       I     |     2.42
14.833    1.67    0.00      1.065  o       |       |       I     |     2.44
14.917    1.64    0.00      1.077  o       |       |      I|     |     2.46
15.000    1.64    0.00      1.088  o       |       |      I|     |     2.48
15.083    1.61    0.01      1.099  o       |       |      I|     |     2.51
15.167    1.58    0.01      1.110  o       |       |     I |     |     2.53
15.250    1.57    0.01      1.121  o       |       |     I |     |     2.55
15.333    1.54    0.01      1.132  o       |       |     I |     |     2.57
15.417    1.51    0.01      1.142  o       |       |    I  |     |     2.59
15.500    1.51    0.01      1.153  o       |       |    I  |     |     2.60
15.583    1.40    0.01      1.163  o       |       |   I   |     |     2.62
15.667    1.28    0.01      1.172  o       |       | I     |     |     2.64
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15.750	1.26	0.01	1.181	O	|	| I	|	|	2.66
15.833	1.25	0.01	1.189	O	|	|I	|	|	2.67
15.917	1.24	0.01	1.198	O	|	|I	|	|	2.69
16.000	1.24	0.01	1.206	O	|	|I	|	|	2.70
16.083	0.86	0.01	1.213	O	| I	|	|	|	2.72
16.167	0.42	0.01	1.218	O I	|	|	|	|	2.73
16.250	0.32	0.01	1.220	O I	|	|	|	|	2.73
16.333	0.28	0.01	1.222	O I	|	|	|	|	2.73
16.417	0.26	0.01	1.224	O I	|	|	|	|	2.74
16.500	0.26	0.01	1.226	O I	|	|	|	|	2.74
16.583	0.24	0.01	1.228	O I	|	|	|	|	2.74
16.667	0.21	0.01	1.229	O I	|	|	|	|	2.75
16.750	0.20	0.01	1.230	O I	|	|	|	|	2.75
16.833	0.20	0.01	1.232	O I	|	|	|	|	2.75
16.917	0.20	0.01	1.233	O I	|	|	|	|	2.75
17.000	0.20	0.01	1.234	O I	|	|	|	|	2.76
17.083	0.25	0.01	1.236	O I	|	|	|	|	2.76
17.167	0.31	0.01	1.238	O I	|	|	|	|	2.76
17.250	0.32	0.01	1.240	O I	|	|	|	|	2.77
17.333	0.32	0.01	1.242	O I	|	|	|	|	2.77
17.417	0.33	0.01	1.244	O I	|	|	|	|	2.77
17.500	0.33	0.01	1.246	O I	|	|	|	|	2.78
17.583	0.33	0.01	1.249	O I	|	|	|	|	2.78
17.667	0.33	0.01	1.251	O I	|	|	|	|	2.79
17.750	0.33	0.01	1.253	O I	|	|	|	|	2.79
17.833	0.30	0.01	1.255	O I	|	|	|	|	2.79
17.917	0.27	0.01	1.257	O I	|	|	|	|	2.80
18.000	0.27	0.01	1.259	O I	|	|	|	|	2.80
18.083	0.26	0.01	1.261	O I	|	|	|	|	2.81
18.167	0.26	0.01	1.263	O I	|	|	|	|	2.81
18.250	0.26	0.01	1.264	O I	|	|	|	|	2.81
18.333	0.26	0.01	1.266	O I	|	|	|	|	2.81
18.417	0.26	0.01	1.268	O I	|	|	|	|	2.82
18.500	0.26	0.01	1.270	O I	|	|	|	|	2.82
18.583	0.24	0.01	1.271	O I	|	|	|	|	2.82
18.667	0.21	0.01	1.273	O I	|	|	|	|	2.83
18.750	0.20	0.01	1.274	O I	|	|	|	|	2.83
18.833	0.17	0.01	1.275	O I	|	|	|	|	2.83
18.917	0.14	0.01	1.276	O I	|	|	|	|	2.83
19.000	0.13	0.01	1.277	OI	|	|	|	|	2.84
19.083	0.16	0.01	1.278	O I	|	|	|	|	2.84
19.167	0.19	0.01	1.279	O I	|	|	|	|	2.84
19.250	0.19	0.01	1.281	O I	|	|	|	|	2.84
19.333	0.22	0.01	1.282	O I	|	|	|	|	2.84
19.417	0.25	0.01	1.284	O I	|	|	|	|	2.85
19.500	0.26	0.01	1.285	O I	|	|	|	|	2.85
19.583	0.23	0.01	1.287	O I	|	|	|	|	2.85
19.667	0.21	0.01	1.288	O I	|	|	|	|	2.86
19.750	0.20	0.01	1.290	O I	|	|	|	|	2.86
19.833	0.17	0.01	1.291	O I	|	|	|	|	2.86
19.917	0.14	0.01	1.292	O I	|	|	|	|	2.86
20.000	0.13	0.01	1.293	OI	|	|	|	|	2.86
20.083	0.16	0.01	1.294	O I	|	|	|	|	2.87
20.167	0.19	0.01	1.295	O I	|	|	|	|	2.87
20.250	0.19	0.01	1.296	O I	|	|	|	|	2.87
20.333	0.19	0.01	1.298	O I	|	|	|	|	2.87
20.417	0.20	0.01	1.299	O I	|	|	|	|	2.88
20.500	0.20	0.01	1.300	O I	|	|	|	|	2.88
20.583	0.20	0.01	1.302	O I	|	|	|	|	2.88
20.667	0.20	0.01	1.303	O I	|	|	|	|	2.88
20.750	0.20	0.01	1.304	O I	|	|	|	|	2.89
20.833	0.17	0.01	1.305	O I	|	|	|	|	2.89
20.917	0.14	0.01	1.306	O I	|	|	|	|	2.89
21.000	0.13	0.01	1.307	OI	|	|	|	|	2.89
21.083	0.16	0.01	1.308	O I	|	|	|	|	2.89
21.167	0.19	0.01	1.309	O I	|	|	|	|	2.90
21.250	0.19	0.01	1.311	O I	|	|	|	|	2.90
21.333	0.17	0.01	1.312	O I	|	|	|	|	2.90
21.417	0.14	0.01	1.313	O I	|	|	|	|	2.90
21.500	0.13	0.01	1.314	OI	|	|	|	|	2.90
21.583	0.16	0.01	1.315	O I	|	|	|	|	2.91
21.667	0.19	0.01	1.316	O I	|	|	|	|	2.91
21.750	0.19	0.01	1.317	O I	|	|	|	|	2.91
21.833	0.17	0.01	1.318	O I	|	|	|	|	2.91
21.917	0.14	0.01	1.319	O I	|	|	|	|	2.91
22.000	0.13	0.01	1.320	OI	|	|	|	|	2.92
22.083	0.16	0.01	1.321	O I	|	|	|	|	2.92
22.167	0.19	0.01	1.322	O I	|	|	|	|	2.92
22.250	0.19	0.01	1.324	O I	|	|	|	|	2.92
22.333	0.17	0.01	1.325	O I	|	|	|	|	2.92
22.417	0.14	0.01	1.326	O I	|	|	|	|	2.93
22.500	0.13	0.01	1.327	OI	|	|	|	|	2.93
22.583	0.13	0.01	1.328	OI	|	|	|	|	2.93
22.667	0.13	0.01	1.329	OI	|	|	|	|	2.93
22.750	0.13	0.01	1.330	OI	|	|	|	|	2.93
22.833	0.13	0.01	1.330	OI	|	|	|	|	2.93

