Appendix H

Water Quality Management Plan

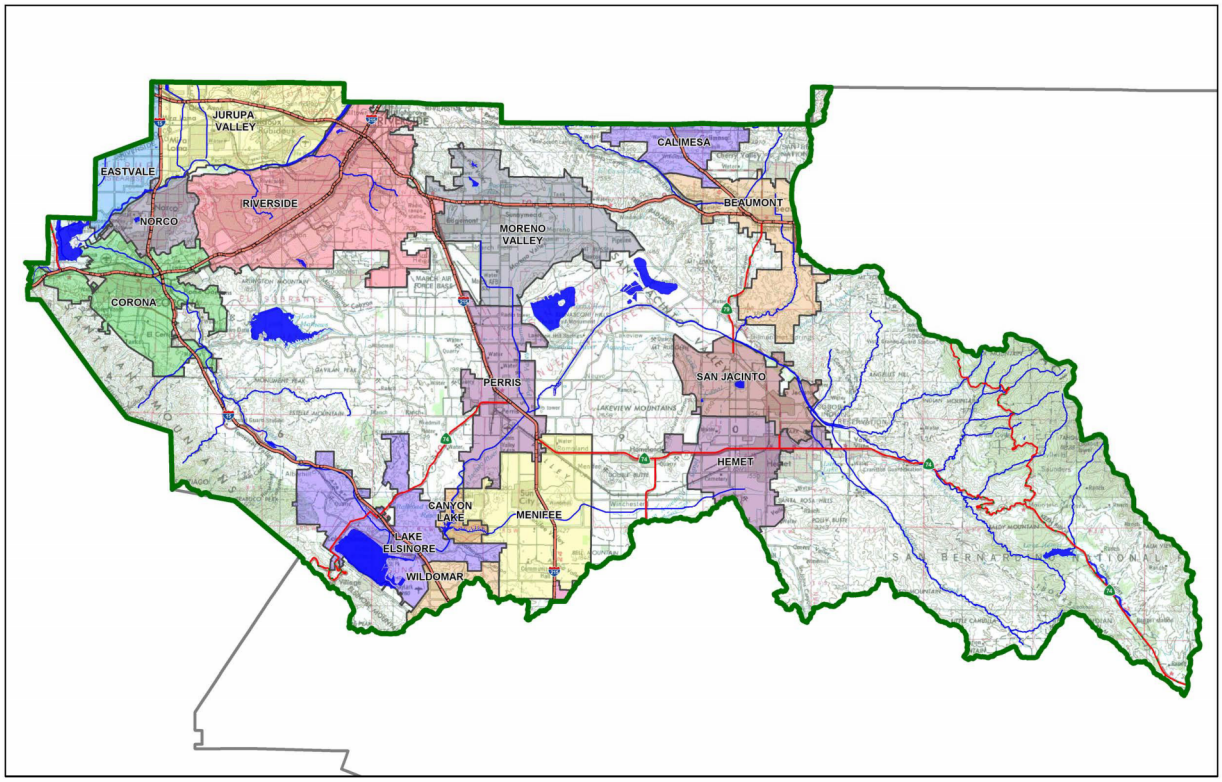
Project Specific Water Quality Management Plan

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

Project Title: Rocas Grandes Apartments II

Development No:

Design Review/Case No:



☒ **Preliminary**
☐ **Final**

Original Date Prepared: July 2024

Revision Date(s): February 2025

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

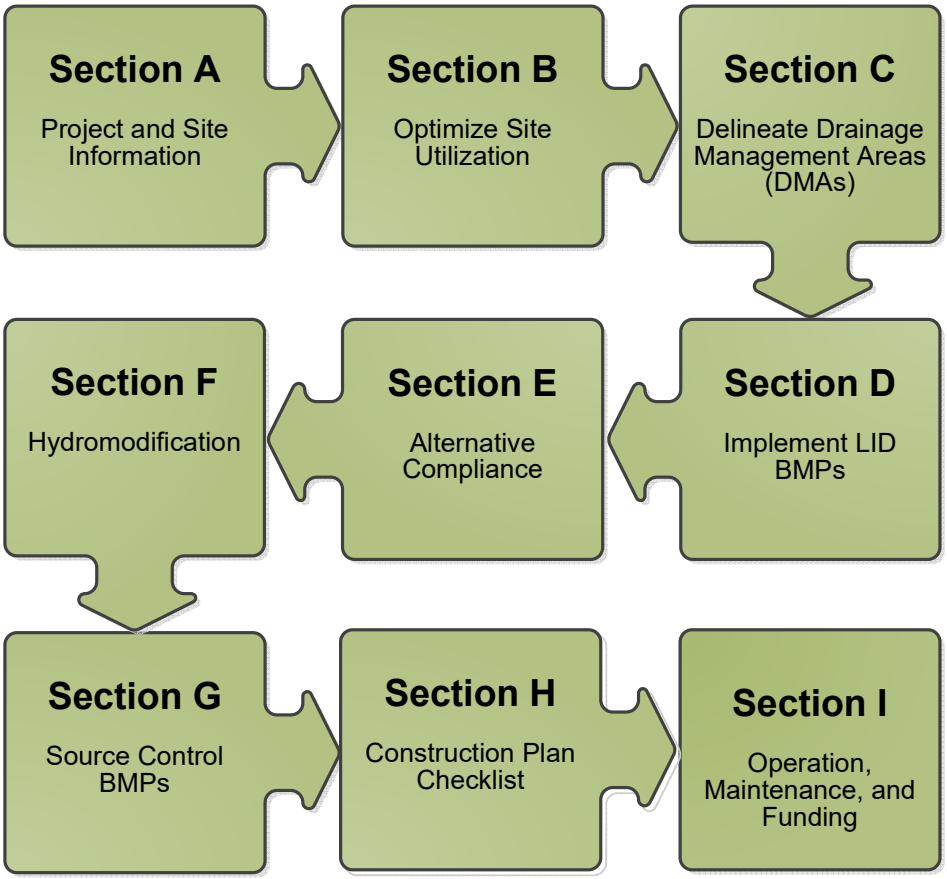
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A Brief Introduction

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 SEC Allesandro Darwin, LLC by Pasco Laret Suiter & Associates for the Rocas Grandes II Apartments project.

This WQMP is intended to comply with the requirements of Moreno Valley for Riverside County Ordinance No. 827 which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

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

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

Owner's Signature	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."

DRAFT

Preparer's Signature	02-18-2025 Date
W. Justin Suiter Preparer's Printed Name	President Preparer's Title/Position

Preparer's Licensure:



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Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	Multifamily Apartments
Planning Area:	R30
Community Name:	Moreno Valley
Development Name:	Rocas Grandes Apartments II
PROJECT LOCATION	
Latitude & Longitude (DMS): N 33°54'55", W 117°12'12"	
Project Watershed and Sub-Watershed: Lower San Jacinto River & Moreno Valley	
APN(s): 486-280-002 & -004	
Map Book and Page No.: Book 11, Page 10	
PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	Multifamily
Proposed or Potential SIC Code(s)	N/A
Area of Impervious Project Footprint (SF)	632,498
Total Area of proposed Impervious Surfaces within the Project Limits (SF)/or Replacement	538,757 ; 93,741 public
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 (SF)	0
Is the project located within any MSHCP Criteria Cell?	☐ Y ☒ N
If so, identify the Cell number:	
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)	
What is the Water Quality Design Storm Depth for the project?	0.66 Inches

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

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

A.2 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
Perris Valley Storm Drain	None	None	N/A
San Jacinto Reach 3	None	AGR, GWR, MUN, REC-1, REC-2, WILD, WARM, RARE	9 Miles
Canyon Lake (Railroad Canyon Reservoir)- San Jacinto Reach 2	Nutrients, Pathogens	AGR, GWR, MUN, REC-1, REC-2, COMM, WILD, WARM, RARE	16 Miles
San Jacinto Reach 1	None	AGR, GWR, MUN, REC-1, REC-2, WILD, WARM, RARE	20 Miles
Lake Elsinore	PCBs, (Organic Compound), Nutrients, Organic Enrichment (Low DO), Sedeiment Toxicity, Unknown Toxicity	MUN, REC-1, REC-2, COMM WARM, WILD, RARE	22.5 Miles
Temescal Creek Reach 6	Indicator Bacteria	MUN, GWR, REC-1, REC-2, WARM, WILD	25 Miles
Temescal Creek Reach 5	None	MUN, AGR, GWR, REC-1, REC-2, WARM, WILD, RARE	26 Miles
Temescal Creek Reach 4	None	MUN, AGR, GWR, REC-1, REC-2, WARM, WILD, RARE	33.5 Miles
Lee Lake - Temescal Creek Reach 3	None	MUN, AGR, IND, GWR, REC-1, REC-2, COMM, WARM, WILD	N/A
Temescal Creek Reach 2	None	MUN, AGR, GWR, REC-1, REC-2, WARM, WILD, RARE	35.5 Miles
Temescal Creek Reach 1b to 1a	pH	MUN, REC-2, WARM, WILD	N/A
Prado Basin Management Zone	pH	MUN, REC-1, REC-2, WARM, WILD, RARE	49.5 Miles
Santa Ana River Reach 3	Copper, Lead, Pathogens	MUN, AGR, GWR, REC-1, REC-2, WARM, WILD, RARE, SPWN	51.5 Miles

A.3 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 permit is required.	☒ 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.

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?

- *Historic drainage patterns were maintained with the discharge location of the site remaining at the original location.*

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

- *No, the existing site is bare, with little to no existing vegetation.*

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

- *A Geotechnical report was performed of the site by GeoTek, Inc. on December 17, 2021 to determine Soil Type and Infiltration capacity of the site. Infiltration testing showed infiltration rate of less than 1.5" per hour. Per section 3.2 of the GeoTek report, the results indicate the infiltration rate range is 0.69 to 0.91 inches/hour. Per Table 3-4 LID BMP Applicability Table of the WQMP guidance document, since the infiltration rates fall in between 0.3 inches/hour < Ksat < 1.6 inches/hour, bioretention should be used. Additionally, per section 2.4.5 of the Moreno Valley WQMP document, the BMP will be placed in a fill condition and unable to extend into natural soils, so infiltration cannot be used. The site is located on B and C soils. No existing natural infiltration areas occupy the site and the design assumes zero infiltration. The proposed site-wide bioretention system involves lining of the underground R-Tank detention system.*

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

- *Pervious areas are utilized where feasible. Runoff is directed towards landscape areas and biotreatment units.*

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

- *Yes, runoff is directed towards biotreatment units and roof drains will discharge to landscape areas.*

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]	Area (Sq. Ft.)	DMA Type
1.0	Street, Curb and Gutter, Concrete sidewalks	42,837	Type D
1.1	Street, Curb and Gutter, Concrete sidewalks	38,104	Type D
1.3	Street, Curb and Gutter, Concrete sidewalks	4,711	Type A
1.4	Street, Curb and Gutter, Concrete sidewalks	9,078	Type A
1.5	Street, Curb and Gutter, Concrete sidewalks	16,964	Type A
2.0	Roofs, Asphalt, Concrete sidewalks	329,496	Type D
2.1	Roofs, Asphalt, Concrete sidewalks	52,369	Type D
3.0	Roofs, Asphalt, Concrete sidewalks	178,612	Type D

3.1	Roofs, Asphalt, Concrete sidewalks	66,229	Type D
3.2	Roofs, Asphalt, Concrete sidewalks	103,309	Type D
3.3	Roofs, Asphalt, Concrete sidewalks	18,174	Type D
4.0	Roofs, Asphalt, Concrete sidewalks	13,551	Type D

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

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

DMA Name or ID	Area (Sq. Ft.)	Stabilization Type	Irrigation Type (if any)
1.3	4,711	N/A	N/A
1.4	9,078	N/A	N/A
1.5	16,964	N/A	N/A

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)	Storm Depth (inches)	DMA Name / ID	[C] from Table C.4 =	Required Retention Depth (inches)
		[A]	[B]		[C]	[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	Runoff factor	Product	DMA name /ID	Area (square feet)	Ratio
	[A]		[B]	[C] = [A] x [B]		[D]	[C]/[D]

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

DMA Name or ID	BMP Name or ID
DMA 1.0	EcoStream System #1.0
DMA 1.1	EcoStream System #1.1
DMA 2.0	EcoStream System #2.0
DMA 2.1	EcoStream System #2.1
DMA 3.0	EcoStream System #3.0
DMA 3.1	EcoStream System #3.1
DMA 3.2	EcoStream System #3.2
DMA 3.3	EcoStream System #3.3
DMA 4.0	EcoStream System #4.0

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. 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:	DMA 1-4	
…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: DMA 2-4		
…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.

If any of the above boxes have been checked, Harvest and Use BMPs need not be assessed for the site. If neither 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: 2.97 AC

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

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: 14.54 AC

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: 0.6

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: 9.67 AC

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)
9.67 AC	2.97 AC

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: 1672

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: 14.54 AC

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: 108

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: 1742 AC

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)
1742 AC	1672

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:

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:

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

Enter the factor from Table 2-3:

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

Minimum required use:

Step 5: Determine if harvesting stormwater runoff for other non-potable 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 non-potable use (Step 4)	**Projected average daily use (Step 1)**

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, unless a site-specific analysis has been completed that demonstrates technical infeasibility as noted in D.3 below.

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	
1.0	☐	☐	☐	☒	☐
1.1	☐	☐	☐	☒	☐
2.0	☐	☐	☐	☒	☐
2.1	☐	☐	☐	☒	☐
3.0	☐	☐	☐	☒	☐
3.1	☐	☐	☐	☒	☐
3.2	☐	☐	☐	☒	☐
3.3	☐	☐	☐	☒	☐
4.0	☐	☐	☐	☒	☐

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.

N/A

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**	***Enter BMP Name / Identifier Here***

	[A]		[B]	[C]	[A] x [C]			
						Design Storm Depth (in)	*Design Capture Volume,* $\mathbf{V_{BMP}}$ *(cubic feet)*	*Proposed Volume on Plans (cubic feet)*
	A_T = Σ[A]				Σ= [D]	[E]	$[F] = \frac{[D]x[E]}{12}$	[G]

[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

****** SEE APPENDIX '6' FOR LID BMP DESIGN FLOW RATE, DESIGN CAPTURE VOLUME, AND BIORETENTION CALCULATIONS ******

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

N/A

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]	$[F] = \frac{[D] \times [E]}{[G]}$	[F] X (1-[H])	[I]

[B], [C] is obtained as described in Section 2.3.1 from the WQMP Guidance Document
[E] is 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**
Time of Concentration			
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 Sensitivity 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:

Canyon Lake, Please see the HCOC Applicability map in appendix 7. This map is an excerpt from ' Hydromodification Susceptibility Documentation Report and Mapping: Santa Ana Region ' , Dated January 18th, 2017

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
Onsite Storm Drain inlets	Mark all inlets with the words "Only Rain Down the Storm Drain" or similar	Maintain and periodically repaint or replace inlet marking. Provide stormwater pollution prevention information to new site owner, lessees, or operators. Include the following in lease agreement: "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 drain."

Landscape/Outdoor pesticide	Design landscape to minimize irrigation and runoff to promote surface infiltration. Consider using pest-resistant plants, specially adjacent to hardscape	Maintain Landscaping using minimum or no pesticides. See applicable operational BMPs in "What you should know for…Landscape and Gardening" at https://rcwatershed.org/ Provide IPM information to new owners, lessees and operators.
Pool	Plumbed to sanitary sewer	See applicable operational BMP's in "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" at https://rcwatershed.org/
Refuse areas	Signs will be posted on or near dumpsters with the words " Do no dump hazardous materials here"	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 material available on-site. See Fact sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com
Miscellaneous Drain or Wash Water or Other sources • Condensate drain lines • Rooftop equipment • Roofing, gutters and trim. • Other sources	Condensate drain lines may discharge to landscape areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system. Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.	
Sidewalks, Parking lots		Sweep sidewalks, parking lots. Collect debris from pressure washing to prevent entry into the storm drain system.

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.1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)
1.0, 3.0	EcoStream	Preliminary Grading/ Plot Plan Sheet #3
1.1, 2.0-2.1, 3.1-3.3, 4.0	EcoStream	Preliminary Grading/ Plot Plan Sheet #4

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:

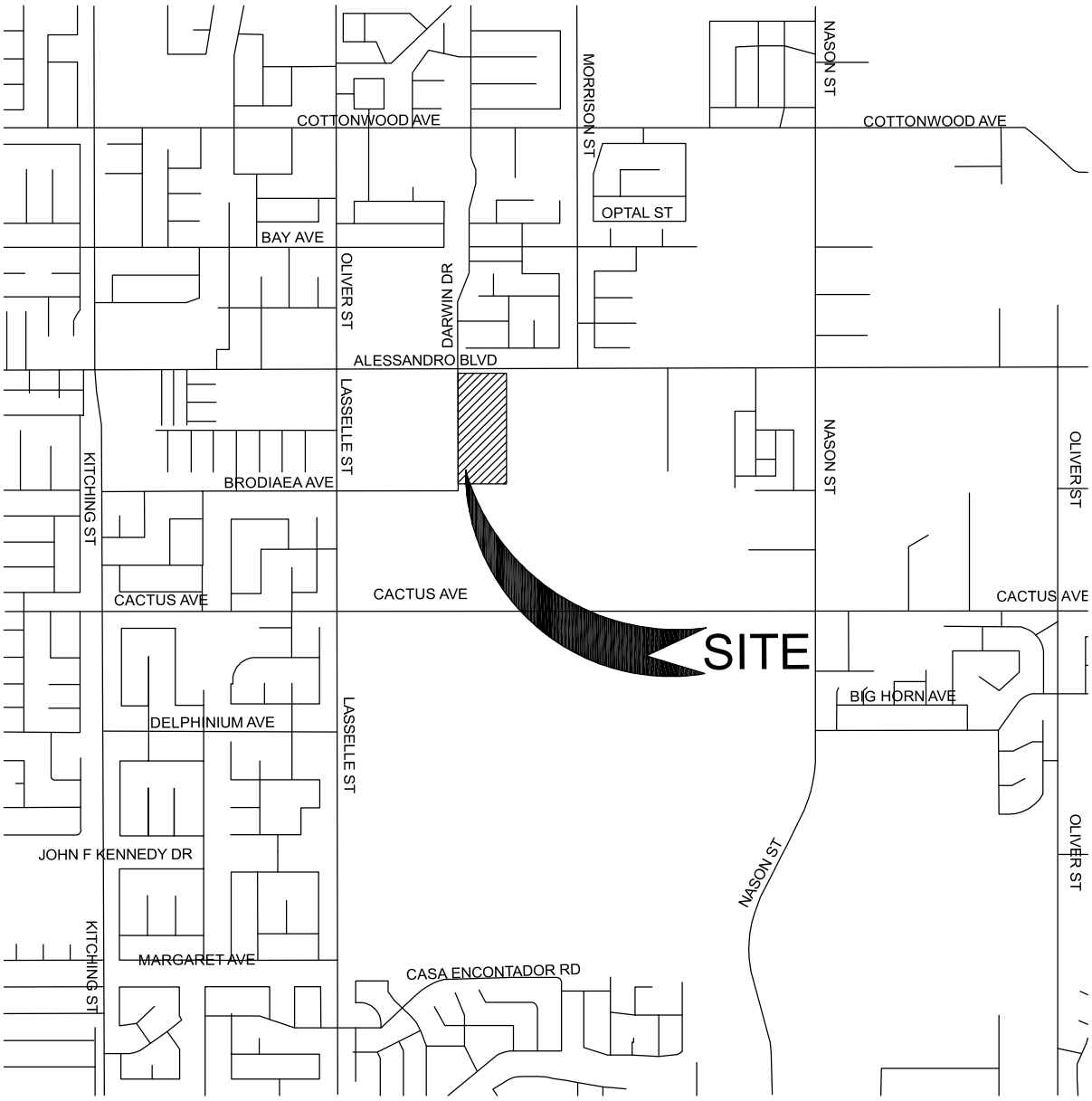
Will the proposed BMPs be maintained by a Home Owners' Association (HOA) or Property Owners Association (POA)?

☒ Y ☐ N

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

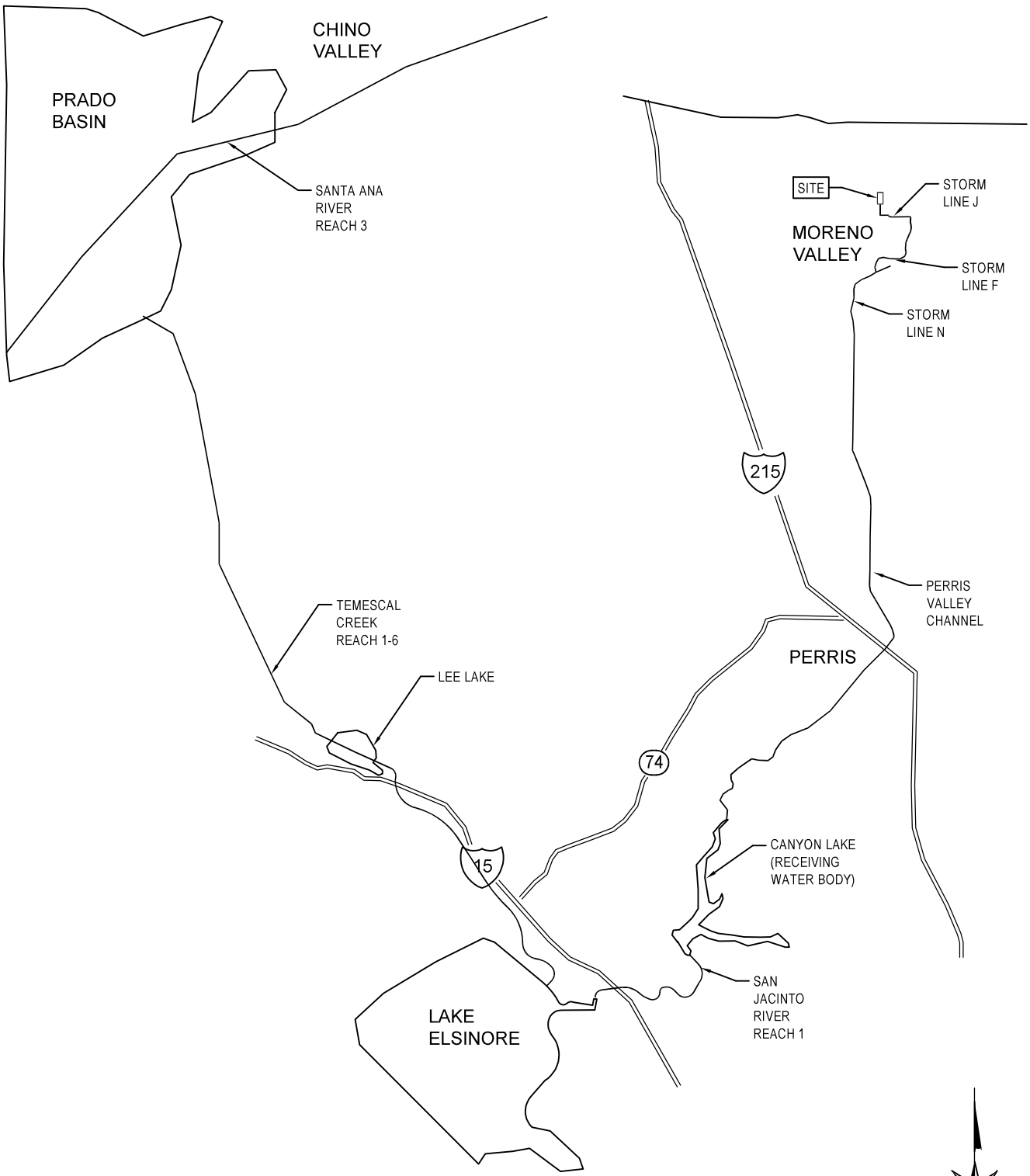
Appendix 1: Maps and Site Plans

Location Map, WQMP Site Plan and Receiving Waters Map



VICINITY MAP

NOT TO SCALE

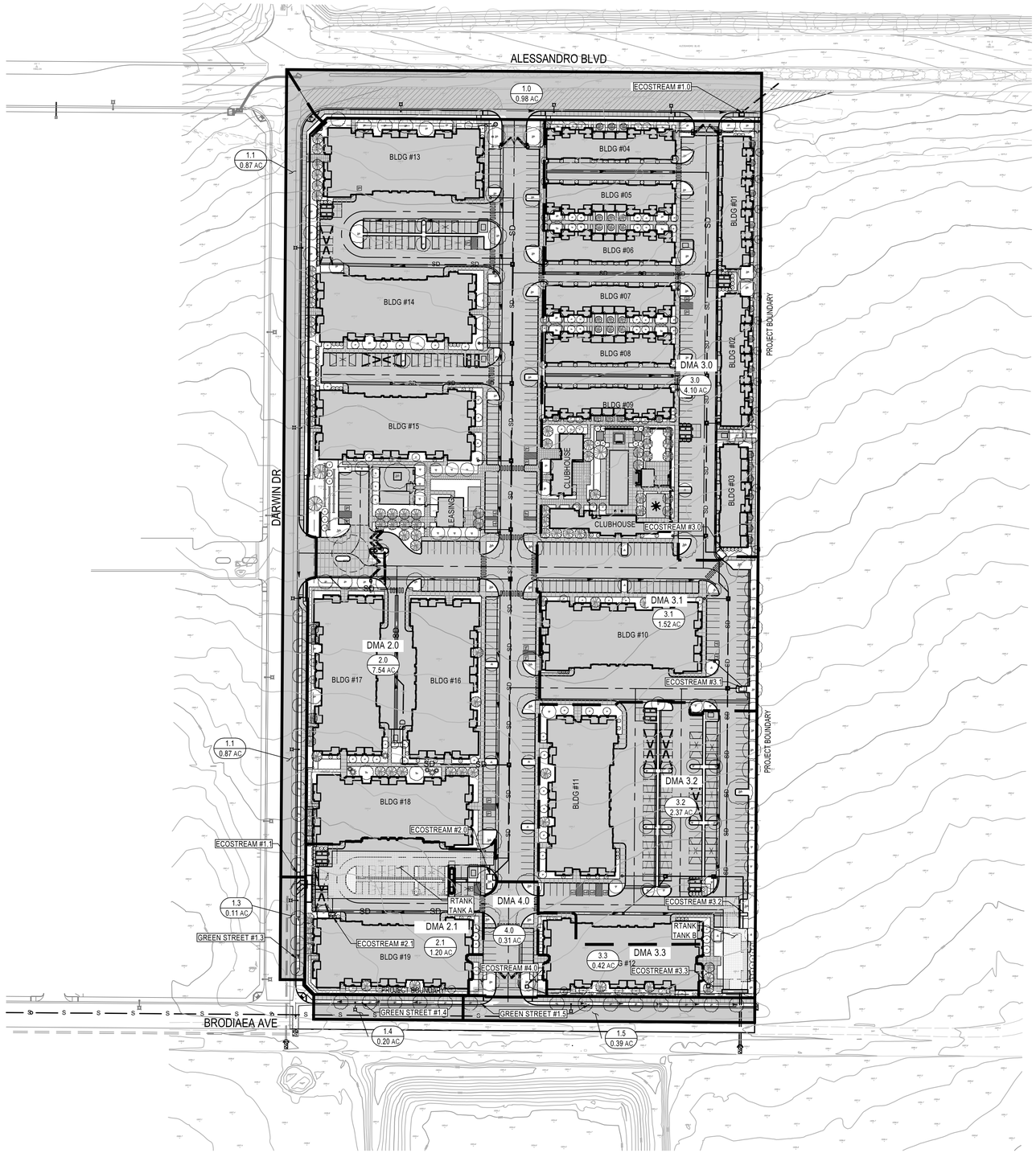


ROCAS GRANDE II
RECEIVING WATERS

PROJECT ADDRESS: APN 486-280-002 & -004
SCALE: NTS
DATE: 07-02-24
SHEET 1 OF 1

PASCO LARET SUITER & ASSOCIATES
San Diego | Solana Beach | Orange County
Phone 858.259.8212 | www.plsaengineering.com

SAVE DATE: 04/04/22 ~ PLOT DATE: 07/02/24 ~ FILE NAME: J:\ACTIVE JOBS\3816 ROCAS GRANDE II\CIVIL\REPORTS\WQMP\Appendix 01 Maps and Site Plans\3816_WQMP Recieving Waters.dwg



DMA TABLE

DMA #	IMPERVIOUS (SF) [ROOF/PAVING]	PERVIOUS (SF) [LANDSCAPING]	TOTAL AREA (SF)	(AC)
DMA 2.0	275,107	53,360	328,737	7.54
DMA 2.1	43,970	8,399	52,369	1.20
DMA 3.0	143,680	34,932	178,612	4.10
DMA 3.1	59,671	6,558	66,229	1.52
DMA 3.2	83,331	19,978	103,309	2.37
DMA 3.3	15,100	3,074	18,174	0.42
DMA 4.0	10,639	2,912	13,551	0.31
DMA 1.0	39,627	3,210	42,837	0.98
DMA 1.1	32,713	5,391	38,104	0.87
SELF-TREATING DMA 1.3	4,048	663	4,711	0.11
SELF-TREATING DMA 1.4	5,822	3,256	9,078	0.20
SELF-TREATING DMA 1.5	11,531	5,433	16,964	0.39

BMP TABLE

DMA #	BMP TYPE AREA (SF)	REQ. CFS	DESIGN CFS	DESIGN (FT)
DMA 2.0	ECOSTREAM	0.642	0.662	6x12
DMA 2.1	ECOSTREAM	1.185	1.20	8x20
DMA 3.0	ECOSTREAM	0.625	0.668	8x12
DMA 3.1	ECOSTREAM	0.251	0.251	6x6
DMA 3.2	ECOSTREAM	0.362	0.418	6x10
DMA 3.3	ECOSTREAM	0.065	0.111	4x4
DMA 4.0	ECOSTREAM	0.065	0.111	4x4
DMA 1.0	ECOSTREAM	0.166	0.167	4x6
DMA 1.1	ECOSTREAM	0.136	0.167	4x6
DMA 1.3	GREEN STREET			
DMA 1.4	GREEN STREET			
DMA 1.5	GREEN STREET			

SOURCE CONTROLS BMPS

1. STORM DRAIN STENCILING AND SIGNAGE
2. REDUCE PESTICIDE USE WITH NATIVE PLANTING
3. POOL TO BE PLUMBED TO THE SANITARY SEWER
4. COVERED TRASH ENCLOSURES
5. MISCELLANEOUS DRAIN OR WASH WATER WILL NOT INCREASE RUNOFF AND NOT DISCHARGE TO THE STORM DRAIN SYSTEM.
6. STREET AND SIDEWALK SWEEPING

LEGEND

MAJOR BASIN BOUNDARY	
MINOR BASIN BOUNDARY	
IMPERVIOUS AREA	14.54 AC (632,498 SF)
PERVIOUS AREA	2.97 AC (129,483 SF)
TOTAL AREA	17.49 AC (761,981 SF)

ROCAS GRANDES II WQMP EXHIBIT

PROJECT ADDRESS: APN 486-280-002 & -004
SCALE: 1" = 80'
DATE: 02-05-25
SHEET 1 OF 1

PLSA
PLSAENGINEERING.COM

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T 01 S
T 02 S
T 03 S
T 04 S
T 05 S
T 06 S
T 07 S
T 08 S

06	05	04	03	02	01
07	08	09	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Project Site

0.85 MiraLoma
0.61 RiversideNorth
0.54 RiversideSouth
0.88 PradoDam
0.51 Woodcrest
0.50 LakeMathews
0.68 PigeonPass
0.66 MorenoEast
0.68 PerrisReservoir
0.85 Beaumont
0.70 SanJacintoNWS
0.87 VistaGrandeGS
1.18 Idyllwild
0.90 HurkeyCreek
0.58 SunCity
0.68 Winchester
0.70 ElsinoreNWS
1.11 ElCarisoStation
0.77 WildomarLaCresta
0.77 SantaRosaPlateau
1.00 TemeculaNWS
0.52 SkinnerLake
0.65 Anza
0.64 AguangaValley

Santa Ana River Watershed
Santa Margarita Watershed

EASTVALE | JURUPA VALLEY | NORCO | CORONA | RIVERSIDE | MORENO VALLEY | BEAUMONT | SAN JACINTO | PERRIS | CANYON LAKE | LAKE ELSINORE | WILDOMAR | MENIFEE | HEMET | MURRIETA | TEMECULA

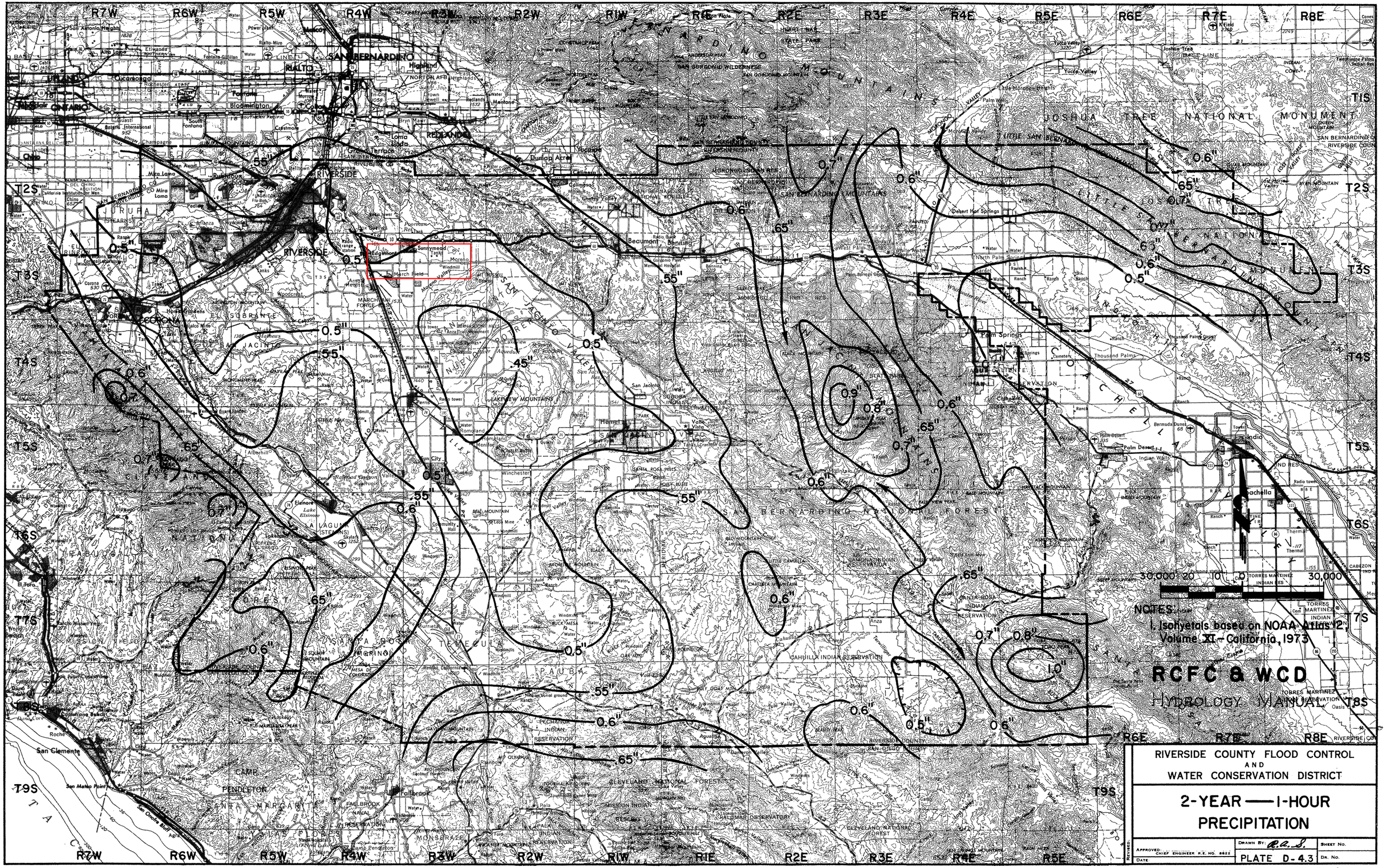
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Rain Gage Locations

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

Isohyetal Map for the 85th Percentile 24 hour Storm Event

July 2011



NOTES:
1. Isohyetals based on NOAA Atlas 2, Volume XI - California, 1973

RCFC & WCD
HYDROLOGY MANUAL

RIVERSIDE COUNTY FLOOD CONTROL
AND
WATER CONSERVATION DISTRICT

2-YEAR — 1-HOUR PRECIPITATION

APPROVED CHIEF ENGINEER R.E. NO. 8822	DRAWN BY: R.A.S.	SHEET No.
DATE	PLATE D-4.3	DR. No.

REVISED:

NOTES:
1. Isohyetals based on NOAA Atlas 2, Volume XI - California, 1973

RCFC & WCD
HYDROLOGY MANUAL

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

100-YEAR — 1-HOUR PRECIPITATION

APPROVED: CHIEF ENGINEER R.E. NO. 6822
DATE
REVISED
DRAWN BY: A.A.S.
SHEET NO.
PLATE D-4.4
DR. NO.