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22.917    0.13    0.01      1.331  OI      |       |       |       |     2.94
23.000    0.13    0.01      1.332  OI      |       |       |       |     2.94
23.083    0.13    0.01      1.333  OI      |       |       |       |     2.94
23.167    0.13    0.01      1.334  OI      |       |       |       |     2.94
23.250    0.13    0.01      1.335  OI      |       |       |       |     2.94
23.333    0.13    0.01      1.336  OI      |       |       |       |     2.94
23.417    0.13    0.01      1.336  OI      |       |       |       |     2.95
23.500    0.13    0.01      1.337  OI      |       |       |       |     2.95
23.583    0.13    0.01      1.338  OI      |       |       |       |     2.95
23.667    0.13    0.01      1.339  OI      |       |       |       |     2.95
23.750    0.13    0.01      1.340  OI      |       |       |       |     2.95
23.833    0.13    0.01      1.341  OI      |       |       |       |     2.95
23.917    0.13    0.01      1.342  OI      |       |       |       |     2.95
24.000    0.13    0.01      1.342  OI      |       |       |       |     2.96
24.083    0.08    0.01      1.343  OI      |       |       |       |     2.96
24.167    0.02    0.01      1.343  O       |       |       |       |     2.96
24.250    0.01    0.01      1.343  O       |       |       |       |     2.96
24.333    0.00    0.01      1.343  O       |       |       |       |     2.96
24.417    0.00    0.01      1.343  O       |       |       |       |     2.96

Remaining water in basin =    1.34 (Ac.Ft)

*****************************HYDROGRAPH DATA*****************************
               Number of intervals =   293
               Time interval =    5.0 (Min.)
               Maximum/Peak flow rate =        0.006 (CFS)
               Total volume =       0.007 (Ac.Ft)
       Status of hydrographs being held in storage
                  Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
       Peak (CFS)      0.000     0.000     0.000     0.000     0.000
       Vol (Ac.Ft)     0.000     0.000     0.000     0.000     0.000
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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.1on 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.**

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! Hyperlink reference not valid.** ☒ **Provide IPM information to new owners, lessees and operators.**

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**

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/

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**

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):** ❑ **Washwater 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.**

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/

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.**

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**

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		
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
☒ 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

Operations & Maintenance Responsibility for Treatment Control BMP's

BMP Required Maintenance	Frequency	Maintenance Requirements	Responsibility
Trash	Weekly	Empty Dumpsters	Property Owner
Roof Drains/ Gutters	Before wet season, or significant rain event, or when needed	Roof Gutters shall be visually inspected for defects and possible leakage. Damage or defects found shall be corrected as soon as possible. Owners should avoid use of gutters, roofing, and trim made of copper so as to prevent the metal from leaching into runoff.	Property Owner
Infiltration Basin	Ongoing including just before annual storm seasons and following rainfall events. Annually. If possible, schedule these inspections within 72 hours after a significant rainfall	Maintain vegetation as needed. Use of fertilizers, pesticides and herbicides should be strenuously avoided to ensure they don't contribute to water pollution. If appropriate native plant selections and other IPM methods are used, such products shouldn't be needed. If such projects are used, o Products shall be applied in accordance with their labeling, especially in relation to application to water, and in areas subjected to flooding. o Fertilizers should not be applied within 15 days before, after, or during the rain season. Remove debris and litter from the entire basin to minimize clogging and improve aesthetics. Check for obvious problems and repair as needed. Address odor, insects, and overgrowth issues associated with stagnant or standing water in the basin bottom. There should be no long-term ponding water. Check for erosion and sediment laden areas in the basin. Repair as needed. Clean forebay if needed. Revegetate side slopes where needed. Inspection of hydraulic and structural facilities. Examine the inlet for blockage, the embankment and spillway integrity, as well as damage to any structural element. Check for erosion, slumping and overgrowth. Repair as needed. Check basin depth for sediment build up and reduced total capacity. Scrape bottom as needed and remove sediment. Restore to original cross-section and infiltration rate. Replant basin vegetation. Verify the basin bottom is allowing acceptable infiltration. Use a disc or other method to aerate basin bottom only if there is actual significant loss of infiltrative capacity, rather than on a routine basis No water should be present 72 hours after an event. No long term standing water should be present at all. No algae formation should be visible. Correct problem as needed.	Home Owners Association
Self-Retaining/ Landscape Areas	Bi-Weekly	Mow, weed, trim and remove accumulation of trash debris and/or sediment. Retaining areas should be mowed at 4-6 inches in height if grass is proposed. **Maintain landscaping using minimal pesticides**	Home Owners Association

BMP's should start and be inspected prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.

Funding

Funding for Ongoing Maintenance will be provided by the Home Owner's Association.

Basin Site Maintenance Summary Form

Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
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Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		

Appendix 10:Educational Materials

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

3.1 INFILTRATION BASIN

Type of BMP	LID - Infiltration
Treatment Mechanisms	Infiltration, Evapotranspiration (when vegetated), Evaporation, and Sedimentation
Maximum Treatment Area	50 acres
Other Names	Bioinfiltration Basin

Description

An Infiltration Basin is a flat earthen basin designed to capture the design capture volume, V_{BMP}. The stormwater infiltrates through the bottom of the basin into the underlying soil over a 72 hour drawdown period. Flows exceeding V_{BMP} must discharge to a downstream conveyance system. Trash and sediment accumulate within the forebay as stormwater passes into the basin. Infiltration basins are highly effective in removing all targeted pollutants from stormwater runoff.

Figure 1 – Infiltration Basin

See Appendix A, and Appendix C, Section 1 of *Basin Guidelines*, for additional requirements.

Siting Considerations

The use of infiltration basins may be restricted by concerns over ground water contamination, soil permeability, and clogging at the site. See the applicable WQMP for any specific feasibility considerations for using infiltration BMPs. Where this BMP is being used, the soil beneath the basin must be thoroughly evaluated in a geotechnical report since the underlying soils are critical to the basin's long term performance. To protect the basin from erosion, the sides and bottom of the basin must be vegetated, preferably with native or low water use plant species.

In addition, these basins may not be appropriate for the following site conditions:

- Industrial sites or locations where spills of toxic materials may occur
- Sites with very low soil infiltration rates
- Sites with high groundwater tables or excessively high soil infiltration rates, where pollutants can affect ground water quality
- Sites with unstabilized soil or construction activity upstream
- On steeply sloping terrain
- Infiltration basins located in a fill condition should refer to Appendix A of this Handbook for details on special requirements/restrictions

Setbacks

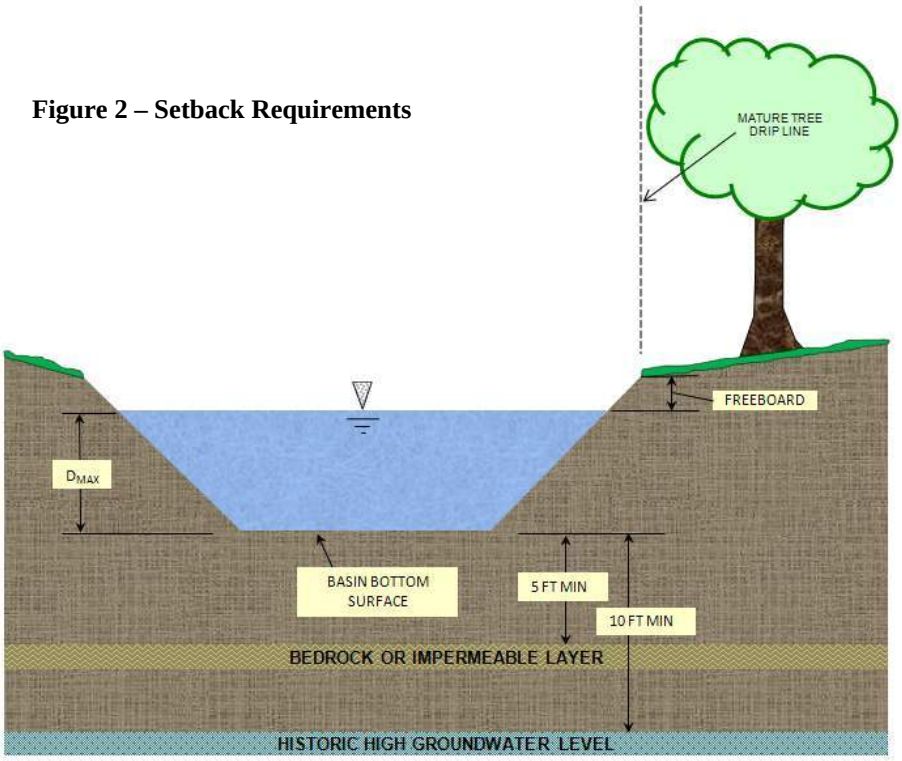
Always consult your geotechnical engineer for site specific recommendations regarding setbacks for infiltration trenches. Recommended setbacks are needed to protect buildings, existing trees, walls, onsite or nearby wells, streams, and tanks. Setbacks should be considered early in the design process since they can affect where infiltration facilities may be placed and how deep they are allowed to be. For instance, depth setbacks can dictate fairly shallow facilities that will have a larger footprint and, in some cases, may make an infiltration basin infeasible. In that instance, another BMP must be selected.

Infiltration basins typically must be set back:

- 10 feet from the historic high groundwater (measured vertically from the bottom of the basin, as shown in Figure 2)
- 5 feet from bedrock or impermeable surface layer (measured vertically from the bottom of the basin, as shown in Figure 2)
- From all existing mature tree drip lines as indicated in Figure 2 (to protect their root structure)
- 100 feet horizontally from wells, tanks or springs

Setbacks to walls and foundations must be included as part of the Geotechnical Report. All other setbacks shall be in accordance with applicable standards of the District's *Basin Guidelines* (Appendix C).

Figure 2 – Setback Requirements



Forebay

A concrete forebay shall be provided to reduce sediment clogging and to reduce erosion. The forebay shall have a design volume of at least 0.5% V_{BMP} and a minimum 1 foot high concrete splashwall / berm. Full height notch-type weir(s), offset from the line of flow from the basin inlet to prevent short circuiting, shall be used to outlet the forebay. It is recommended that two weirs be used and that they be located on opposite sides of the forebay (see Figure 2).

Overflow

Flows exceeding V_{BMP} must discharge to an acceptable downstream conveyance system. Where an adequate outlet is present, an overflow structure may be used. Where an embankment is present, an emergency spillway may be used instead. Overflows must be placed just above the design water surface for V_{BMP} and be near the outlet of the system. The overflow structure shall be similar to the District's Standard Drawing CB 110. Additional details may be found in the District's *Basin Guidelines* (Appendix C).