RAINFALL INTENSITY—INCHES PER HOUR

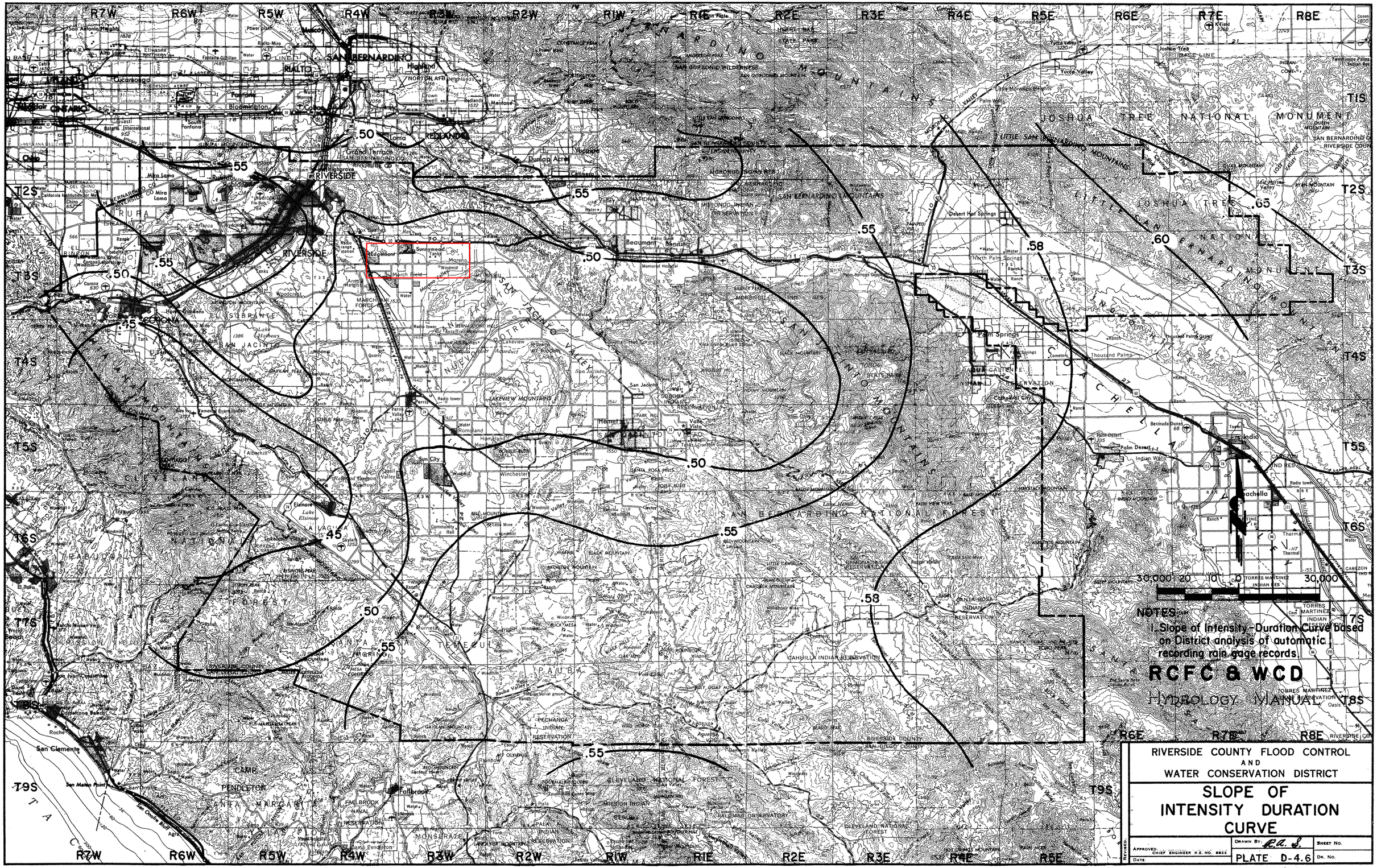
SUNNYMEAD - MORENO			WOODCREST		
DURATION MINUTES	FREQUENCY 10 YEAR	100 YEAR	DURATION MINUTES	FREQUENCY 10 YEAR	100 YEAR
5	2.84	4.16	5	3.37	5.30
6	2.59	3.79	6	3.05	4.79
7	2.40	3.51	7	2.80	4.40
8	2.25	3.29	8	2.60	4.09
9	2.12	3.10	9	2.44	3.83
10	2.01	2.94	10	2.30	3.62
11	1.92	2.80	11	2.19	3.43
12	1.83	2.68	12	2.08	3.27
13	1.76	2.58	13	1.99	3.13
14	1.70	2.48	14	1.91	3.01
15	1.64	2.40	15	1.84	2.89
16	1.59	2.32	16	1.78	2.79
17	1.54	2.25	17	1.72	2.70
18	1.50	2.19	18	1.67	2.62
19	1.46	2.13	19	1.62	2.54
20	1.42	2.08	20	1.57	2.47
22	1.35	1.98	22	1.49	2.34
24	1.30	1.90	24	1.42	2.23
26	1.25	1.82	26	1.36	2.14
28	1.20	1.76	28	1.31	2.05
30	1.16	1.70	30	1.26	1.98
32	1.12	1.64	32	1.22	1.91
34	1.09	1.59	34	1.18	1.85
36	1.06	1.55	36	1.14	1.79
38	1.03	1.51	38	1.11	1.74
40	1.00	1.47	40	1.07	1.69
45	.95	1.39	45	1.01	1.58
50	.90	1.31	50	.95	1.49
55	.86	1.25	55	.90	1.42
60	.82	1.20	60	.86	1.35
65	.79	1.15	65	.82	1.29
70	.76	1.11	70	.79	1.24
75	.73	1.07	75	.76	1.19
80	.71	1.04	80	.73	1.15
85	.69	1.01	85	.71	1.11
SLOPE = .500			SLOPE = .550		

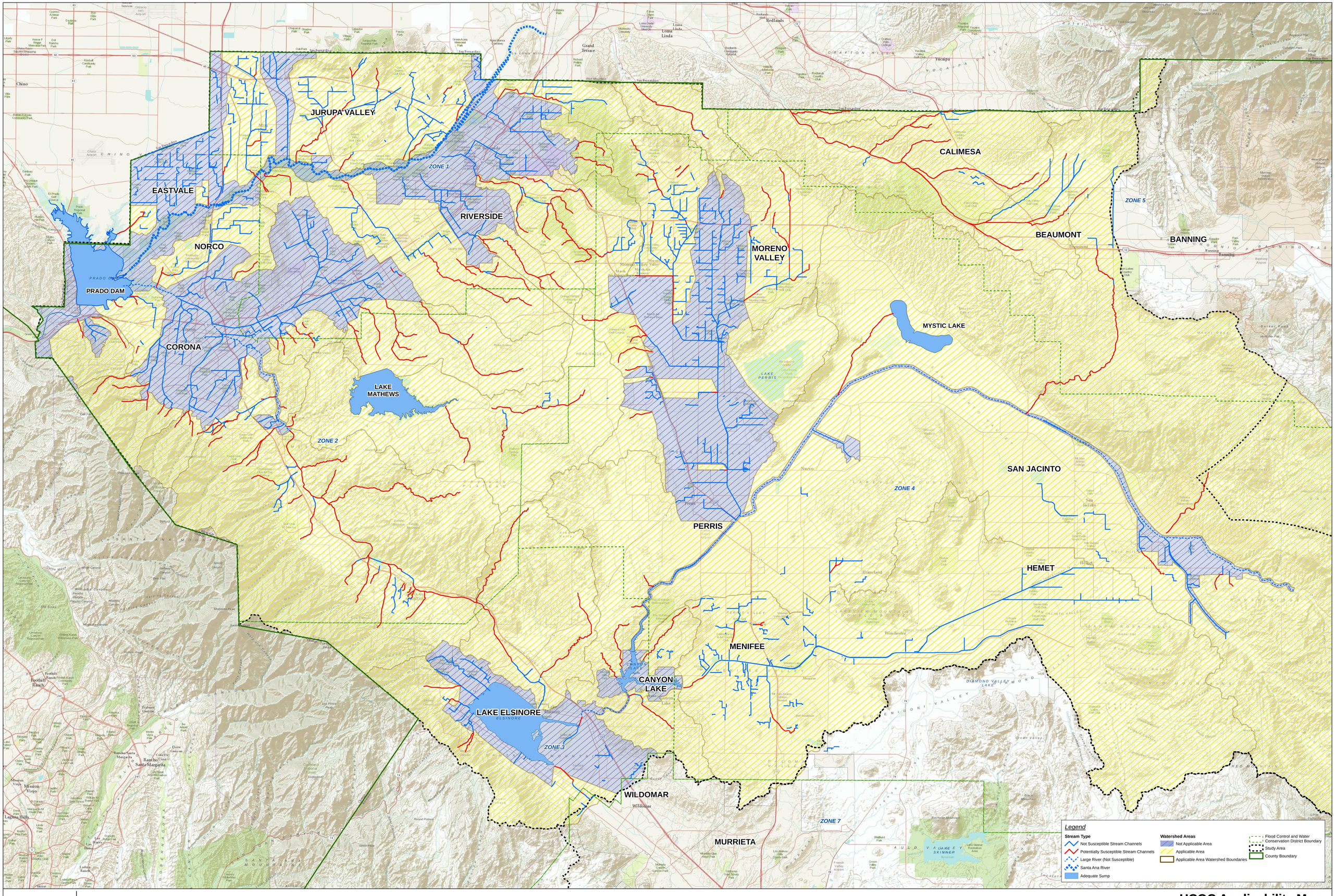
RCFC & WCD

HYDROLOGY MANUAL

STANDARD INTENSITY-DURATION CURVES DATA

PLATE D-4.1 (6 of 6)


.50
.55
.45
.58
.60
.65
NOTES
1. Slope of Intensity-Duration Curve based on District analysis of automatic recording rain gage records
RCFC & WCD
HYDROLOGY MANUAL
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
SLOPE OF INTENSITY DURATION CURVE
PLATE D-4.6



0 1 2 3 4 Miles

HCOC Applicability Map

Hydromodification Susceptibility Documentation Report and Mapping
Riverside County Flood Control and Water Conservation District

Map 2

Appendix 2: Construction Plans

Preliminary Grading/ Plot Plan

PRELIMINARY GRADING PLAN FOR
MORENO VALLEY, CA
ROCAS GRANDE II APARTMENTS PROJECT

APPLICANT / OWNER:

SEC ALESSANDRO DARWIN, LLC
320 S CEDROS AVE, SUITE 400
SOLANA BEACH, CA 92075

APN

486-280-062, 486-280-063

SITE ADDRESS

THE PARCEL IS LOCATED DIRECTLY SOUTHEAST OF THE INTERSECTION OF ALESSANDRO BOULEVARD AND DARWIN DRIVE

SITE AREA

TOTAL GROSS AREA = 17.99 ACRES
TOTAL NET AREA = 17.55 ACRES

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: LOTS 2 AND 7 IN BLOCK 120 OF BEAR VALLEY AND ALESSANDRO DEVELOPMENT COMPANY, AS SHOWN BY MAP ON FILE IN BOOK 11, PAGE 10 OF MAPS, RECORDS OF RIVERSIDE, CALIFORNIA.

DENSITY

ZONE: DOWNTOWN CENTER (DC) - ALLOWS MULTI-FAMILY RESIDENTIAL USE
(PREVIOUSLY ZONE R30)
ZONE R30 MAXIMUM DENSITY: 30 DU/AC
ZONE R30 MINIMUM DENSITY: 24 DU/AC
PROPOSED DENSITY: 24.9 DU/AC

LAND USE

EXISTING USE	PROPOSED USE
TOTAL NUMBER OF LOTS: 2	TOTAL NUMBER OF LOTS: 1
USE: UN-DEVELOPED LAND	USE: MULTI-FAMILY APARTMENTS

LEGEND

PROJECT BOUNDARY
RIGHT-OF-WAY CENTERLINE
EXISTING LOTLINE
PROPOSED LOTLINE
EXISTING CONTOUR 150
EXISTING SEWER LINE (S)
EXISTING WATER LINE (W)
EXISTING OVERHEAD UTILITIES (OHE)
EXISTING GAS MAIN (GAS)
EXISTING EASEMENT LINE
PROPOSED BLDG. SETBACK
PROPOSED DAYLIGHT
PROPOSED CONTOUR 150
PROPOSED 2:1/3:1 SLOPE
PROPOSED PRIVATE SEWER LINE S
PROPOSED FENCELINE x x
PROPOSE PRIVATE STORM DRAIN SD
PROPOSE PRIVATE WATER LINE W
PROPOSE PRIVATE FIRE SERVICE LINE
PROPOSE SEWER MANHOLE
PROPOSE STORM DRAIN CLEAN OUT
PROPOSED STORM DRAIN INLET
PROPOSED STORM DRAIN CATCH BASIN
PROPOSED STORM DRAIN ENDWALL
PROPOSED RIP-RAP
PROPOSED BROW DITCH
PROPOSED GUTTER FLOW
PROPOSED FIRE HYDRANT
PROPOSED DOUBLE CHECK DETECTOR DCDA
PROPOSED BACKFLOW PREVENTOR & METER RPDA
PROPOSED STREET LIGHT
PROPOSED AC PAVEMENT
PROPOSED DECORATIVE PAVERS
PROPOSED SIDEWALK
PROPOSED CURB RAMP
PROPOSED DETENTION RTANK
PROPOSED 6" CURB AND GUTTER
PROPOSED ROLLED CURB AND GUTTER
ROLLED CURB TRANSITION
PROPOSED RETAINING WALL
PROPOSED ECOSTREAM

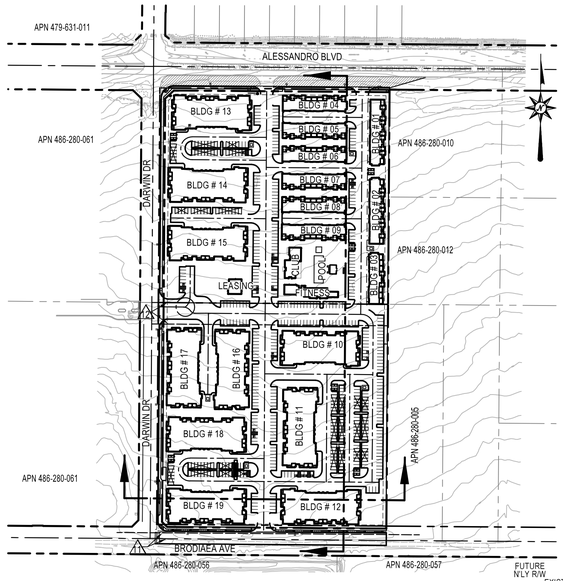
PLOTTED EASEMENTS

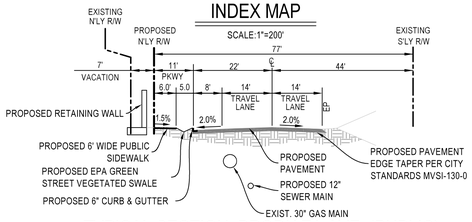
1. AN EASEMENT FOR RIGHT OF WAY AND INCIDENTAL PURPOSES, RECORDED DECEMBER 13, 1947 AS BOOK 882, PAGE 90 OF OFFICIAL RECORDS.
IN FAVOR OF: SOUTHERN CALIFORNIA GAS COMPANY, A CORPORATION ORGANIZED AND EXISTING UNDER AND BY VIRTUE OF THE LAWS OF THE STATE OF CALIFORNIA, AND SOUTHERN COUNTIES GAS COMPANY OF CALIFORNIA, ALSO A CORPORATION ORGANIZED AND EXISTING UNDER AND BY VIRTUE OF THE LAWS OF THE STATE OF CALIFORNIA, AS TENANTS IN COMMON, WITH AND UNDIVIDED THREE-FOURTHS (3/4) INTEREST IN SOUTHERN COUNTIES GAS COMPANY OF CALIFORNIA.
AFFECTS: AS DESCRIBED THEREIN

2. AN EASEMENT FOR PIPE LINE, INGRESS AND EGRESS AND INCIDENTAL PURPOSES, RECORDED SEPTEMBER 19, 1957 AS BOOK 2150, PAGE 299 OF OFFICIAL RECORDS.
IN FAVOR OF: FOUR CORNERS PIPE LINE COMPANY, A DELAWARE CORPORATION
AFFECTS: AS DESCRIBED THEREIN
THE TERMS AND PROVISIONS CONTAINED IN THE DOCUMENT ENTITLED "FORM OF ASSIGNMENT OF EASEMENTS, LICENSES AND CONTRACTS" RECORDED MAY 10, 1999 AS INSTRUMENT NO. 097748 OF OFFICIAL RECORDS.
THE LOCATION OF THE EASEMENT CANNOT BE DETERMINED FROM RECORD INFORMATION.

STANDARD GENERAL IMPROVEMENT NOTES

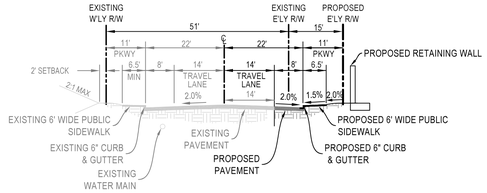
1. ALL WORK CALLED FOR ON THE PLANS SHALL BE IN COMPLIANCE WITH CURRENT CITY STANDARD PLANS ADOPTED BY THE CITY COUNCIL.
2. A CONSTRUCTION PERMIT MUST BE OBTAINED FROM THE LAND DEVELOPMENT DIVISION COUNTER BY THE CONTRACTOR PRIOR TO GRADING AND/OR CONSTRUCTION WORK OF ANY TYPE WITHIN THE PUBLIC RIGHT-OF-WAY.
3. AN ENCROACHMENT PERMIT IS REQUIRED IN ALL CASES WHERE WORK WILL INTERFERE WITH EITHER VEHICULAR OR PEDESTRIAN TRAFFIC.
4. CITY INSPECTION OF THE WORK CALLED FOR ON THE PLANS SHALL NOT IN ANY WAY RELIEVE THE CONTRACTOR AND / OR THE DEVELOPER OF THEIR OBLIGATION TO PERFORM THE WORK IN COMPLIANCE WITH THE PLANS.
5. ANY ALTERATIONS OR VARIANCES FROM THE PLANS, EXCEPT MINOR ADJUSTMENTS IN THE FIELD TO MEET EXISTING CONDITIONS, SHALL BE REQUESTED IN WRITING AND MAY NOT BE INSTITUTED UNTIL APPROVED BY THE CITY ENGINEER OR DESIGNATED REPRESENTATIVE ACTING SPECIFICALLY ON HIS/HER INSTRUCTIONS.
6. THE GRADING AND/OR IMPROVEMENT PLANS ARE APPROVED FOR A PERIOD OF TWO (2) YEARS FROM THE DATE SIGNED BY THE CITY ENGINEER. AFTER THE TWO (2) YEAR PERIOD HAS LAPSED, THE ENGINEER OF RECORD MAY BE REQUIRED TO SUBMIT AND PROCESS FOR THE CITY ENGINEER APPROVAL, UPDATED PLANS THAT COMPLY WITH THE MOST CURRENT CITY STANDARDS, PRACTICES AND POLICIES.
7. ALL ELEVATIONS SHOWN ON THE PLAN ARE ESTABLISHED BY LOCAL BENCH MARK. SURVEY MONUMENTS SHALL BE PROTECTED IN PLACE.
8. QUANTITIES AS SHOWN ON THE PLAN ARE ESTIMATED AND THE CONTRACTOR IS ADVISED THAT ALL FINAL QUANTITIES OF MATERIAL AND WORK IN PLACE MAY BE SOMEWHAT GREATER OR LESS THAN THOSE INDICATED ON THE PLANS.
9. CONCRETE GUTTERS, ALLEY APPROACHES, DRIVEWAYS AND OTHER CONCRETE ITEMS SUBJECT TO VEHICULAR TRAFFIC SHALL BE BARRICADED WITH NO VEHICULAR TRAFFIC PERMITTED FOR A PERIOD NO LESS THAN SEVEN DAYS FOLLOWING THE PLACEMENT OF SAID CONCRETE ITEM(S). WHEN THE GENERAL PROVISIONS CALL FOR THE USE OF SAID CONCRETE ITEM(S) FOR VEHICULAR TRAFFIC EARLIER THAN THE SEVENTH DAY FOR CONVENIENCE OF OPERATION OR WHEN THE CONTRACTOR SO DESIRES, CONCRETE CONTAINING EIGHT SACKS OF CEMENT PER CUBIC YARD SHALL BE USED UNDER THE DIRECTION OF THE CITY ENGINEER TO ALLOW TRAFFIC AFTER 72 HOURS OF PLACEMENT OF CONCRETE.
10. IRRIGATION LINE WITHIN ANY CITY STREET SHALL HAVE A THIRTY INCH MINIMUM COVER FROM FINISH SURFACE UNLESS SAID IRRIGATION LINE IS ENCASED IN CONCRETE OR BEDDED IN A SPECIAL CONCRETE CRADLE.
11. THE CONTRACTOR SHALL OPERATE IN A MANNER COMPLIANT WITH ALL APPLICABLE SECTIONS OF THE MUNICIPAL CODE AND COMPLIANT WITH ALL APPLICABLE CITY COUNCIL RESOLUTIONS.
12. THE LOCATION OF UNDERGROUND UTILITY OR IRRIGATION LINES AS SHOWN ON THE PLANS, IS APPROXIMATE, AND SINCE THE ACTUAL LOCATION MAY BE SOMEWHAT DIFFERENT FROM THAT SHOWN, THE UTILITY OR CONTRACTOR IS REQUIRED TO CONTACT THE INTERESTED THE VICINITY OF ANY SUCH WATER COMPANY BEFORE EXCAVATING IN LINES.
13. PARKWAY TREES INSTALLED BY THE DEVELOPER SHALL BE PLANTED AND MAINTAINED IN COMPLIANCE WITH THE APPROPRIATE CITY STANDARD.
14. ALL STREET NAME AND TRAFFIC REGULATORY SIGNS INDICATED ON THE PLANS WILL BE INSTALLED BY THE DEVELOPER IN ACCORDANCE WITH THE APPROPRIATE CITY STANDARDS.
15. IF THE STREETS LIGHTS INDICATED ON THE PLANS ARE SERVICED BY SOUTHERN CALIFORNIA EDISON (SCE), THE STREET LIGHTS SHALL BE INSTALLED BY SCE. IF THE STREET LIGHTS INDICATED ON THE PLANS ARE SERVICED BY MORENO VALLEY UTILITY (MVU), THE STREET LIGHTS SHALL BE INSTALLED BY THE DEVELOPER. THE DEVELOPER SHALL WORK DIRECTLY WITH THE CORRESPONDING UTILITY PURVEYOR WHEN THE LIGHTS ARE TO BE SERVED FROM AN UNDERGROUND SYSTEM.
16. AN APPROVED WEED KILLER SHALL BE APPLIED TO THE PREPARED BASE PRIOR TO ASPHALT PAVING IN ALL AREAS WHERE THERE IS ANY EVIDENCE OF HUMUS OR ORGANIC MATERIAL PRESENT IN THE BASE (EITHER NATIVE OR IMPORTED) MATERIAL. ALL WEED KILLERS SHALL BE APPLIED IN STRICT ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS AND INSTRUCTIONS.
17. PROVISIONS SHALL BE MADE BY THE CONTRACTOR FOR CONTRIBUTORY DRAINAGE AT ALL TIMES.
18. WHEN APPLICABLE, ALL ANTI-GRAFFITI COATING SHALL BE VITROCEM HI-BUILD GRAFFITI GLAZED COATING FOR CONCRETE BLOCK OR AN EQUAL APPROVED BY THE CITY ENGINEER.
19. HOURS OF OPERATION ARE 7:00 AM - 7:00 PM MONDAY - FRIDAY; 8:00 AM - 4:00 PM (RESIDENTIAL). SATURDAY BY PRIOR APPOINTMENT ONLY. NO WORK ON SUNDAY OR PUBLIC HOLIDAY WITHOUT PRIOR CITY APPROVAL.