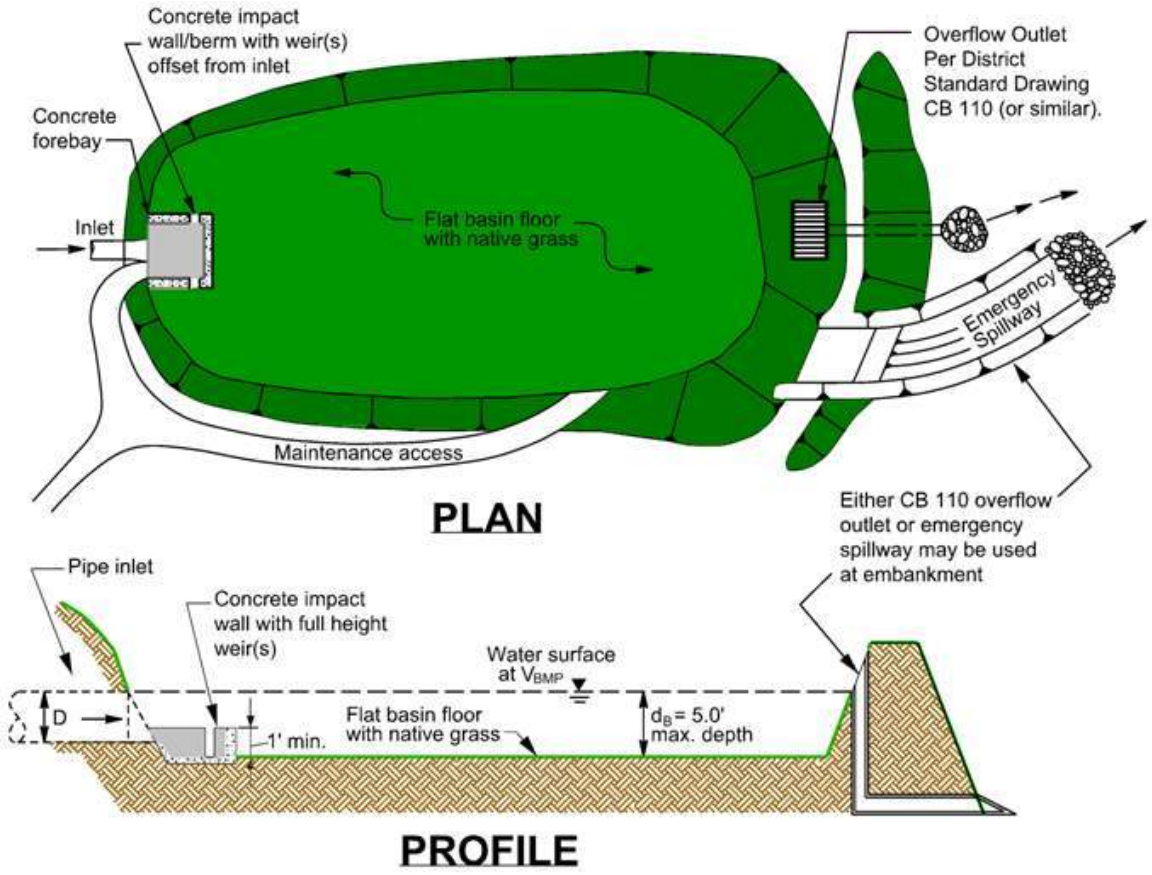


Figure 3 – Infiltration Basin

Landscaping Requirements

Basin vegetation provides erosion protection, improves sediment removal and assists in allowing infiltration to occur. The basin surface and side slopes shall be planted with native grasses. Proper landscape management is also required to ensure that the vegetation does not contribute to water pollution through pesticides, herbicides, or fertilizers. Landscaping shall be in accordance with County of Riverside Ordinance 859 and the District's *Basin Guidelines* (Appendix C), or other guidelines issued by the Engineering Authority.

Maintenance

Normal maintenance of an infiltration basin includes the maintenance of landscaping, debris and trash removal from the surface of the basin, and tending to problems associated with standing water (vectors, odors, etc.). Significant ponding, especially more than 72 hours after an event, may indicate that the basin surface is no longer providing sufficient infiltration and requires aeration. See the District's *Basin Guidelines* (Appendix C) for additional requirements (i.e., fencing, maintenance access, etc.).

Table 1 - Inspection and Maintenance

Schedule	Inspection and Maintenance Activity
Ongoing including just before annual storm seasons and following rainfall events.	• Maintain vegetation as needed. Use of fertilizers, pesticides and herbicides should be strenuously avoided to ensure they don't contribute to water pollution. If appropriate native plant selections and other IPM methods are used, such products shouldn't be needed. If such projects are used, o Products shall be applied in accordance with their labeling, especially in relation to application to water, and in areas subjected to flooding. o Fertilizers should not be applied within 15 days before, after, or during the rain season. • Remove debris and litter from the entire basin to minimize clogging and improve aesthetics. • Check for obvious problems and repair as needed. Address odor, insects, and overgrowth issues associated with stagnant or standing water in the basin bottom. There should be no long-term ponding water. • Check for erosion and sediment laden areas in the basin. Repair as needed. Clean forebay if needed. • Revegetate side slopes where needed.
Annually. If possible, schedule these inspections within 72 hours after a significant rainfall.	• Inspection of hydraulic and structural facilities. Examine the inlet for blockage, the embankment and spillway integrity, as well as damage to any structural element. • Check for erosion, slumping and overgrowth. Repair as needed. • Check basin depth for sediment build up and reduced total capacity. Scrape bottom as needed and remove sediment. Restore to original cross-section and infiltration rate. Replant basin vegetation. • Verify the basin bottom is allowing acceptable infiltration. Use a disc or other method to aerate basin bottom only if there is actual significant loss of infiltrative capacity, rather than on a routine basis[1]. • No water should be present 72 hours after an event. No long term standing water should be present at all. No algae formation should be visible. Correct problem as needed.