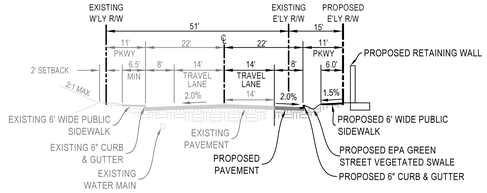
TYPICAL SECTION: BRODIAEA AVE. (PUBLIC)

NOT TO SCALE
(NEIGHBORHOOD COLLECTOR PER MVSI-106C-0)



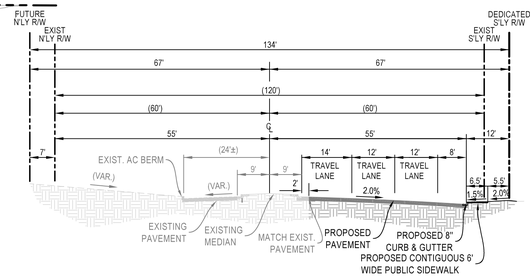
TYPICAL SECTION: DARWIN DRIVE (PUBLIC)

NOT TO SCALE
(COLLECTOR PER MVSI-106B-0)



TYPICAL SECTION: DARWIN DRIVE (PUBLIC)

NOT TO SCALE
(COLLECTOR PER MVSI-106B-0)



TYPICAL SECTION: ALESSANDRO BOULEVARD (PUBLIC)

NOT TO SCALE
(DIVIDED MAJOR ARTERIAL PER MVSI-101A-1)

emwd — COMPUTER MODEL TEST

Grid Number:	55		Date:	September 26, 2022	
Customer Name:	Alliance Residential		Address:	27127 Calle Arroyo, Suite 1904	
City, State Zip:	San Juan Capistrano, CA 92657				
Contact Name:	Ryan Wuolfe				
Phone:	(540) 661-6695		Cell:		
Fax:			Email:	Ryan.Wuolfe@lsaengineering.com	
Project Record Number:	WS 2022-1249		WO/CO:		
Project Name:	Rocas Grande II		APN:	486-280-002, -004	
(Approximate) Test & Hydrant Location:	The fire flow test location is approximately 50 feet west of the northeast corner of the parcel. The test location fronts an existing hydrant with the following connection sizes: 6" x 1-2.5". Note the hydrant is upgradeable.				
MODEL	DS_MM_202108_V2.mxd				

EMWD RESULTS			Requested	Flow Availability for Fire Department
POC Test Location	POC1	POC2		
Test Location	1568.8	1564.2		
Elevation*	1568.8	1564.2		
Steady State, Dynamics (psi):	75.2	77.2		
Residual Pressure (psi):	68.2	71.0		
Tested FF (gpm):	1760	1760	1750	
Combined Total (gpm):	MDD 183 gpm** plus 1750 gpm fire flow		1933	
Number of Hydrants:	Fire		2	
Duration Tested:	Two Hours		2	
Demand Conditions:	Max Day			
Pressure Zone/Tank Name(Lowest):	1764 PZ (Large)	Pefill I	/ Base Elevation:	1729.9 ft
Pump Operating Status:	ON	Computer Model Setting:	EPS	

Number of Points of connections:	POC (Circle One)		Reason (Circle what Applies)						
	Main	Gate Valve	Design Conditions	Limited Capacity Existing System	Supply Redundancy	Conditions of Approval	Fire Sprinkler Connection(s)	Single Lot Residential	Existing POC(s)
(POC)									

Comments: The water system is capable of providing 1760 GPM for 2 hours at a minimum of 20 psi, as shown in Figure 1. These Fire flow test results may need to be completed by Design Conditions and do not include all facility conditioning that may be required for this project. The Applicant is responsible for contacting EMWD's Fire Marshal to verify any Fire Flow changes occur in the Fire Agency Conditions, you may need to request another Fire Flow test at the requestor's expense.

The above results are not a guarantee the District's system will supply water to the project at any specific flows or pressures. These results were determined from a computer simulation of the District's water system and/or from hydraulic calculations pertaining to distribution pipelines: Pressures shown on these hydraulic results are at the watermain. The capacity of the service laterals, meters, backflow assemblies, on-site fire system, and other appurtenances were not considered in these results. The design and sizing of service laterals and downstream facilities shall be the responsibility of the Project Sponsor.

EMWD's Fire Flow test results are valid for twelve months from the date of testing.

Completed By: Elizabeth Caliva, Dudek (consultants for EMWD)

Should you have any questions or need additional information, please contact me at (951) 928-3777, ext. 4478.

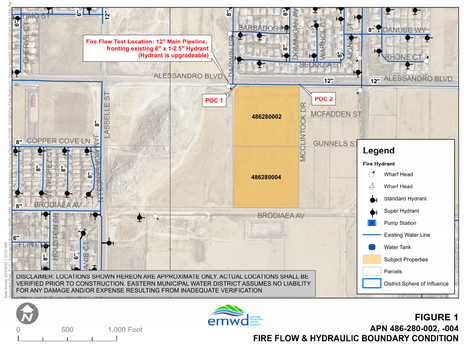
Sincerely, Rusty Esparza
Sr. Engineering Technician
New Business Development

Reviewed By: Rusty Esparza Date: 9-29-2022

* Elevation based on Riverside County Flood Control digital data.
** Assumed 460 VHDR DU (average day demand = 290 gpd/DU, Max Day Demand (MDD) is 2 times average day).

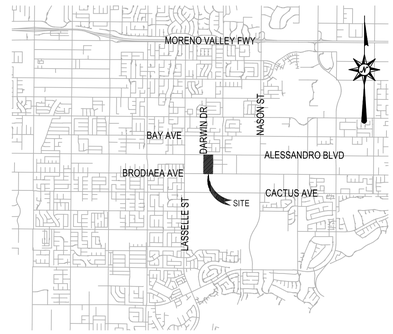
P:\1701 Engineering\Esparza\ MWD Tasks - As Needed_Modeling_Fire Flow Testing 7.5\YEAR_1\FF\Rocas Fire Flow Testing FF - Design Date.mxd

FIRE FLOW TEST RESULTS



emwd

FIGURE 1
APN 486-280-002, -004
FIRE FLOW & HYDRAULIC BOUNDARY CONDITION



VICINITY MAP

NOT TO SCALE

SURVEY NOTES:

TOPOGRAPHIC AND BOUNDAY SURVEY SHOWN HEREON WAS PREPARED BY:

TOPOGRAPHIC SURVEY	BOUNDARY SURVEY
PHOTO GEODETIC, CORP	WINCHESTER ASSOCIATES, INC.
1161 EAST MAIN ST.,	23540 TOWER ST. STE. 3
SUITE 102	P.O. BOX 280
EL CAJON, CA 92021	MORENO VALLEY, CA 92556-0280
DATED: 01/20/2022	DATED: 11/18/2021

1. THE BOUNDARIES AND DIMENSIONS OF THE SURVEYED PARCEL(S) SHOWN HEREON ARE COMPILED FROM RECORDED OR FILED DATA, AND ARE TO BE USED FOR PLANNING PURPOSES ONLY.
2. THE LOCATIONS OF UNDERGROUND UTILITY LINES AND/OR STRUCTURES AS SHOWN HEREON ARE BASED ON OBSERVED ABOVE GROUND EVIDENCE AND RECORD INFORMATION PROVIDED TO THE SURVEYOR. NO EXCAVATIONS WERE MADE DURING THE COURSE OF THIS SURVEY TO LOCATE UNDERGROUND UTILITIES. LOCATIONS OF UNDERGROUND UTILITIES MAY VARY FROM LOCATIONS SHOWN HEREON. ADDITIONAL UNDERGROUND UTILITIES MAY EXIST.

NOTES:

1. A LOT LINE ADJUSTMENT WILL BE PREPARED TO CONSOLIDATE THE LOTS ALONG WITH FINAL ENGINEERING PLANS.

UTILITY COMPANIES

EASTERN MUNICIPAL WATER DISTRICT	(951) 928-3777
VERIZON	(951) 929-9412
MORENO VALLEY ELECTRIC UTILITIES (MVU)	(951) 413-3500
SOUTHERN CALIFORNIA GAS COMPANY (SCG)	(951) 335-3919
TIME WARNER (TWC)	(909) 748-6656
RIVERSIDE TRANSIT AGENCY (RTA)	(951) 684-1007
RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT (RCFC & WCD)	(951) 955-7170
MORENO VALLEY UNIFIED SCHOOL DISTRICT	(951) 571-7500

ADA NOTE

I HEREBY DECLARE THAT I HAVE COMPARED THESE PLANS WITH ALL APPLICABLE ADA TITLE II AND TITLE 24 REQUIREMENTS FOR DISABILITY ACCESS FOR THIS PROJECT, AND THESE PLANS ARE IN FULL COMPLIANCE WITH THOSE REQUIREMENTS

FEMA

THE SUBJECT PROPERTY IS NOT LOCATED WITHIN FEMA FLOODPLAIN

EARTHWORK

TOTAL CUT = 10,000 CY
TOTAL FILL = 90,000 CY
NET IMPORT = 80,000 CY

TOTAL ON-SITE DISTURBED AREA = 764,851 SF (17.56 AC)
TOTAL OFF-SITE DISTURBED AREA = 92,465 SF (2.12 AC)

MAX DEPTH OF CUT = 4.9' FT
MAX DEPTH OF FILL = 10.7' FT

EARTHWORK ESTIMATES DO NOT INCLUDE VALUES FOR REMEDIAL GRADING. ESTIMATES ARE BASED ON IN PLACE VOLUMES AND DO NOT ACCOUNT FOR ANY SHRINKAGE OR BULKING OF THE SOIL THAT MAY OCCUR DURING GRADING ACTIVITIES.

PROJECT INFORMATION

EXISTING CONDITION IMPERVIOUS AREA = 0 SF (0.00 AC)
EXISTING CONDITION PERVIOUS AREA = 764,850 (17.55 AC)

PROPOSED CONDITION IMPERVIOUS AREA = 632,498 SF (14.54 AC)
PROPOSED CONDITION PERVIOUS AREA = 129,483 SF (2.97 AC)

SHEET INDEX

SHEET NO.	DESCRIPTION
1	TITLE SHEET
2	SECTIONS AND DETAILS
3	PRELIMINARY GRADING PLAN
4	PRELIMINARY GRADING PLAN

PREPARED BY:

REGISTERED PROFESSIONAL ENGINEER — WILLIAM J. SUITER — No. RCE 68964 — EXP. 12-31-25 — Civil — STATE OF CALIFORNIA

WILLIAM J. SUITER RCE 68964 — DATE 02/20/2025

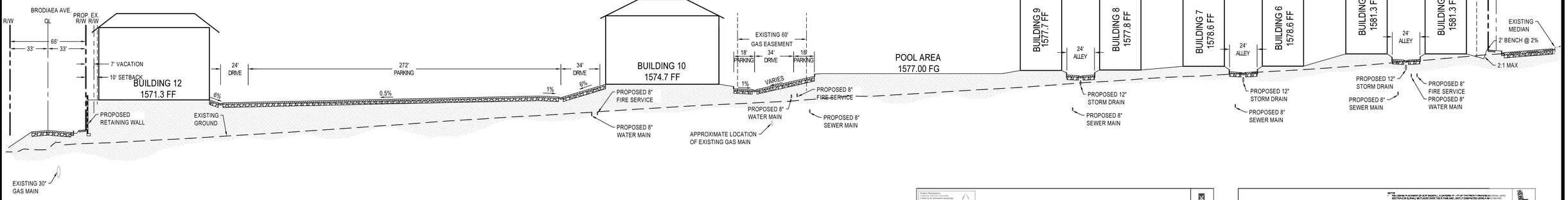
PRELIMINARY GRADING PLAN PEN24-0125

PLSA
PLSAENGINEERING.COM

SHEET C1 OF C4

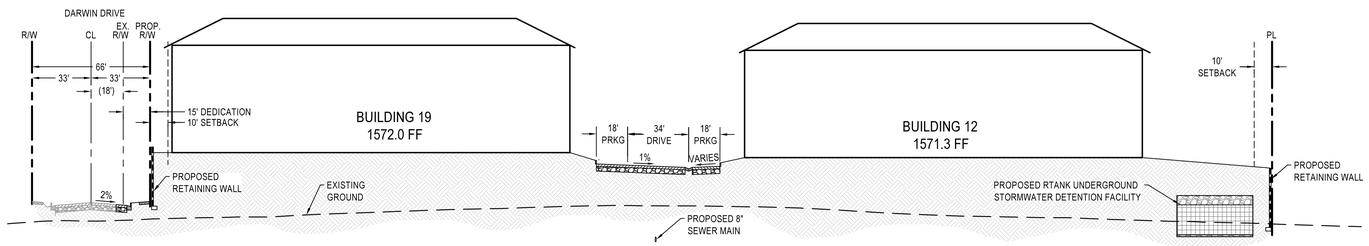
DATED: 02/20/2025

PLSA 3816



SITE CROSS SECTION - SOUTH TO NORTH

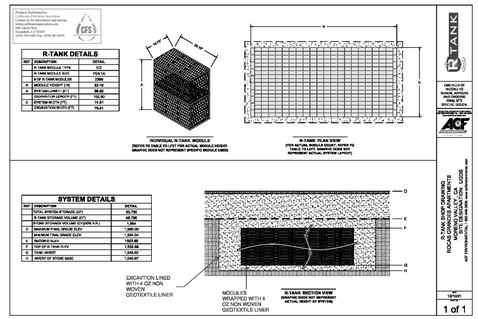
HORIZONTAL SCALE: 1"=40' VERTICAL SCALE 1"=10'

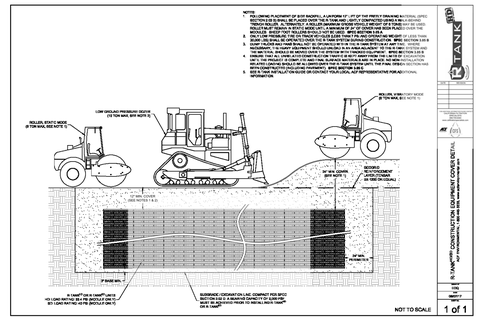


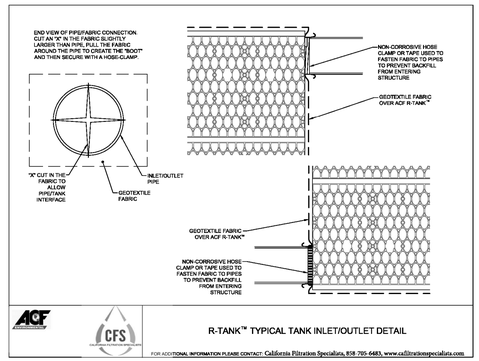
SITE CROSS SECTION - WEST TO EAST

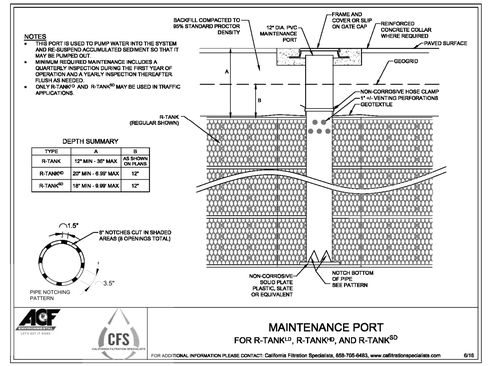
HORIZONTAL SCALE: 1"=40' VERTICAL SCALE 1"=10'

*BUILDING HEIGHT PER ARCHITECTURAL PLANS.



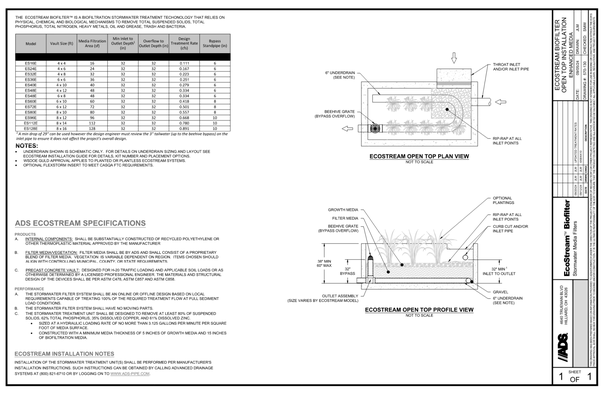


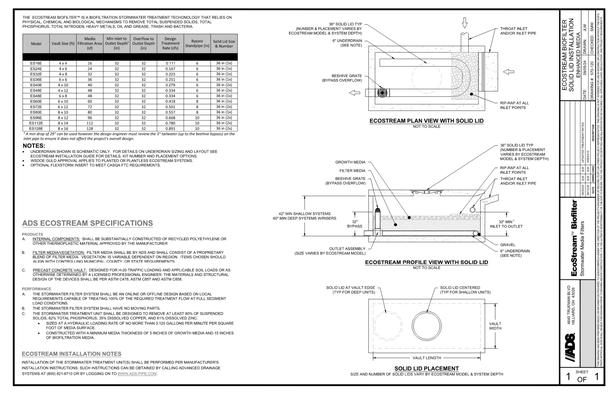




TYPICAL R-TANK DETENTION SYSTEM

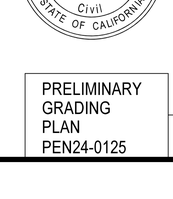
NTS





TYPICAL ECOSTREAM BIOFILTRATION SYSTEM

NTS



WILLIAM J. SUITER RCE 68964 — DATE 02/20/25

PREPARED BY:

PLSA

PLSAENGINEERING.COM

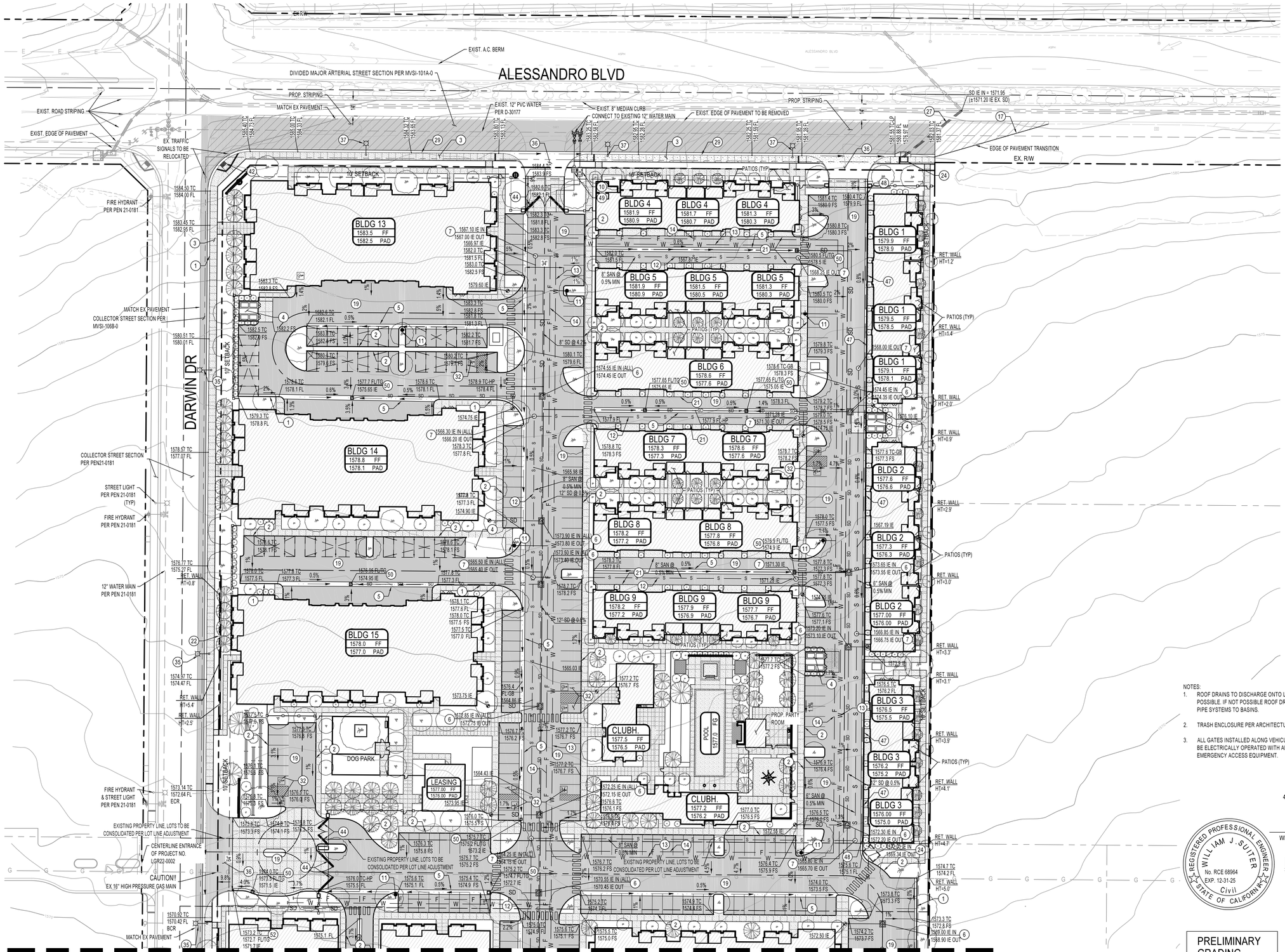
PRELIMINARY GRADING PLAN PEN24-0125

SHEET C2 OF C4

DATED: 02/20/2025

PLSA 3816

SAVE DATE: — — PLOT DATE: 02/20/25 — FILE NAME: J:\ACTIVE JOBS\3816 ROCAS GRANDE II\CIVIL\DRAWING\DISCRETIONARY PLANS\3816-PP-02 Sections.dwg



SEE SHEET 4

IMPROVEMENT NOTES :

1. PROPOSED 6" CURB & GUTTER PER MVSI-120A-0
2. PROPOSED 6" CURB PER MVSI-121A-0
3. PROPOSED SIDEWALK PER MVSI-115A-0
4. PROPOSED TRASH ENCLOSURE PER MVGF-660A-0 TO 660-F-0
5. PROPOSED 4' WIDE RIBBON GUTTER
6. PROPOSED STORM DRAIN MANHOLE PER MVFE-320A-0
7. PROPOSED 48" SEWER MANHOLE
8. PROPOSED 24"X24" BROOKS BOX
9. PROPOSED ENDWALL
10. PROPOSED DOUBLE CHECK DETECTOR
11. PROPOSED FIRE HYDRANT PER EMWD B-362
12. PROPOSED PRIVATE 8" SEWER MAIN
13. PROPOSED PRIVATE 8" WATER MAIN
14. PROPOSED PRIVATE 8" FIRE SERVICE MAIN
15. PROPOSED CATCH BASIN PER MVFE-300A-0
16. PROPOSED 8" CURB PER MVSI-121B-0
17. PROPOSED PAVEMENT EDGE TAPER PER CITY STANDARDS MVSI-130-0
18. PROPOSED EPA GREEN STREET VEGETATED SWALE.
19. PROPOSED A.C. PAVEMENT
20. PROPOSED DECORATIVE CONCRETE OR PAVERS
21. PROPOSED 0" CURB
22. PROPOSED RETAINING WALL PER SEPARATE PERMIT
23. PROPOSED CONCRETE BROW DITCH
24. PROPOSED CURB OPENING ECOSTREAM SYSTEM
25. PROPOSED RIP RAP
26. PROPOSED SUBGRADE RTANK DETENTION SYSTEM
27. PROPOSED STORM DRAIN, SIZE AND SLOPE PER PLAN
28. PROPOSED 2' WIDE CURB OPENING
29. PROPOSED 8" CURB & GUTTER PER MVSI-120B-0
30. PROPOSED 6' HIGH FENCE PER MVGF-641A-0
31. PROPOSED PUBLIC 12" SEWER MAIN.
32. PROPOSED HANDICAP PARKING, 2% MAX.
33. EXISTING OVERHEAD ELECTRICAL LINE
34. EXISTING POWER POLE
35. PROPOSED STREET LIGHT PER MVLT-400A-0
36. PROPOSED DRIVEWAY PER MODIFIED MVSI-112D-0
37. PROPOSED STREET LIGHT PER MVLT-400B-0
38. PROPOSED CROSS GUTTER PER MVSI-127-1
39. PROPOSED ECOSTREAM BIOFILTRATION BASIN
40. 2' PARKING OVERHANG
41. PROPOSED INFILTRATION TRENCH
42. PROPOSED PEDESTRIAN RAMP PER MVSI-114A-1
43. PROPOSED FENCE PER LANDSCAPE PLANS
44. PROPOSED GATE PER ARCHITECTURAL PLANS
45. PROPOSED MONUMENT PER ARCHITECTURAL PLANS
46. PROPOSED DRIVEWAY PER MVSI-112A-0
47. PROPOSED 6" ROLLED CURB AND GUTTER PER MVSI-123-0
48. PROPOSED CURB TRANSITION PER MVSI-125-0
49. PROPOSED BACKFLOW PREVENTOR
50. PROPOSED TRAFFIC RATED 2424CB OLDCASTLE CATCH BASIN
51. PROPOSED PARKWAY CULVERT STRUCTURE PER MVSI-150A-0
52. PROPOSED TRAFFIC RATED 1212CB OLDCASTLE CATCH BASIN

NOTES:

1. ROOF DRAINS TO DISCHARGE ONTO LANDSCAPE AREAS WHERE POSSIBLE. IF NOT POSSIBLE ROOF DRAINS TO BE ROUTED BY PIPE SYSTEMS TO BASINS.
2. TRASH ENCLOSURE PER ARCHITECTURAL PLANS.
3. ALL GATES INSTALLED ALONG VEHICULAR ACCESS AREAS, WILL BE ELECTRICALLY OPERATED WITH APPROVED KNOX EMERGENCY ACCESS EQUIPMENT.

SCALE: 1" = 40'

40 20 0 40 80 120

REGISTERED PROFESSIONAL ENGINEER
WILLIAM J. SUTTER
No. RCE 68964
EXP. 12-31-25
Civil
STATE OF CALIFORNIA

WILLIAM J. SUTTER RCE 68964 — DATE 02/20/2025

PREPARED BY:

PLSA

PLSAENGINEERING.COM

PRELIMINARY GRADING PLAN PEN24-0125

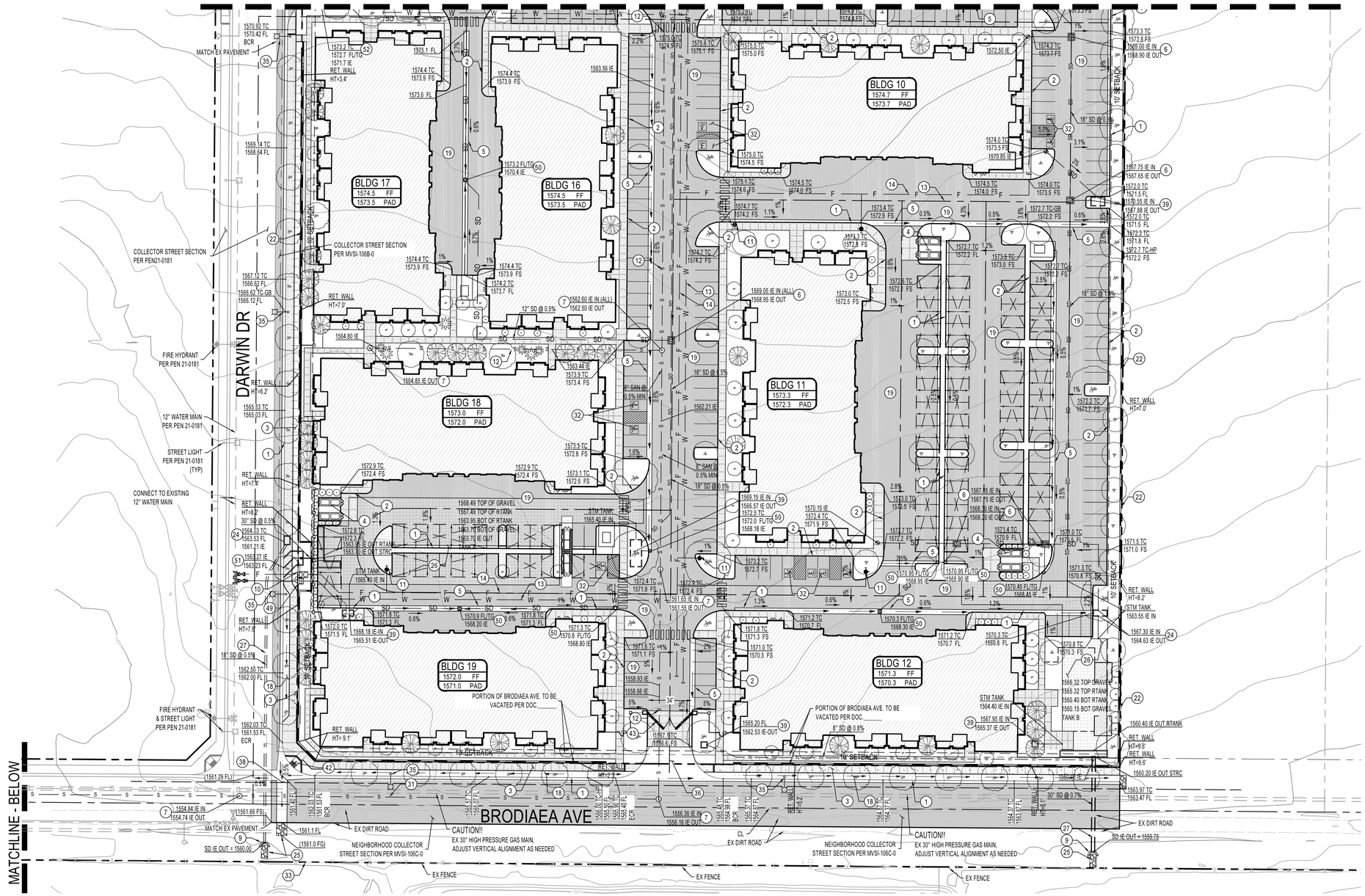
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SEE SHEET 3



IMPROVEMENT NOTES :

1. PROPOSED 6" CURB & GUTTER PER MVSI-120A-0
2. PROPOSED 6" CURB PER MVSI-121A-0
3. PROPOSED SIDEWALK PER MVSI-115A-0
4. PROPOSED TRASH ENCLOSURE PER MVGF-660A-0 TO 660-F-0
5. PROPOSED 4' WIDE RIBBON GUTTER
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REGISTERED PROFESSIONAL ENGINEER
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No. RCE 68964
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02/20/2025

WILLIAM J. SUITER RCE 68964 DATE

PREPARED BY:

PLSA

PLSAENGINEERING.COM

PRELIMINARY GRADING PLAN PEN24-0125

SHEET C4 OF C4

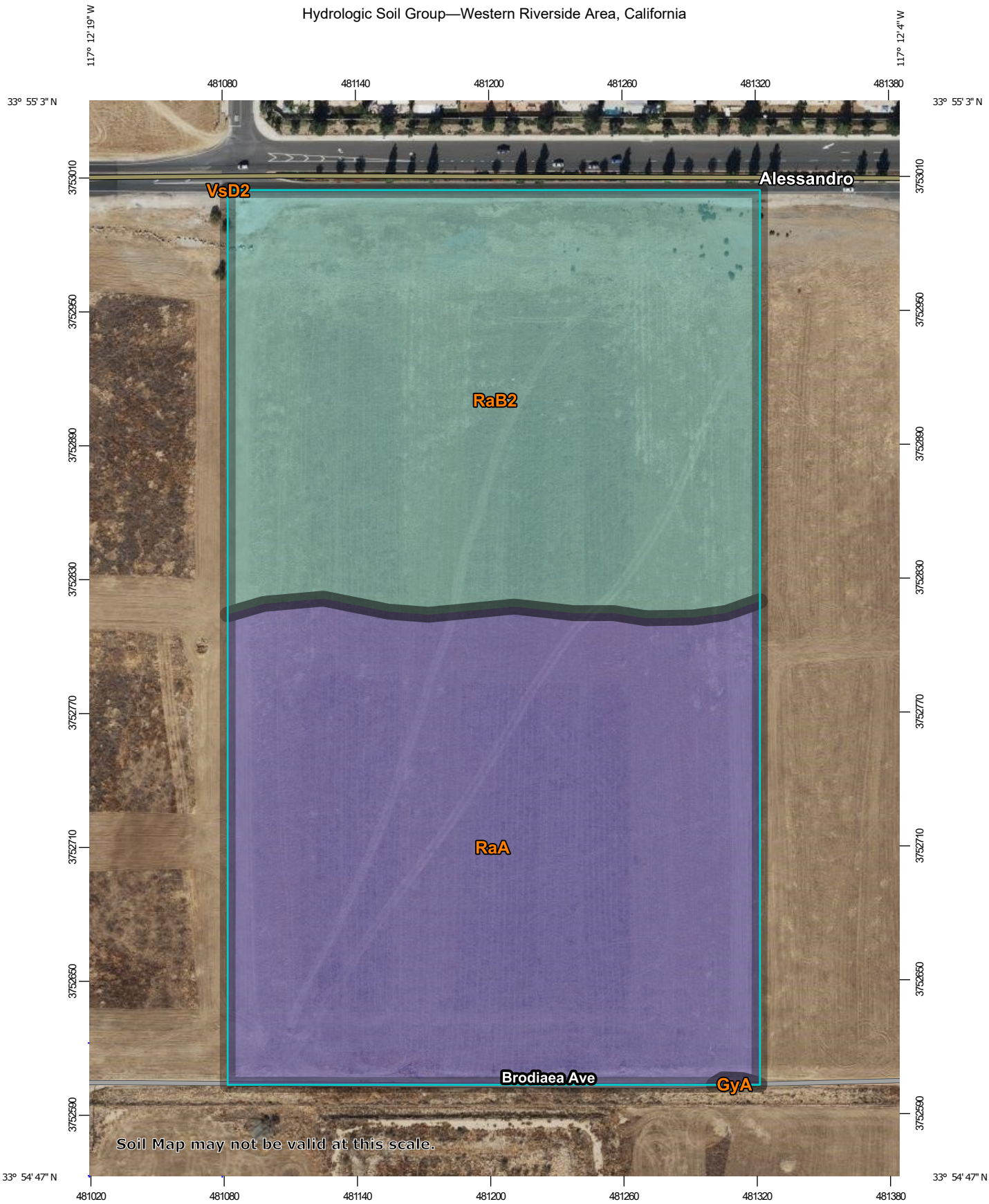
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Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data



Map Scale: 1:2,350 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 30 60 120 180

Feet
0 100 200 400 600

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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

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

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

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

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

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

Soil Survey Area: Western Riverside Area, California
Survey Area Data: Version 14, Sep 13, 2021

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

Date(s) aerial images were photographed: Nov 15, 2020—Nov 19, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
GyA	Greenfield sandy loam, 0 to 2 percent slopes	A	0.0	0.0%
RaA	Ramona sandy loam, 0 to 2 percent slopes, MLRA 19	B	12.6	53.0%
RaB2	Ramona sandy loam, 2 to 5 percent slopes, eroded	C	11.2	46.9%
VsD2	Vista coarse sandy loam, 8 to 15 percent slopes, eroded	B	0.0	0.0%
Totals for Area of Interest			**23.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

GEOTECHNICAL AND INFILTRATION EVALUATION
PROPOSED MULTI-FAMILY RESIDENTIAL DEVELOPMENT
DARWIN COURT PROJECT
ALESSANDRO BOULEVARD AND DARWIN COURT
MORENO VALLEY, RIVERSIDE COUNTY, CALIFORNIA

PREPARED FOR

OAKDALE COMMUNITIES
675 BERING DRIVE, SUITE 160
HOUSTON, TEXAS 77057

PREPARED BY

GEOTEK, INC.
1548 NORTH MAPLE STREET
CORONA, CALIFORNIA 92878

PROJECT NO. 2950-CR **DECEMBER 17, 2021**

GEOTEK

GeoTek, Inc.
1548 North Maple Street, Corona, California 92878
(951) 710-1160 Office (951) 710-1167 Fax www.geotekusa.com

December 17, 2021
Project No. 2950-CR

Oakdale Communities
675 Bering Drive, Suite 160
Houston, Texas 77057

Attention: Mr. Ken Hauser

Subject: **Geotechnical and Infiltration Evaluation**
Proposed Multi-Family Residential Development
Darwin Court Project
APNs 486-280-002 and -004
Southeast Corner of Alessandro Boulevard and Darwin Court
Moreno Valley, Riverside County, California

Dear Mr. Hauser:

GeoTek, Inc. (GeoTek) is pleased to provide the results of this Geotechnical and Infiltration Evaluation for the proposed project located in Moreno Valley, Riverside County, California. This report presents the results of GeoTek's evaluation, discussion of findings, and provides geotechnical recommendations for foundation design and construction.