1. **CA Stormwater BMP Handbook for New Development and Significant Redevelopment**

Table 2 - Design and Sizing Criteria for Infiltration Basins

Design Parameter	Infiltration Basin
Design Volume	V_{BMP}
Forebay Volume	0.5% V_{BMP}
Drawdown time (maximum)	72 hours
Maximum tributary area	50 acres [2]
Minimum infiltration rate	Must be sufficient to drain the basin within the required Drawdown time over the life of the BMP. The WQMP may include specific requirements for minimum tested infiltration rates.
Maximum Depth	5 feet
Spillway erosion control	Energy dissipators to reduce velocities[1]
Basin Slope	0%
Freeboard (minimum)	1 foot [1]
Historic High Groundwater Setback (max)	10 feet
Bedrock/impermeable layer setback (max)	5 feet
Tree setbacks	Mature tree drip line must not overhang the basin
Set back from wells, tanks or springs	100 feet
Set back from foundations	As recommended in Geotechnical Report

1. **Ventura County's Technical Guidance Manual for Stormwater Quality Control Measures**
2. **CA Stormwater BMP Handbook for New Development and Significant Redevelopment**

Note: The information contained in this BMP Factsheet is intended to be a summary of design considerations and requirements. Additional information which applies to all detention basins may be found in the District's Basin Guidelines (Appendix C). In addition, information herein may be superseded by other guidelines issued by the co-permittee.

INFILTRATION BASIN SIZING PROCEDURE

1. Find the Design Volume, V_{BMP}.
   a) Enter the Tributary Area, $A_{T.}$
   b) Enter the Design Volume, V_{BMP}, determined from Section 2.1 of this Handbook.
2. Determine the Maximum Depth.
   a) Enter the infiltration rate. The infiltration rate shall be established as described in Appendix A: "Infiltration Testing".
   b) Enter the design Factor of Safety from Table 1 in Appendix A: "Infiltration Testing".
   c) The spreadsheet will determine D_1, the maximum allowable depth of the basin based on the infiltration rate along with the maximum drawdown time (72 hours) and the Factor of Safety.

$$D_1 = [(t) \times (I)] / 12s$$

Where I = site infiltration rate (in/hr)
s = safety factor
t = drawdown time (maximum 72 hours)

d) Enter the depth of freeboard.

e) Enter the depth to the historic high groundwater level measured from the top of the basin.

f) Enter the depth to the top of bedrock or other impermeable layer measured from the finished grade.

g) The spreadsheet will determine D_2, the total basin depth (including freeboard, if used) of the basin, based on restrictions to the depth by groundwater and an impermeable layer.

D_2 = Depth to groundwater – (10 + freeboard) (ft);

or

D_2 = Depth to impermeable layer – (5 + freeboard) (ft)

Whichever is least.

h) The spreadsheet will determine the maximum allowable effective depth of basin, D_{MAX}, based on the smallest value between D_1 and D_2. D_{MAX} is the maximum depth of water only and does not include freeboard. D_{MAX} shall not exceed 5 feet.

3. Basin Geometry

a) Enter the basin side slopes, z (no steeper than 4:1).

b) Enter the proposed basin depth, d_B excluding freeboard.

c) The spreadsheet will determine the minimum required surface area of the basin:

$$A_s = V_{BMP} / d_B$$

Where A_s = minimum area required (ft^2)
V_{BMP} = volume of the infiltration basin (ft^3)
d_B= proposed depth not to exceed maximum allowable depth, D_{MAX} (ft)

d) Enter the proposed bottom surface area. This area shall not be less than the minimum required surface area.

4. Forebay

A concrete forebay with a design volume of at least 0.5% V_{BMP} and a minimum 1 foot high concrete splashwall shall be provided. Full-height rectangular weir(s) shall be used to outlet the forebay. The weir(s) must be offset from the line of flow from the basin inlet. It is recommended that two weirs be used and that they be located on opposite sides of the forebay (see Figure 2).

a) The spreadsheet will determine the minimum required forebay volume based on 0.5% V_{BMP}.

b) Enter the proposed depth of the forebay berm/splashwall (1foot minimum).

c) The spreadsheet will determine the minimum required forebay surface area.

d) Enter the width of rectangular weir to be used (minimum 1.5 inches). Weir width should be established based on a 5 minute drawdown time.

3.5 Bioretention Facility

Type of BMP	LID – Bioretention
Treatment Mechanisms	Infiltration, Evapotranspiration, Evaporation, Biofiltration
Maximum Drainage Area	This BMP is intended to be integrated into a project's landscaped area in a distributed manner. Typically, contributing drainage areas to Bioretention Facilities range from less than 1 acre to a maximum of around 10 acres.
Other Names	Rain Garden, Bioretention Cell, Bioretention Basin, Biofiltration Basin, Landscaped Filter Basin, Porous Landscape Detention

Description

Bioretention Facilities are shallow, vegetated basins underlain by an engineered soil media. Healthy plant and biological activity in the root zone maintain and renew the macro-pore space in the soil and maximize plant uptake of pollutants and runoff. This keeps the Best Management Practice (BMP) from becoming clogged and allows more of the soil column to function as both a sponge (retaining water) and a highly effective and self-maintaining biofilter. In most cases, the bottom of a Bioretention Facility is unlined, which also provides an opportunity for infiltration to the extent the underlying onsite soil can accommodate. When the infiltration rate of the underlying soil is exceeded, fully biotreated flows are discharged via underdrains. Bioretention Facilities therefore will inherently achieve the maximum feasible level of infiltration and evapotranspiration and achieve the minimum feasible (but highly biotreated) discharge to the storm drain system.

Siting Considerations

These facilities work best when they are designed in a relatively level area. Unlike other BMPs, Bioretention Facilities can be used in smaller landscaped spaces on the site, such as:

- ✓ Parking islands
- ✓ Medians
- ✓ Site entrances

Landscaped areas on the site (such as may otherwise be required through minimum landscaping ordinances), can often be designed as Bioretention Facilities. This can be accomplished by:

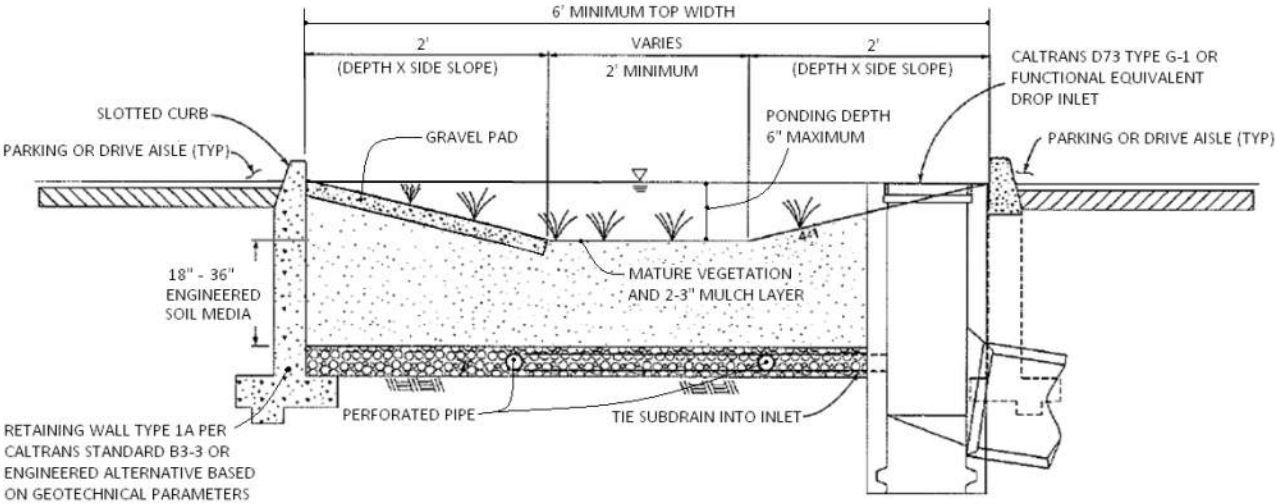
- *Depressing* landscaped areas below adjacent impervious surfaces, rather than elevating those areas
- Grading the site to direct runoff from those impervious surfaces *into* the Bioretention Facility, rather than away from the landscaping
- Sizing and designing the depressed landscaped area as a Bioretention Facility as described in this Fact Sheet

Bioretention Facilities should however not be used downstream of areas where large amounts of sediment can clog the system. Placing a Bioretention Facility at the toe of a steep slope should also be avoided due to the potential for clogging the engineered soil media with erosion from the slope, as well as the potential for damaging the vegetation.

Design and Sizing Criteria

The recommended cross section necessary for a Bioretention Facility includes:

- Vegetated area
- 18' minimum depth of engineered soil media
- 12' minimum gravel layer depth with 6' perforated pipes (added flow control features such as orifice plates may be required to mitigate for HCOC conditions)



While the 18-inch minimum engineered soil media depth can be used in some cases, it is recommended to use 24 inches or a preferred 36 inches to provide an adequate root zone for the chosen plant palate. Such a design also provides for improved removal effectiveness for nutrients. The recommended ponding depth inside of a Bioretention Facility is 6 inches; measured from the flat bottom surface to the top of the water surface as shown in Figure 1.

Because this BMP is filled with an engineered soil media, pore space in the soil and gravel layer is assumed to provide storage volume. However, several considerations must be noted:

- Surcharge storage above the soil surface (6 inches) is important to assure that design flows do not bypass the BMP when runoff exceeds the soil's absorption rate.
- In cases where the Bioretention Facility contains engineered soil media deeper than 36 inches, the pore space within the engineered soil media can only be counted to the 36-inch depth.
- A maximum of 30 percent pore space can be used for the soil media whereas a maximum of 40 percent pore space can be use for the gravel layer.

Figure 1: Standard Layout for a Bioretention Facility

Engineered Soil Media Requirements

The engineered soil media shall be comprised of 85 percent mineral component and 15 percent organic component, by volume, drum mixed prior to placement. The mineral component shall be a Class A sandy loam topsoil that meets the range specified in Table 1 below. The organic component shall be nitrogen stabilized compost[1], such that nitrogen does not leach from the media.

Table 1: Mineral Component Range Requirements

Percent Range	Component
70-80	Sand
15-20	Silt
5-10	Clay

The trip ticket, or certificate of compliance, shall be made available to the inspector to prove the engineered mix meets this specification.

Vegetation Requirements

Vegetative cover is important to minimize erosion and ensure that treatment occurs in the Bioretention Facility. The area should be designed for at least 70 percent mature coverage throughout the Bioretention Facility. To prevent the BMP from being used as walkways, Bioretention Facilities shall be planted with a combination of small trees, densely planted shrubs, and natural grasses. Grasses shall be native or ornamental; preferably ones that do not need to be mowed. The application of fertilizers and pesticides should be minimal. To maintain oxygen levels for the vegetation and promote biodegradation, it is important that vegetation not be completely submerged for any extended period of time. Therefore, a maximum of 6 inches of ponded water shall be used in the design to ensure that plants within the Bioretention Facility remain healthy.

A 2 to 3-inch layer of standard shredded aged hardwood mulch shall be placed as the top layer inside the Bioretention Facility. The 6-inch ponding depth shown in Figure 1 above shall be measured from the top surface of the 2 to 3-inch mulch layer.

Curb Cuts

To allow water to flow into the Bioretention Facility, 1-foot-wide (minimum) curb cuts should be placed approximately every 10 feet around the perimeter of the Bioretention Facility. Figure 2 shows a curb cut in a Bioretention Facility. Curb cut flow lines must be at or above the V_{BMP} water surface level.

[1] For more information on compost, visit the US Composting Council website at: http://compostingcouncil.org/

Figure 2: Curb Cut located in a Bioretention Facility

To reduce erosion, a gravel pad shall be placed at each inlet point to the Bioretention Facility. The gravel should be 1- to 1.5-inch diameter in size. The gravel should overlap the curb cut opening a minimum of 6 inches. The gravel pad inside the Bioretention Facility should be flush with the finished surface at the curb cut and extend to the bottom of the slope.

In addition, place an apron of stone or concrete, a foot square or larger, inside each inlet to prevent vegetation from growing up and blocking the inlet. See Figure 3.