Based upon review and evaluation, site development appears feasible from a geotechnical viewpoint provided that the recommendations included in this report are incorporated into the design and construction phases of the project.

The opportunity to be of service is sincerely appreciated. If you should have any questions, please do not hesitate to contact GeoTek.

Respectfully submitted,
GeoTek, Inc.





Bruce A. Hick
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Project Geologist

Distribution: (1) Addressee via email (one PDF file)

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ENCLOSURES

Figure 1 – Site Location Map
Figure 2 – Exploration Location Map

Appendix A – Log of Exploratory Borings
Appendix B – Results of Laboratory Testing
Appendix C – Percolation Data & Porchet Calculations
Appendix D – Seismic Settlement Analysis
Appendix E – General Earthwork Grading Guidelines

1. PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to evaluate the geotechnical engineering and geologic conditions at the project site, as outlined in GeoTek's proposal P-1008721-CR, dated November 2, 2021. Services provided for this study included the following:

- Research and review of available geologic data and general information pertinent to the site,
- Site exploration consisting of the excavation, logging, and sampling of eight (8) exploratory test borings extending to depths ranging from 20.5 to 51.5 feet below grade,
- Excavation of eight (8) additional borings to a depth of about five (5) feet below grade and performing an infiltration test in each boring,
- Laboratory testing of soil samples collected during the field investigation,
- Review and evaluation of site seismicity, and
- Preparation of this geotechnical report which presents GeoTek's findings, conclusions, and recommendations for this site.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

2.1 SITE DESCRIPTION

The subject project, referred to as the "Darwin Court Project", is located adjacent to the southeast corner of Alessandro Boulevard and the future extension of Darwin Drive, in the City of Moreno Valley, Riverside County, California (See Figure 1). Additionally, the site is identified as Riverside County Assessor's Parcel Numbers (APNs) 486-280-002 and -004. The rectangular-shaped property is comprised of approximately 18.39 acres of land.

The property is bounded by vacant land to the east and west; a dirt roadway that will be the future extension of Brodiaea Avenue, followed by vacant land; and Alessandro Boulevard, followed by residential development to the north.

The site can be considered as having gently sloping terrain with total relief across the site on the order of approximately 20 feet, with surface drainage generally directed toward the southeast. Topographically, elevations across the property range from approximately 1,585 to approximately 1,565 feet above mean sea level (msl).

The site was vacant land at the time of the field exploration. The site appears to have been previously utilized for agriculture. The majority of the project site appears to have been disced for vegetation control but a light covering of grass and small brush was present in the northern portions of the site along with scattered domestic trees adjacent to the eastern edge of the property. High-pressure natural gas utility lines and easements trend in an east-west direction through the central portion of the site, as well as along the future extension of Brodiaea Avenue on the adjacent property to the south.

2.2 PROJECT DESCRIPTION

GeoTek reviewed the *Conceptual Site Plan*, prepared by AO Architecture and dated October 25, 2021. It is GeoTek's understanding the proposed development includes the construction of eight (8) multi-family residential buildings with associated utilities and interior streets. Additionally proposed are two leasing/club house structures, two swimming pool areas, a fitness/cabana structure, and parking areas. Four (4) proposed infiltration locations were provided to GeoTek on an *Alta Survey* (undated), prepared by Winchester Associates, Inc. and are shown on the Exploration Location Map (Figure 2).

Based upon past experience, grading of the site will likely involve cuts and fills generally less than about five feet in height, not including any recommended remedial grading.

Sewage disposal will be by a public sewer.

Based on the *Conceptual Site Plan*, the proposed multi-family buildings will be three- to four-stories. The ancillary buildings are anticipated to be one-story in height. GeoTek assumes the proposed buildings will be supported by conventional shallow spread footings and will most likely include a conventional slab on-grade floor system. For the purposes of this report, it is assumed maximum column and wall loads will be about 30 kips and 2 kips per foot, respectively for the proposed one-story structures. It is assumed maximum column and wall loads will be about 150 kips and 5 kips per foot, respectively, for the proposed three to four-story structures. Specific site foundation plans were not provided as of the date of this report. Once actual loads are known that information should be provided to GeoTek to determine if modifications to the recommendations presented in this report are warranted.

If site development differs from the assumptions made herein, the recommendations included in this report should be subject to further review and evaluation. Site development plans should be reviewed by GeoTek when they become available.

3. FIELD EXPLORATION AND LABORATORY TESTING

3.1 FIELD EXPLORATION

The field exploration for this report was conducted on November 19th and 24th, 2021 and consisted of excavating eight (8) geotechnical exploratory borings with a hollow-stem drill rig to depths ranging from about 20.5 to 51.5 feet below grade. The approximate locations of the GeoTek excavations are shown on the Exploration Location Map (Figure 2). A geologist from GeoTek logged the excavations and collected soil samples for use in subsequent laboratory testing. The logs of the exploratory borings are included in Appendix A.

Relatively undisturbed soil samples were recovered at various intervals in the geotechnical borings with a California sampler. The California sampler is a 3-inch outside diameter, 2.5-inch inside diameter, split barrel sampler lined with brass rings. The sampler was 18 inches long. The sampler conformed to the requirements of ASTM D 3550. A 140-pound automatic trip hammer was utilized, dropping 30 inches for each blow. The relatively undisturbed samples, together with bulk samples of representative soil types, were returned to the laboratory for testing and evaluation. The California sampler test data are presented on the boring logs in Appendix A.

In Boring B-5 standard penetration tests (SPT) were performed with a 2.0-inch outside diameter, 1.5-inch inside diameter, split-barrel sampler. The sampler was 18 inches long. The inside diameter of the sampler shoe was 1.4 inches. The sampler was unlined. The sampler conformed to the requirements of ASTM D 1586. A 140-pound automatic trip hammer was utilized, dropping 30 inches for each blow. The sampler penetration test data are presented on the log for Boring B-5 in Appendix A.

3.2 PERCOLATION TESTING

In addition to the geotechnical exploratory borings, eight (8) percolation test borings (I-1 through I-8) were excavated in the areas of the proposed storm water management basins to depths of about 5 feet. These proposed locations were provided to GeoTek by the project civil engineer. Infiltration testing was conducted in these borings in general accordance County

of Riverside guidelines. The infiltration tests consisted of drilling eight-inch diameter test holes to the desired depth and installing approximately two inches of gravel in the bottom of the holes. A three-inch diameter perforated PVC pipe, wrapped in a filter sock, was placed in the excavations and the annular space was filled with gravel to prevent caving within the borings. Water was then placed in the borings to presoak the holes and percolation testing was performed following the pre-soak period. Following presoaking, the percolation tests were performed which consisted of adding water to each test hole and measuring the water drop over a 30-minute period. The water drop was recorded for twelve test intervals. Water was added to the test holes after each test interval. The field percolation rates were then converted to an infiltration rate using the Porchet Method. The infiltration rates calculated using the Porchet Method are presented in the following table:

SUMMARY OF INFILTRATION RATES		
Boring	Depth of Test (Feet)	Infiltration Rate (Inches per hour)
I-1	5.0	0.80
I-2	5.0	0.80
I-3	5.0	0.86
I-4	5.0	0.86
I-5	5.0	0.69
I-6	5.0	0.80
I-7	5.0	0.86
I-8	5.0	0.91

The results of the conversions indicate infiltration rate range from about 0.69 to 0.91 inch per hour. Copies of the percolation data sheets and the Porchet infiltration rate conversion calculations are presented in Appendix C. No factors of safety were applied to the rates provided. Over the lifetime of the infiltration areas, the infiltration rates may be affected by sediment build up and biological activities, as well as local variations in near surface soil conditions. A suitable factor of safety should be applied to the field rate in designing the infiltration system.

It should be noted that the infiltration rates provided above were performed in relatively undisturbed on-site soils. Infiltration rates will vary and are mostly dependent on the underlying consistency of the site soils and relative density. Infiltration rates may be impacted by weight of equipment travelling over the soils, placement of engineered fill and other various factors. GeoTek assumes no responsibility or liability for the ultimate design or performance of the storm water facility.

3.3 LABORATORY TESTING

Laboratory testing was performed on selected relatively undisturbed ring and bulk samples collected during the field exploration. The purpose of the laboratory testing was to confirm the field classification of the materials encountered and to evaluate their physical properties for use in the engineering design and analysis. Results of the laboratory testing program along with a brief description and relevant information regarding testing procedures are included on the exploratory borings logs included in Appendix A and in Appendix B.

4. GEOLOGIC AND SOILS CONDITIONS

4.1 REGIONAL SETTING

The subject property is situated in the Peninsular Ranges geomorphic province. The Peninsular Ranges province is one of the largest geomorphic units in western North America. It extends approximately 975 miles south of the Transverse Ranges geomorphic province to the tip of Baja California. This province varies in width from about 30 to 100 miles. It is bounded on the west by the Pacific Ocean, on the south by the Gulf of California and on the east by the Colorado Desert Province.

The Peninsular Ranges are essentially a series of northwest-southeast oriented fault blocks. Several major fault zones are found in this province. The Elsinore Fault zone and the San Jacinto Fault zone trend northwest-southeast and are found near the middle of the province. The San Andreas Fault zone borders the northeasterly margin of the province.

More specific to the subject property, the site is located in an area geologically mapped to be underlain by alluvium (Dibblee, T.W., and Minch, J.A., 2003). No active faults are shown in the immediate site vicinity on the maps reviewed for the area.

4.2 GENERAL SOIL CONDITIONS

A brief description of the earth materials encountered is presented in the following section. Based on the site reconnaissance, the exploratory excavations and review of published geologic maps, the area investigated is locally underlain by older alluvium.

4.2.1 Fill

While not encountered in any of the exploratory borings, artificial fills are anticipated in areas adjacent to existing streets and within the high pressure gas lines in the extension of Brodiaea Avenue along the southern boundary and through the central portion of the subject site. This fill is most likely from locally derived sources. Fill may be present within unexplored areas of the site.

4.2.2 Older Alluvium

Older alluvium was encountered in all the borings and extended to the maximum depth explored of 51.5 feet. As encountered in the borings, the older alluvium consisted of interbedded layers of sandy silts, silty sands, clayey sands, and relatively clean sands with variable amounts of gravel (ML, SM, SC and SP soil types based upon the Unified Soil Classification System).

Based on the laboratory test results, the near surface soils have a "very low" expansion index (ASTM D 4829). Based on the laboratory test results, the near surface soils have a soluble sulfate content of less than 0.1 percent (ASTM D 4327). Consolidation (collapse) test results indicate that some of the upper site soils are subject to significant hydroconsolidation (settlement upon wetting with or without additional load). The test results are provided in Appendix B.

4.3 SURFACE WATER AND GROUNDWATER

4.3.1 Surface Water

If encountered during earthwork operations, surface water on this site will most likely be the result of precipitation or possibly some minor surface run-off from the surrounding areas. Overall site area drainage varies due to the site topography and existing improvements. Provisions for surface drainage will need to be accounted for by the project civil engineer.

4.3.2 Groundwater

Groundwater was not encountered within any of the exploratory borings drilled at the site to the maximum depth drilled of 51.5 below the existing ground surface. Based on a review of groundwater depths noted on the State Department of Water Resources Water Data Library website, it is estimated the historic high groundwater depth is in excess of 100 feet below existing grade at the site. Based on the results of the field exploration, review of site area geomorphology and geology, groundwater is not anticipated to adversely affect the proposed improvements.

4.4 FAULTING AND SEISMICITY

4.4.1 Faulting

The geologic structure of the entire California area is dominated mainly by northwest-trending faults associated with the San Andreas system. The site is in a seismically active region. However, the site is not situated within a State of California designated *"Alquist-Priolo"* Earthquake Fault Zone. The County of Riverside indicates that the site is "not in a fault zone" and "not in a fault line." The nearest known active fault is the San Jacinto Fault – San Jacinto Valley Section located about 3.85 miles to the northeast.

4.4.2 Seismic Design Parameters

The site is located at approximately 33.9154 degrees West Latitude and -117.2035 degrees North Longitude. Site spectral accelerations (S_a and S_1) for 0.2 and 1.0 second periods for a Class "D" site, was determined from the SEAOC/OSHPD web interface that utilizes the USGS web services and retrieves the seismic design data and presents that information in a report format. Using the ASCE 7-16 option on the SEAOC/OSHPD website results in the values for S_{M1} and S_{D1} reported as "null-See Section 11.4.8" (of ASCE 7-16). As noted in ASCE 7-16, Section 11.4.8, a site-specific ground motion procedure is recommended for Site Class D when the value S_1 exceeds 0.2. The value S_1 for the subject site exceeds 0.2.

For a site Class D, an exception to performing a site-specific ground motion analysis is allowed in ASCE 7-16 where S_1 exceeds 0.2 provided the value of the seismic response coefficient, Cs, is conservatively calculated by Eq 12.8-2 of ASCE 7-16 for values of $T \leq 1.5T_s$ and taken as equal to 1.5 times the value computed in accordance with either Eq. 12.8-3 for $T_L \geq T > 1.5T_s$ or Eq. 12.8-4 for $T > T_L$.

The results, based on the 2015 NEHRP and the 2019 CBC, are presented in the following table assuming that the exception as allowed in ASCE 7-16 is applicable. If the exception is deemed not appropriate, a site-specific ground motion analysis will be required.

SITE SEISMIC PARAMETERS	
Mapped 0.2 sec Period Spectral Acceleration, S_S	1.751g
Mapped 1.0 sec Period Spectral Acceleration, S_1	0.685g
Site Coefficient for Site Class "D", F_a	1
Site Coefficient for Site Class "D", F_V	1.7
Maximum Considered Earthquake Spectral Response Acceleration for 0.2 Second, S_{MS}	1.751g
Maximum Considered Earthquake Spectral Response Acceleration for 1.0 Second, S_{M1}	1.165g
5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, S_{DS}	1.167g
5% Damped Design Spectral Response Acceleration Parameter at 1 second, S_{D1}	0.776g
Peak Ground Acceleration (PGA_M)	0.815g
Seismic Design Category	D

Final selection of the appropriate seismic design coefficients should be made by the project structural engineer based upon the local practices and ordinances, expected building response and desired level of conservatism.

4.5 LIQUEFACTION

Liquefaction describes a phenomenon in which cyclic stresses, produced by earthquake-induced ground motion, create excess pore pressures in relatively cohesionless soils. These soils may thereby acquire a high degree of mobility, which can lead to lateral movement, sliding, consolidation and settlement of loose sediments, sand boils and other damaging deformations. This phenomenon occurs only below the water table, but, after liquefaction has developed, the effects can propagate upward into overlying non-saturated soil as excess pore water dissipates.

The factors known to influence liquefaction potential include soil type and grain size, relative density, groundwater level, confining pressures, and both intensity and duration of ground shaking. In general, materials that are susceptible to liquefaction are loose, saturated granular soils having low fines content under low confining pressures.

The site is not designated as having the potential for liquefaction by the State of California; however, the County of Riverside indicates that the site has "low" liquefaction potential. The depth to groundwater at the site is estimated to be greater than 100 feet below grade. Based on the depth to groundwater and generally dense nature of the alluvium, it is GeoTek's opinion that the potential for liquefaction at this site is very low.

4.6 OTHER SEISMIC HAZARDS

The potential for seismic densification ("dry-sand" seismic settlement) resulting from seismic activity was assessed. For this analysis, the soil profile identified within Boring B-5, a ground acceleration (PGA_M) of 0.815g and a mean earthquake magnitude of 7.3. The ground acceleration and earthquake magnitude values were obtained from the USGS websites. Based on the recommendations provided in this report, engineered fill will be incorporated within the upper four to five feet of pad grade; this change has been incorporated into the liquefaction analysis. The computer software program LiquefyPro Version 5 was utilized to estimate the dry-sand seismic settlement potential.

The result of the seismic settlement analysis indicates a total seismic settlement of approximately 0.83 inches. It is estimated a differential settlement of ½ the total estimated settlement over a 40-foot span will occur. Based on the magnitudes of estimated seismic settlements, special mitigation or design is not considered necessary. However, the estimated seismic settlements should be considered in structural design. A copy of the computer output file for this analysis is presented in Appendix D.

The County of Riverside indicates that the site is "susceptible" to subsidence.

Due to the general flat terrain, the potential for seismic induced landslides or lateral spreading is considered nil.

The potential for secondary seismic hazards such as a seiche and tsunami is considered negligible due to site elevation and distance from an open body of water. Additionally, the County of Riverside has designated the subject site as being "outside floodplain".

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

Development of the site appears feasible from a geotechnical engineering viewpoint. The following recommendations should be incorporated into the design and construction phases of development.

5.2 EARTHWORK CONSIDERATIONS

5.2.1 General

Earthwork and grading should be performed in accordance with the applicable grading ordinances of the County of Riverside, City of Moreno Valley and the 2019 California Building Code (CBC), and recommendations contained in this report. The Grading Guidelines included in Appendix E outline general procedures and do not anticipate all site-specific situations. In the event of conflict, the recommendations presented in the text of this report should supersede those contained in Appendix E.

5.2.2 Site Clearing

Initial site preparation should commence with removal of debris, deleterious materials and vegetation within the limits of the planned improvements. These materials should be properly disposed of off-site. Voids resulting from removing any materials should be replaced with engineered fill materials with expansion characteristics similar to the onsite materials.

5.2.3 Site Preparation

Due to the non-uniform nature and thickness and significant hydroconsolidation potential of the near-surface alluvium, it is recommended that the soils be removed beneath the planned building footprint of the proposed structure to a depth of at least 4 feet below existing natural (below existing fill) grade, or two (2) feet beneath the base of the proposed foundations, whichever is greater. Removal bottoms should be relatively uniform in soil type which is not visibly porous and having an in-place density of at least 85 percent of the soil's maximum dry density as determined by ASTM D 1557 test procedures. A representative of this firm should observe and approve the bottom of all remedial excavations. The lateral extent of this recommended over-excavation should extend at least 5 feet beyond the building or foundation limits.

A minimum of 12 inches of engineered fill should be provided below asphaltic concrete pavement and Portland cement concrete hardscape areas. The horizontal extent of removals should extend at least two feet beyond the edge of hardscaping.

Following site clearing operations, over-excavation and lowering of site grades, where necessary, it is recommended that the exposed subgrade soils beneath all surface improvements be proof rolled with a heavy rubber-tired piece of construction equipment approved by and in the presence of the geotechnical engineering representative. The proof rolling equipment should possess a minimum weight of 15 tons and proof rolling should include at least 4 passes, two in each perpendicular direction. All soil that ruts or excessively deflects during proof rolling should be removed as recommended by the GeoTek representative. Following proof

rolling and removal of any unsuitable bearing soil, the exposed subgrade should be scarified to a depth of about 12 inches, be moisture conditioned to slightly above the soil's optimum moisture content and then be compacted to at least 90 percent of the soil's maximum dry density as determined by ASTM D-1557 test procedures.

Remedial grading, trench backfill, fill placement and/or construction within or adjacent to the on-site high-pressure natural gas utility lines and easements should be performed in strict conformance with the gas utility requirements. Additional recommendations may be required for construction once formal development plans are available for review.

5.2.4 Engineered Fill

The on-site soils are generally considered suitable for reuse as engineered fill provided they are free from vegetation, debris, oversized materials (6-inch diameter or greater) and other deleterious material. All areas should be brought to final subgrade elevations with fill materials that are placed and compacted in general accordance with minimum project standards. Engineered fill should be placed in 6- to 8-inch loose lifts, moisture conditioned to slightly above the optimum moisture content and compacted to a minimum relative compaction of 90 percent as determined by ASTM D-1557 test procedures.