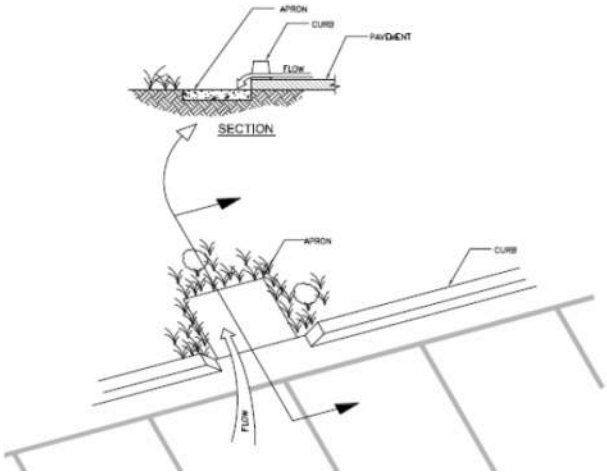


Figure 3: Apron located in a Bioretention Facility

Terracing the Landscaped Filter Basin

It is recommended that Bioretention Facilities be level. In the event the facility site slopes and lacks proper design, water would fill the lowest point of the BMP and then discharge from the basin without being treated. To ensure that the water will be held within the Bioretention Facility on sloped sites, the BMP must be terraced with nonporous check dams to provide the required storage and treatment capacity.

The terraced version of this BMP shall be used on non-flat sites with no more than a 3 percent slope. The surcharge depth cannot exceed 0.5 feet, and side slopes shall not exceed 4:1. Table 2 below shows the spacing of the check dams, and slopes shall be rounded up (i.e., 2.5 percent slope shall use 10' spacing for check dams).

Table 2: Check Dam Spacing

6" Check Dam Spacing	
Slope	**Spacing**
1%	*25'*
2%	*15'*
3%	*10'*

Roof Runoff

Roof downspouts may be directed towards Bioretention Facilities. However, the downspouts must discharge onto a concrete splash block to protect the Bioretention Facility from erosion.

Retaining Walls

It is recommended that Retaining Wall Type 1A, per Caltrans Standard B3-3 or equivalent, be constructed around the entire perimeter of the Bioretention Facility. This practice will protect the sides of the Bioretention Facility from collapsing during construction and maintenance or from high service loads adjacent to the BMP. Where such service loads would not exist adjacent to the BMP, an engineered alternative may be used if signed by a licensed civil engineer.

Side Slope Requirements

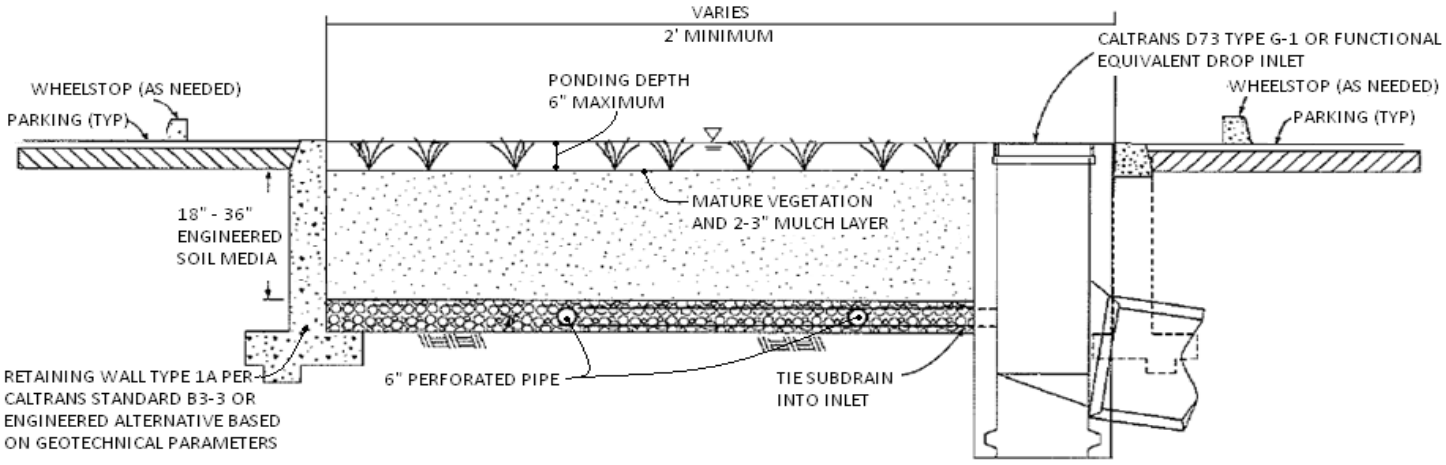
Bioretention Facilities Requiring Side Slopes

The design should assure that the Bioretention Facility does not present a tripping hazard. Bioretention Facilities proposed near pedestrian areas, such as areas parallel to parking spaces or along a walkway, must have a gentle slope to the bottom of the facility. Side slopes inside of a Bioretention Facility shall be 4:1. A typical cross section for the Bioretention Facility is shown in Figure 1.

Bioretention Facilities Not Requiring Side Slopes

Where cars park perpendicular to the Bioretention Facility, side slopes are not required. A 6-inch maximum drop may be used, and the Bioretention Facility must be planted with trees and shrubs to prevent pedestrian access. In this case, a curb is not placed around the Bioretention Facility,

but wheel stops shall be used to prevent vehicles from entering the Bioretention Facility, as shown in Figure 4.



Planter Boxes

Bioretention Facilities can also be placed above ground as planter boxes. Planter boxes must have a minimum width of 2 feet, a maximum surcharge depth of 6 inches, and no side slopes are necessary. Planter boxes must be constructed so as to ensure that the top surface of the engineered soil media will remain level. This option may be constructed of concrete, brick, stone or other stable materials that will not warp or bend. Chemically treated wood or galvanized steel, which has the ability to contaminate stormwater, should not be used. Planter boxes must be lined with an impermeable liner on all sides, including the bottom. Due to the impermeable liner, the inside bottom of the planter box shall be designed and constructed with a cross fall, directing treated flows within the subdrain layer toward the point where subdrain exits the planter box, and subdrains shall be oriented with drain holes oriented down. These provisions will help avoid excessive stagnant water within the gravel underdrain layer. Similar to the in-ground Bioretention Facility versions, this BMP benefits from healthy plants and biological activity in the root zone. Planter boxes should be planted with appropriately selected vegetation.

Figure 5: Planter Box
Source: LA Team Effort

Overflow

An overflow route is needed in the Bioretention Facility design to bypass stored runoff from storm events larger than V_{BMP} or in the event of facility or subdrain clogging. Overflow systems must connect to an acceptable discharge point, such as a downstream conveyance system as shown in Figure 1 and Figure 4. The inlet to the overflow structure shall be elevated inside the Bioretention Facility to be flush with the ponding surface for the design capture volume (V_{BMP}) as shown in Figure 4. This will allow the design capture volume to be fully treated by the Bioretention Facility, and for larger events to safely be conveyed to downstream systems. The overflow inlet shall **not** be located in the entrance of a Bioretention Facility, as shown in Figure 6.

Underdrain Gravel and Pipes

An underdrain gravel layer and pipes shall be provided in accordance with Appendix B – Underdrains.

Figure 6: Incorrect Placement of an Overflow Inlet.

Inspection and Maintenance Schedule

The Bioretention Facility area shall be inspected for erosion, dead vegetation, soggy soils, or standing water. The use of fertilizers and pesticides on the plants inside the Bioretention Facility should be minimized.

Schedule	Activity
Ongoing	• Keep adjacent landscape areas maintained. Remove clippings from landscape maintenance activities. • Remove trash and debris • Replace damaged grass and/or plants • Replace surface mulch layer as needed to maintain a 2-3 inch soil cover.
After storm events	• Inspect areas for ponding
Annually	• Inspect/clean inlets and outlets

Bioretention Facility Design Procedure

1) Enter the area tributary, A_T, to the Bioretention Facility.

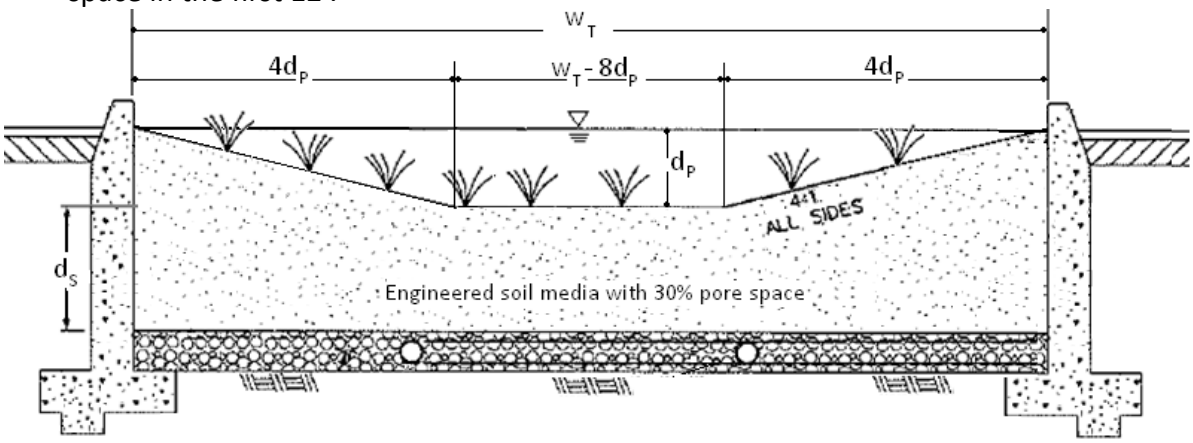
2) Enter the Design Volume, $V_{BMP,}$ determined from Section 2.1 of this Handbook.

3) Select the type of design used. There are two types of Bioretention Facility designs: the standard design used for most project sites that include side slopes, and the modified design used when the BMP is located perpendicular to the parking spaces or with planter boxes that do not use side slopes.

4) Enter the depth of the engineered soil media, d_S. The minimum depth for the engineered soil media can be 18' in limited cases, but it is recommended to use 24' or a preferred 36' to provide an adequate root zone for the chosen plant palette. Engineered soil media deeper than 36' will only get credit for the pore space in the first 36'.

5) Enter the top width of the Bioretention Facility.

6) Calculate the total effective depth, d_E, within the Bioretention Facility. The maximum allowable pore space of the soil media is 30% while the maximum allowable pore space for the gravel layer is 40%. Gravel layer deeper than 12' will only get credit for the pore space in the first 12'.



a. For the design with side slopes the following equation shall be used to determine the total effective depth. Where, d_P is the depth of ponding within the basin.

$$d_E(\text{ft}) = \frac{0.3 \times \left[\left(w_T(\text{ft}) \times d_S(\text{ft})\right) + 4\left(d_P(\text{ft})\right)^2\right] + 0.4 \times 1(\text{ft}) + d_P(\text{ft})\left[4d_P(\text{ft}) + \left(w_T(\text{ft}) - 8d_P(\text{ft})\right)\right]}{w_T(\text{ft})}$$

This above equation can be simplified if the maximum ponding depth of 0.5' is used. The equation below is used on the worksheet to find the minimum area required for the Bioretention Facility:

$$d_E(\text{ft}) = (0.3 \times d_S(\text{ft}) + 0.4 \text{ x } 1(\text{ft})) - \left(\frac{0.7\ (\text{ft}^2)}{w_T(\text{ft})}\right) + 0.5(\text{ft})$$

b. For the design without side slopes the following equation shall be used to determine the total effective depth:

$$d_E(\text{ft}) = d_P(\text{ft}) + [(0.3) \times d_S(\text{ft}) + (0.4) \times 1(\text{ft})]$$

The equation below, using the maximum ponding depth of 0.5', is used on the worksheet to find the minimum area required for the Bioretention Facility:

$$d_E(\text{ft}) = 0.5\ (\text{ft}) + [(0.3) \times d_S(\text{ft}) + (0.4) \times 1(\text{ft})]$$

7) Calculate the minimum surface area, A_M, required for the Bioretention Facility. This does not include the curb surrounding the Bioretention Facility or side slopes.

$$A_M(\text{ft}^2) = \frac{V_{BMP}(\text{ft}^3)}{d_E\ (\text{ft})}$$

8) Enter the proposed surface area. This area shall not be less than the minimum required surface area.

9) Verify that side slopes are no steeper than 4:1 in the standard design, and are not required in the modified design.

10) Provide the diameter, minimum 6 inches, of the perforated underdrain used in the Bioretention Facility. See Appendix B for specific information regarding perforated pipes.

11) Provide the slope of the site around the Bioretention Facility, if used. The maximum slope is 3 percent for a standard design.

12) Provide the check dam spacing, if the site around the Bioretention Facility is sloped.

13) Describe the vegetation used within the Bioretention Facility.

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