If wet soils are encountered during remedial grading, methods for drying soils such as stockpiling or mixing with dry soils may be required to bring the soils to the required moisture content for placement as engineered fill. Placement of engineered fill should be observed and tested on a full-time basis by a GeoTek representative during grading activities.

5.2.5 Transition Lot Condition

Building pads graded with a cut/fill transition should be undercut to reduce the potential for differential settlement. The cut portion of the cut/fill transition should be undercut to a depth of at least 3 feet or one (1) foot below the deepest proposed footing, whichever is deeper, and be backfilled with a properly compacted engineered fill. The bottom of the undercut should be sloped at a minimum of 1 percent toward the adjacent lot area.

5.2.6 Oversized Rock Disposal

Although unlikely, oversized cobbles, boulders and rock fragments may be encountered during rough grading and utility trench operations. If encountered, on-site disposal of oversized materials is possible, provided the oversized materials are placed as recommended on Plate G-4 within Appendix E. Alternatively, over-sized materials can be exported from the site.

5.2.7 Excavation Characteristics

Excavations in the on-site older alluvium should be readily accomplished with heavy-duty earthmoving or excavating equipment in good operating condition. All excavations should be formed in accordance with current Cal-OSHA requirements.

5.2.8 Trench Excavations and Backfill

Temporary trench excavations within the on-site materials should be stable at a 1:1 inclination for short durations during construction and where cuts do not exceed 15 feet in height. Deeper temporary excavations should be reviewed by GeoTek prior to their planned excavation to determine if supplemental recommendations or analysis are warranted. It is anticipated that temporary cuts to a maximum height of 4 feet can be excavated vertically.

Trench excavations should conform to Cal-OSHA regulations. The contractor should have a competent person, per OSHA requirements, on site during construction to observe conditions and to make the appropriate recommendations.

Utility trench backfill should be compacted to at least 90 percent relative compaction (as determined by ASTM D-1557 test procedures). Under-slab trenches should also be compacted to project specifications. Where applicable, based on jurisdictional requirements, the top 12 inches of backfill below subgrade for road pavements should be compacted to at least 95 percent relative compaction. On-site materials may not be suitable for use as bedding material but should be suitable as backfill provided particles larger than 6 inches are removed.

Compaction should be achieved with a mechanical compaction device. Ponding or jetting of trench backfill is not recommended. If backfill soils have dried out, they should be properly moisture conditioned prior to placement in trenches.

5.2.9 Shrinkage and Bulking

For planning purposes, a shrinkage loss of about 15 to 25 percent is anticipated for the upper 3 feet of existing materials across the site, and 10 to 20 percent for the natural materials necessitating remedial grading and/or over-excavation below the upper 3 feet. Several factors will impact earthwork balancing on the site, including shrinkage, trench spoil from utilities and footing excavations, as well as the accuracy of topography. Shrinkage and bulking are primarily dependent upon the degree of compactive effort achieved during construction, depth of fill and underlying site conditions.

A subsidence loss of up to 0.2 foot is estimated for the site. Subsidence will occur below the processed removal bottoms at the site.

Site balance areas should be available in order to adjust project grades, depending on actual field conditions at the conclusion of earthwork construction.

5.2.10 Import Soils

Import soils should have expansion characteristics similar to the on-site soils. GeoTek also recommends that the proposed import soils be tested for expansion and sulfate potential. GeoTek should be notified a minimum of 72 hours prior to importing so that appropriate sampling and laboratory testing can be performed.

5.2.11 Grading Plan Review

Upon completion of the site grading plans, it is recommended that those plans be provided to GeoTek for review. Based on that review, some modifications to the recommendations provided in this report may be necessary.

5.3 DESIGN RECOMMENDATIONS

5.3.1 Foundation Design Criteria

Foundation design criteria for a conventional foundation system, in general conformance with the 2019 CBC, are presented herein. These are typical design criteria and are not intended to supersede the design by the structural engineer.

Based on the expansion index testing performed for this report and visual examination of the site soils, site soils possess a "very low" (0-20) expansion index (ASTM D4829). Therefore, it is GeoTek's opinion that conventional foundations supported by engineered fill may be used for this site.

A summary of GeoTek's preliminary foundation design recommendations is presented in the table below:

Design Parameter	"Very Low" Expansion Potential (0≤EI≤20)
Foundation Depth or Minimum Perimeter Beam Depth (inches below lowest adjacent grade)	12 - One- and Two-Stories 24 – Three- and Four-Stories
Minimum Foundation Width (Inches)*	12 - One- and Two-Stories 15 – Three-Stories 18 – Four-Stories
Minimum Slab Thickness (actual)	4 inches
Minimum Slab Reinforcing	6" x 6" – W1.4/W1.4 welded wire fabric placed in middle of slab or No. 3 bars at 24-inch centers.
Minimum Footing Reinforcement	Two No. 4 Reinforcing Bars, one top and one bottom
Presaturation of Subgrade Soil (Percent of Optimum)	Minimum 100% to a depth of 12 inches prior to placement of concrete

*Code minimums per Table 1809.7 of the 2019 CBC.

It should be noted that the criteria provided are based on soil support characteristics only. The structural engineer should design the slab and beam reinforcement based on actual loading conditions.

The following criteria for design of foundations are preliminary and should be re-evaluated based on the results additional laboratory testing of samples obtained at/near finish pad grade.

5.3.1.1 An allowable bearing capacity of 2,000 pounds per square foot (psf) may be used for design of continuous and perimeter footings 12 inches deep and 12 inches wide, and pad footings 24 inches square and 12 inches deep. This allowable soil bearing capacity may be increased by 300 psf for each additional foot of footing depth and 300 psf for each additional foot of footing width to a maximum value of 4,000 psf. An increase of one-third may be applied when considering short-term live loads (e.g., seismic and wind loads).

5.3.1.2 Structural foundations should be designed in accordance with the 2019 CBC, and to withstand a total static settlement of 1 inch and maximum differential static settlement of one-half of the total settlement over a horizontal distance of 40 feet.

5.3.1.3 The passive earth pressure may be computed as an equivalent fluid having a density of 380 psf per foot of depth, to a maximum earth pressure of 3,500 psf for footings founded on engineered fill or competent native soil. A coefficient of friction between soil and concrete of 0.38 may be used with dead load forces. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third. The upper one foot of soil should be ignored in the passive pressure calculations unless the surface is covered with pavements.

5.3.1.4 A grade beam, a minimum of 12 inches wide and 12 inches deep, should be utilized across large entrances. The base of the grade beam should be at the same elevation as the bottom of the adjoining footings.

5.3.1.5 A moisture and vapor retarding system should be placed below slabs-on-grade where moisture migration through the slab is undesirable. Guidelines for these are provided in the 2019 California Green Building Standards Code (CALGreen) Section 4.505.2, the 2019 CBC Section 1907.1 and ACI 360R-10. The vapor retarder design and construction should also meet the requirements of ASTM E 1643. A portion of the vapor retarder design should be the implementation of a moisture vapor retardant membrane.

It should be realized that the effectiveness of the vapor retarding membrane can be adversely impacted as a result of construction related punctures (e.g., stake penetrations, tears, punctures from walking on the vapor retarder placed atop the underlying aggregate layer, etc.). These occurrences should be limited as much as possible during construction. Thicker membranes are generally more resistant to accidental puncture than thinner ones. Products specifically designed for use as moisture/vapor retarders may also be more puncture resistant. Although the CBC specifies a 6-mil vapor retarder membrane, it is GeoTek's opinion that a minimum 10 mil thick membrane with joints properly overlapped and sealed should be considered, unless otherwise specified by the slab design professional. The membrane should consist of Stego wrap or the equivalent.

Moisture and vapor retarding systems are intended to provide a certain level of resistance to vapor and moisture transmission through the concrete, but do not eliminate it. The acceptable level of moisture transmission through the slab is to a large extent based on the type of flooring used and environmental conditions. Ultimately, the vapor retarding system should be comprised of suitable elements to limited migration of water and reduce transmission of water vapor through the slab to acceptable levels. The selected elements should have suitable properties (i.e.,

thickness, composition, strength, and permeability) to achieve the desired performance level.

Moisture retarders can reduce, but not eliminate, moisture vapor rise from the underlying soils up through the slab. Moisture retarder systems should be designed and constructed in accordance with applicable American Concrete Institute, Portland Cement Association, Post-Tensioning Concrete Institute, ASTM and California Building Code requirements and guidelines.

GeoTek recommends that a qualified person, such as the flooring contractor, structural engineer, architect, and/or other experts specializing in moisture control within the building be consulted to evaluate the general and specific moisture and vapor transmission paths and associated potential impact on the proposed construction. That person (or persons) should provide recommendations relative to the slab moisture and vapor retarder systems and for migration of potential adverse impact of moisture vapor transmission on various components of the structures, as deemed appropriate.

In addition, the recommendations in this report and GeoTek's services in general are not intended to address mold prevention; since GeoTek, along with geotechnical consultants in general, do not practice in the area of mold prevention. If specific recommendations addressing potential mold issues are desired, then a professional mold prevention consultant should be contacted.

5.3.1.6 It is recommended that control joints be placed in two directions spaced approximately 24 to 36 times the thickness of the slab in inches. These joints are a widely accepted means to control cracks and should be reviewed by the project structural engineer.

5.3.2 Miscellaneous Foundation Recommendations

5.3.2.1 To reduce moisture penetration beneath the slab on grade areas, utility trench excavations should be backfilled with engineered fill, lean concrete or concrete slurry where they intercept the perimeter footing or thickened slab edge.

5.3.2.2 Soils from the footing excavations should not be placed in the slab-on-grade areas unless properly compacted and tested. The excavations should be free of loose/sloughed materials and be neatly trimmed at the time of concrete placement.

5.3.2.3 Under-slab utility trenches should be compacted to project specifications. Compaction should be achieved with a mechanical compaction device. If backfill soils have dried out, they should be thoroughly moisture conditioned prior to placement in trenches.

5.3.3 Foundation Setbacks

Minimum setbacks for all foundations should comply with the 2019 CBC or City of Moreno Valley requirements, whichever is more stringent. Improvements not conforming to these setbacks are subject to the increased likelihood of excessive lateral movements and/or differential settlements. If large enough, these movements can compromise the integrity of the improvements. The following recommendations are presented:

- The outside bottom edge of all footings should be set back a minimum of H/3 (where H is the slope height) from the face of any descending slope. The setback should be at least 7 feet and need not exceed 40 feet.
- The bottom of all footings for structures near retaining walls should be deepened so as to extend below a 1:1 projection upward from the bottom inside edge of the wall footing.
- The bottom of any foundations for structures should be deepened so as to extend below a 1:1 projection upward from the bottom of the nearest excavation.

5.3.4 Soil Corrosivity

The soil resistivity at this site was tested in the laboratory on two (2) soil samples collected during the field investigation. The results of the testing indicate that the on-site soils are considered to "highly corrosive" to "corrosive" (2,747 to 4,020 ohm-cm) (Roberge, 2000) to buried ferrous metal in accordance with current standards used by corrosion engineers. It is recommended that a corrosion engineer be consulted to provide recommendations for the protection of buried ferrous metal at this site.

5.3.5 Soil Sulfate Content

The sulfate content was determined in the laboratory on two (2) samples collected during the field investigation. The results indicate that the soil water-soluble sulfate content is less than 0.1 percent by weight, which is considered "negligible" as per Table 4.2.1 of ACI 318. Based on the test results and Table 4.3.1 of ACI 318, no special recommendations for concrete are required for this project due to soil sulfate exposure.

5.4 RETAINING AND GARDEN WALL DESIGN AND CONSTRUCTION

5.4.1 General Design Criteria

Recommendations presented in this report apply to typical masonry or concrete vertical retaining walls to a maximum height of up to six (6) feet. Additional review and recommendations should be requested for higher walls. These are typical design criteria and are not intended to supersede the design by the structural engineer.

Retaining wall foundations should be embedded a minimum of 18 inches into engineered fill. Retaining wall foundations should be designed in accordance with Section 5.3 of this report. Structural needs may govern and should be evaluated by the project structural engineer.

All earth retention structure plans, as applicable, should be reviewed by this office prior to finalization.

Earthwork considerations, site clearing and remedial earthwork for all earth retention structures should meet the requirements of this report, unless specifically provided otherwise, or more stringent requirements or recommendations are made by the designer. The backfill material placement for all earth retention structures should meet the requirement of Section 5.2.4 in this report.

In general, cantilever earth retention structures, which are designed to yield at least 0.001H, where H is equal to the height of the earth retention structure, may be designed using the "active" condition. Rigid earth retention structures (including but not limited to rigid walls, and walls braced at top, such as typical basement walls) should be designed using the "at-rest" condition.

In addition to the design lateral forces due to retained earth, surcharges due to improvements, such as an adjacent building or traffic loading, should be considered in the design of the earth retention structures. Loads applied within a 1:1 (horizontal:vertical) projection from the surcharge on the stem of the earth retention structure should be considered in the design.

Final selection of the appropriate design parameters should be made by the designer of the earth retention structures.

5.4.2 Cantilevered Walls

The recommendations presented below are for cantilevered retaining walls up to six (6) feet high. Active earth pressure may be used for retaining wall design, provided the top of the wall

is not restrained from minor deflections. An equivalent fluid pressure approach may be used to compute the horizontal pressure against the wall. Appropriate fluid unit weights are given below for specific slope gradients of the retained material. These do not include other superimposed loading conditions such as traffic, structures, seismic events, or adverse geologic conditions.

ACTIVE EARTH PRESSURES	
Surface Slope of Retained Materials (horizontal:vertical)	Equivalent Fluid Pressure (pcf) Select Backfill* and Native Soils
Level	40
2:1	60

*The design pressures assume the backfill material has an expansion index less than or equal to 20. Backfill zone includes area between back of the wall to a plane (1:1 horizontal : vertical) up from bottom of the wall foundation (on the backside of the wall) to the ground surface.

For walls with a retained height greater than 6 feet, an incremental seismic pressure should be included into the wall design. Where needed, it is recommended that an equivalent fluid pressure of 24 pcf be included into the wall design to account for seismic loading conditions. This pressure may be applied as an inverted triangular distribution.

5.4.3 Retaining Wall Backfill and Drainage

The wall backfill should also include a minimum one (1) foot wide section of ¾- to 1-inch clean crushed rock (or an approved equivalent). The rock should be placed immediately adjacent to the back of the wall and extend up from a back drain to within approximately 24 inches of the finish grade. The upper 24 inches should consist of compacted on-site materials. The rock should be separated from the earth with filter fabric. The presence of other materials might necessitate revision to the parameters provided and modification of the wall designs. The backfill materials should be placed in lifts no greater than eight (8) inches in thickness and compacted to a minimum of 90% relative compaction as determined by ASTM D 1557 test procedures. Proper surface drainage needs to be provided and maintained.

As an alternative to the drain, rock and fabric, a pre-manufactured wall drainage product (example: Mira Drain 6000 or approved equivalent) may be used behind the retaining wall. The wall drainage product should extend from the base of the wall to within two (2) feet of the ground surface. The subdrain should be placed in direct contact with the wall drainage product.

Retaining walls should be provided with an adequate pipe and gravel back drain system to help prevent buildup of hydrostatic pressures. Backdrains should consist of a four (4)-inch diameter perforated collector pipe (Schedule 40, SDR 35, or approved equivalent) embedded in a minimum of one (1) cubic foot per linear foot of ¾- to 1-inch clean crushed rock or an approved equivalent, wrapped in filter fabric (Mirafi 140N or an approved equivalent). The drain system should be connected to a suitable outlet. Waterproofing of site walls should be performed where moisture migration through the walls is undesirable.

5.4.4 Restrained Retaining Walls

Retaining walls that will be restrained at the top that support level backfill or that have reentrant or male corners, should be designed for an equivalent at-rest fluid pressure of 60 pcf, plus any applicable surcharge loading. For areas of male or reentrant corners, the restrained wall design should extend a minimum distance of twice the height of the wall laterally from the corner, or a distance otherwise determined by the project structural engineer.

5.4.5 Other Design Considerations

- Wall design should consider the additional surcharge loads from superjacent slopes and/or footings, where appropriate.
- No backfill should be placed against concrete until minimum design strengths are evident by compression tests of cylinders.
- The retaining wall footing excavations, backcuts, and backfill materials should be approved by the project geotechnical engineer or their authorized representative.
- Positive separations should be provided in garden walls at horizontal distances not exceeding 20 feet.

5.5 SWIMMING POOL CONSIDERATIONS

The proposed swimming pools should derive support entirely from engineered fill. A minimum 12 inches of engineered fill should be provided below the pool shell.

The pool walls should be designed for at-rest soil conditions using an equivalent fluid pressure of 60 pcf for at-rest conditions. Pool walls surcharged by adjacent structures should be designed for additional pressures. Alternatively, the pool walls may be designed as freestanding walls using the active soil state conditions provided that some lateral movement of the pool walls is acceptable. If the active state is to be used, an equivalent fluid pressure of 40 pcf is considered suitable. These recommended pressures are based on "drained" wall conditions and using granular native soils as wall backfill. If a drain system adjacent/beneath the pool is

not provided, the pool walls should then be designed for an equivalent fluid pressure of 96 pcf for the at-rest condition and 84 pcf for the active condition.

As noted above, the use of the lower (drained condition) at-rest or active soil pressures will require a subdrain system beneath/adjacent to the pool. A typical subdrain system includes a series of 4-inch diameter perforated drain pipes encapsulated with at least one cubic foot of free-draining material per linear foot of pipe. The free-draining material should be encapsulated within a geotextile to prevent migration of fines into the drainage medium. The drain pipes should be routed to an acceptable discharge location, as determined by the civil engineer/pool designer. If desired, GeoTek can review the subdrain system once designed to determine if additional measures are warranted. The pool designer should consider hydrostatic relief valves or equivalent in order to prevent the effects of potential hydrostatic pressure on an empty pool shell.

Pool decking supported on grade should be separated from the pool bond beam by a full-depth, mastic construction joint. If it is desired to extend the pool deck over the bond beam, consideration should be given to designing the deck as a structural slab supported by the pool shell. This will reduce the possibility of deck cracking occurring along the outer edge of the bond beam. It is also recommended that the area of the pool decking be pre-saturated prior to concrete placement. The subgrade soils should be moisture conditioned to at least 100 percent of the soil's optimum moisture content to a depth of 12 inches, prior to concrete placement. Testing by the geotechnical engineer is recommended to confirm that the soils have been adequately moisture treated.

Pool decking may consist of five-inch thick concrete and the use of reinforcement is suggested. Control joints should be placed in two directions and located a distance apart approximately equal to 24 to 36 times the slab thickness. Type V cement is recommended for pool construction due to the chemicals associated with the pool water. The project structural engineer should provide final slab thickness, reinforcement, and joint recommendations

5.6 PRELIMINARY PAVEMENT DESIGN RECOMMENDATIONS

One bulk sample has been collected from the subject site and tested to determine a preliminary R-Value for pavement design. Based on laboratory testing, an R-Value of 50 has been utilized for the determination of preliminary pavement sections for this report. The final design should be based on R-Value testing of the soil subgrade following completion of rough grading operations. Project streets should be designed in accordance with City of Moreno Valley requirements when final Traffic Indices and R-Value test results of the subgrade soil are completed.

Pavement design for proposed on-site and off-site street improvements was conducted per Caltrans *Highway Design Manual* guidelines for flexible pavements. Based on Traffic Indices (TIs) specified by the City of Moreno Valley (Standard Plan MVSI-100A-1, approved September 14, 2018) and using a design R-value of 50, the following preliminary sections were calculated:

PRELIMINARY PAVEMENT SECTIONS			
Traffic Index (TI)	R-Value	Thickness of Asphalt Concrete (inches)	Thickness of Aggregate Base (inches)
6.0 (Local Street, Modified Local Street)	50	3.6*	6*
7.0 (Collector)		3.6*	6*
9.0 (Minor Arterial)		5.4*	9*

*Minimum requirements per City of Moreno Valley Standard Plan MVSI-100A-1

The TIs used in the above pavement analysis and design were designated by the City of Moreno Valley for the indicated street types and should provide a pavement life of approximately 20 years with a normal amount of flexible pavement maintenance. Irrigation adjacent to pavements, without a deep curb or other cutoff to separate landscaping from the paving may result in premature pavement failure. Traffic parameters used for design were selected based upon engineering judgment and not upon information furnished to us such as an equivalent wheel load analysis or a traffic study.

The recommended pavement sections provided are intended as a minimum guideline and final selection of pavement cross section parameters should be made by the project civil engineer, based upon the local laws and ordinates, expected subgrade and pavement response, and desired level of conservatism. If thinner or highly variable pavement sections are constructed, increased maintenance and repair could be expected. Final pavement design should be checked by testing of soils exposed at subgrade (the upper 12 inches) after final grading has been completed.

Asphalt concrete and aggregate base should conform to current Caltrans Standard Specifications Section 39 and 26-1.02, respectively. As an alternative, asphalt concrete can conform to Section 203-6 of the current Standard Specifications for Public Work (Green Book). Crushed aggregate base or crushed miscellaneous base can conform to Section 200-2.2

and 200-2.4 of the Green Book, respectively. Pavement base should be compacted to at least 95 percent of the ASTM D1557 laboratory maximum dry density (modified proctor).

All pavement installation, including preparation and compaction of subgrade, compaction of base material, placement and rolling of asphaltic concrete, should be done in accordance with City of Moreno Valley specifications, and under the observation and testing of GeoTek and a City Inspector where required. Jurisdictional minimum compaction requirements in excess of the aforementioned minimums may govern.

Deleterious material, excessive wet or dry pockets, oversized rock fragments, and other unsuitable yielding materials encountered during grading should be removed. Once existing compacted fill are brought to the proposed pavement subgrade elevations, the subgrade should be proof rolled in order to check for a uniform and unyielding surface. The upper 12 inches of pavement subgrade soils should be scarified, moisture conditioned at or near optimum moisture content, and recompacted to at least 95 percent of the laboratory maximum dry density as determined by ASTM D1557 test procedures. If loose or yielding materials are encountered during construction, additional evaluation of these areas should be carried out by GeoTek. All pavement section changes should be properly transitioned.

5.7 CONCRETE CONSTRUCTION

5.7.1 General

Concrete construction should follow the 2019 CBC and ACI guidelines regarding design, mix placement and curing of the concrete. If desired, GeoTek could provide quality control testing of the concrete during construction.

5.7.2 Concrete Mix Design

As discussed in Section 5.3.5, no special recommendations for concrete are required for this project due to soil sulfate exposure. Additional testing should be performed during grading so that specific recommendations can be formulated based on the as-graded conditions.

5.7.3 Concrete Flatwork

Exterior concrete flatwork is often one of the most visible aspects of site development. They are typically given the least level of quality control, being considered "non-structural" components. Cracking of these features is common due to various factors. While cracking usually does not affect the structural performance of the concrete, it is unsightly. It is recommended that the same standards of care be applied to these features as to the structure itself.

Flatwork should consist of a minimum four-inch (actual) thick concrete and the use of temperature and shrinkage control reinforcement is suggested. The project structural engineer should provide final design recommendations.

5.7.4 Concrete Performance

Concrete cracks should be expected. These cracks can vary from sizes that are hairline to more than 1/8 inch in width. Most cracks in concrete while unsightly do not significantly impact long-term performance. While it is possible to take measures (proper concrete mix, placement, curing, control joints, etc.) to reduce the extent and size of cracks that occur, some cracking will occur despite the best efforts to minimize it. Concrete undergoes chemical processes that are dependent on a wide range of variables, which are difficult, at best, to control. Concrete, while seemingly a stable material, is subject to internal expansion and contraction due to external changes over time.

One of the simplest means to control cracking is to provide weakened control joints for cracking to occur along. These do not prevent cracks from developing; they simply provide a relief point for the stresses that develop. These joints are a widely accepted means to control cracks but are not always effective. Control joints are more effective the more closely spaced they are. GeoTek suggests that control joints be placed in two orthogonal directions and located a distance apart approximately equal to 24 to 36 times the slab thickness.

5.8 POST CONSTRUCTION CONSIDERATIONS

5.8.1 Landscape Maintenance and Planting

Water has been shown to weaken the inherent strength of soil, and slope stability is significantly reduced by overly wet conditions. Positive surface drainage away from graded slopes should be maintained and only the amount of irrigation necessary to sustain plant life should be provided for planted slopes. Controlling surface drainage and runoff and maintaining a suitable vegetation cover can minimize erosion. Plants selected for landscaping should be lightweight, deep-rooted types that require little water and are capable of surviving the prevailing climate.

Overwatering should be avoided. Care should be taken when adding soil amendments to avoid excessive watering. Leaching as a method of soil preparation prior to planting is not recommended. An abatement program to control ground-burrowing rodents should be implemented and maintained. This is critical as burrowing rodents can decreased the long-term performance of slopes.

It is common for planting to be placed adjacent to structures in planter or lawn areas. This will result in the introduction of water into the ground adjacent to the foundations. This type of landscaping should be avoided. Planters within 30 feet of the buildings should be above ground and underlain by a concrete slab. Waterproofing of the foundation and/or subdrains may be warranted and advisable. GeoTek could discuss these issues, if desired, when plans are made available.

5.8.2 Drainage

The need to maintain proper surface drainage and subsurface systems cannot be overly emphasized. Positive site drainage should be maintained at all times. Drainage should not flow uncontrolled down any descending slope. Water should be directed away from foundations and not allowed to pond or seep into the ground adjacent to the footings and floor-slabs. Pad drainage should be directed toward approved areas and not be blocked by other improvements.

Roof gutters should be installed that will direct the collected water at least 20 feet from the buildings.

It is the owner's responsibility to maintain and clean drainage devices on or contiguous to their lot. In order to be effective, maintenance should be conducted on a regular and routine schedule and necessary corrections made prior to each rainy season.

5.9 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

It is recommended that site grading, specifications, and foundation plans be reviewed by this office prior to construction to check for conformance with the recommendations of this report. It is also recommended that GeoTek representatives be present during site grading and foundation construction to observe and document for proper implementation of the geotechnical recommendations. The owner/developer should have GeoTek perform at least the following duties:

- Observe site clearing and grubbing operations for proper removal of all unsuitable materials.
- Observe and test bottom of removals prior to fill placement.
- Evaluate the suitability of on-site and import materials for fill placement and collect soil samples for laboratory testing where necessary.
- Observe the fill for uniformity during placement, including utility trench excavation backfill. Also, test the fill for density, relative compaction and moisture content.

- Observe and probe foundation excavations to confirm suitability of bearing materials with respect to density.

If requested, a construction observation and compaction report can be provided by GeoTek which can comply with the requirements of the governmental agencies having jurisdiction over the project. It is recommended that these agencies be notified prior to commencement of construction so that necessary grading permits can be obtained.

6. INTENT

It is the intent of this report to aid in the design and construction of the proposed development. Implementation of the advice presented in this report is intended to reduce risk associated with construction projects. The professional opinions and geotechnical advice contained in this report are not intended to imply total performance of the project or guarantee that unusual or variable conditions will not be discovered during or after construction.

The scope of GeoTek's evaluation is limited to the area explored that is shown on the Exploration Location Map (Figure 2). This evaluation does not and should in no way be construed to encompass any areas beyond the specific area of the proposed construction as indicated to GeoTek by the client. Further, no evaluation of any existing site improvements is included. The scope is based on GeoTek's understanding of the project and the client's needs, GeoTek's proposal (Proposal No. P-1008721-CR) dated November 2, 2021 and geotechnical engineering standards normally used on similar projects in this region.

7. LIMITATIONS

GeoTek's findings are based on site conditions observed and the stated sources. Thus, GeoTek's comments are professional opinions that are limited to the extent of the available data.

GeoTek has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering at this time and location and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report.

Since GeoTek's recommendations are based on the site conditions observed and encountered at the stated times and laboratory testing. Thus, GeoTek's conclusions and recommendations are professional opinions that are limited to the extent of the available data. Observations during construction are important to allow for any change in recommendations found to be warranted. These opinions have been derived in accordance with current standards of practice and no warranty of any kind is expressed or implied. Standards of care/practice are subject to change with time.

8. SELECTED REFERENCES

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Modified from Google Earth Pro Aerial Imagery

2000 Ft.

Oakdale Communities
Darwin Court Project
SEC of Alessandro Boulevard and Darwin Drive
Moreno Valley, Riverside County, California

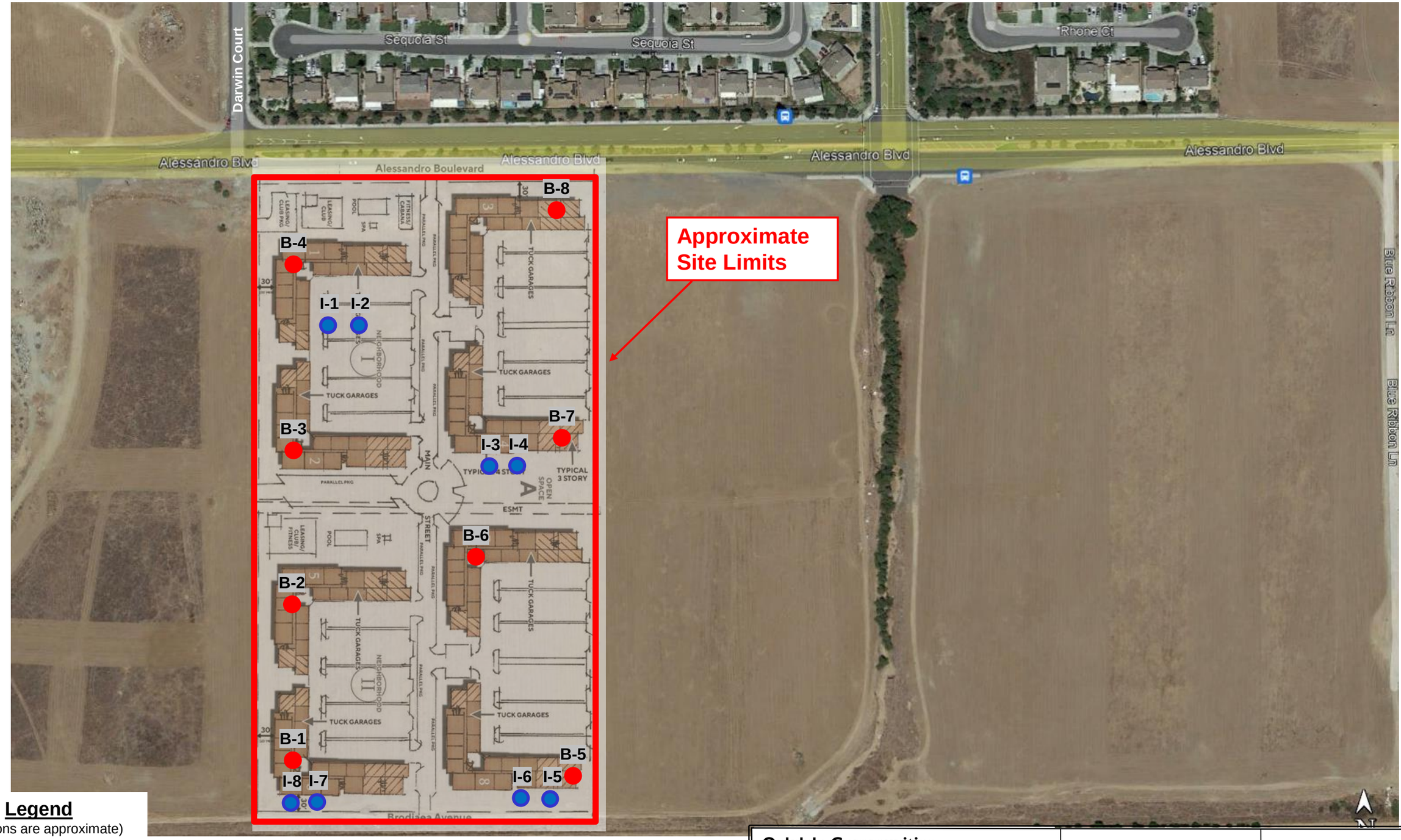
GeoTek Project No. 2950-CR

NORTH

Figure 1

Site Location Map

GEOTEK



Legend
(Locations are approximate)

- Exploratory Geotechnical Boring
- Percolation Test Boring

300 FEET
SCALE

NORTH

Oakdale Communities
Darwin Court Project
SEC of Alessandro Blvd and Darwin Drive
Moreno Valley, Riverside County, California

Project No. 2950-CR

GEOTEK

Figure 2

Exploration Location Map

APPENDIX A

LOG OF EXPLORATORY BORINGS

Multi-Family Residential Development
Darwin Court Project
Moreno Valley, Riverside County, California
Project No. 2950-CR

GEOTEK

FIELD TESTING AND SAMPLING PROCEDURES

The Modified Split-Barrel Sampler (Ring)

The Ring sampler is driven into the ground at various depths in accordance with ASTM D 3550 test procedures. The sampler, with an external diameter of 3.0 inches, is lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sampler is typically driven into the ground 12 or 18 inches with a 140-pound hammer free falling from a height of 30 inches. Blow counts are recorded for every 6 inches of penetration as indicated on the log of boring. The samples are removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

Bulk Samples (Large)

These samples are normally large bags of earth materials over 20 pounds in weight collected from the field by means of hand digging or exploratory cuttings.

Bulk Samples (Small)

These are plastic bag samples which are normally airtight and contain less than 5 pounds in weight of earth materials collected from the field by means of hand digging or exploratory cuttings. These samples are primarily used for determining natural moisture content and classification indices.

B - BORING LOG LEGEND

The following abbreviations and symbols often appear in the classification and description of soil and rock on the log of borings:

SOILS

USCS	Unified Soil Classification System
f-c	Fine to coarse
f-m	Fine to medium

GEOLOGIC

B: Attitudes	Bedding: strike/dip
J: Attitudes	Joint: strike/dip
C: Contact line	
……..	Dashed line denotes USCS material change
———	Solid Line denotes unit / formational change
———	Thick solid line denotes end of boring

(Additional denotations and symbols are provided on the boring logs)

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/19/2021

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/6 in.	SAMPLES: Sample Number	USCS Symbol	BORING NO.: B-1 / MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Older Alluvium: Disced in upper one foot			
		11 18 20	R1	ML	Sandy SILT, brown, moist, very stiff	3.4	113.7	
5		20 21 15	R2	SM	Silty f-c SAND, red-brown, moist, medium dense	5.7	110.7	
		7 12 20	R3					
10		8 11 13	R4		brown, trace gravel	3.5	115.5	
15		14 34 40	R5		red-brown, very dense			
20		12 17 24	R6		Silty f-c SAND with gravel, red-brown, slightly moist, medium dense	2.0	123.2	
					BORING TERMINATED AT 21.5 FEET No groundwater encountered Boring backfilled with soil cuttings			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/19/2021

BORING NO.: B-2

Depth (ft)	Sample Type	Blows/6 in.	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Water Content (%)	Dry Density (pcf)	Others
					Older Alluvium: Disced in upper one foot			
		16 33 40	R1	ML	Sandy SILT, brown, moist, very stiff	4.0		
		24 20 20	R2	SM	Silty f SAND, red-brown, slightly moist, medium dense	5.2	102.1	MD, EI, SH
5		9 9 11	R3	ML	Sandy SILT, red-brown, moist, medium stiff, slightly disturbed sample	5.9		
10		13 21 28	R4	SM	Silty f SAND, light brown, moist, dense			
15		20 37 50	R5		very dense	5.2	121.2	
20		40 50-5"	R6		Silty f-c SAND, red-brown, moist, very dense, trace caliche stringers			
					BORING TERMINATED AT 21 FEET No groundwater encountered Boring backfilled with soil cuttings			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/19/2021

BORING NO.: B-3

Depth (ft)	Sample Type	Blows/6 in.	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Water Content (%)	Dry Density (pcf)	Others
					Older Alluvium: Disced in upper one foot			
		15 40 50-5"	R1	ML	Sandy SILT, brown, moist, very stiff, trace caliche stringers and roothairs	4.6	112.8	
		33 24 16	R2	SM	Silty f-c SAND, brown, slightly moist, medium dense, trace caliche stringers	4.6	106.4	SR
5		7 7 11	R3		trace gravel	2.3	116.9	HC
10		9 11 17	R4	SP	F-c SAND with trace SILT, light brown, moist, medium dense			
15		18 34 50	R5	SM	Silty f-m SAND trace CLAY, dark red-brown, moist, very dense	9.9	124.2	
20		21 34 40	R6					
					BORING TERMINATED AT 21.5 FEET			
					No groundwater encountered Boring backfilled with soil cuttings			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/19/2021

BORING NO.: B-4

Depth (ft)	Sample Type	Blows/6 in.	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Water Content (%)	Dry Density (pcf)	Others
					Older Alluvium: Disced in upper one foot			
	■	13 24 34	R1	ML	Sandy SILT, brown, moist, hard, trace roothairs	5.2	116.7	
	■	28 40 41	R2		red-brown	5.2	118.1	
5	■	19 15 15	R3		very stiff			
	■	13 23 30	R4	SM	Silty f-c SAND, red-brown, moist, dense			
10	■	22 35 39	R5		trace caliche stringers	5.8	119.6	
15	■	23 35 45	R5					
20		50-5"			**BORING TERMINATED AT 20.5 FEET** No groundwater encountered Boring backfilled with soil cuttings			
25								
30								

LEGEND

Sample type: ■ ---Ring ■ ---SPT ▨ ---Small Bulk ▩ ---Large Bulk □ ---No Recovery ▽ ---Water Table

Lab testing: AL = Atterberg Limits; SR = Sulfate/Resisitivity Test; EI = Expansion Index; SH = Shear Test; SA = Sieve Analysis; HC= Consolidation; RV = R-Value Test; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/24/2021

BORING NO.: B-5

Depth (ft)	Sample Type	Blows/6 in.	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Water Content (%)	Dry Density (pcf)	Others
					Older Alluvium: Disced in upper one foot			
		5 14 10	R1	ML	Sandy SILT, brown, slightly moist, very stiff, disturbed sample, roots	3.7		RV, SR
		4 9 20	R2			4.1	105.4	HC
5		12 13 13	R3	SM	Silty f-m SAND, red-brown, moist, medium dense	4.8	117.9	
		16 17 20	R4			3.1	113.8	
10		14 16 18	R5	SP	F-c SAND with trace SILT, dark red-brown, slightly moist, medium dense, friable			
15		24 34 50	R6	SM	Silty f-m SAND, dark reddish brown, moist, very dense	8.9	122.7	
20		20 27 50-5"	R7	SC	Clayey f-m SAND, red-brown, moist, very dense			
25		12 18 28	S1	ML	Sandy SILT, red-brown, moist, hard	11.8		
30		17 20 25	S2	SM	Silty f SAND, red-brown, moist, dense			

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/24/2021

BORING NO.: B-5 (cont.)

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/6 in.	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Older Alluvium:			
35		10 11 17	S3	SP	F-m SAND with trace SILT, red-brown, moist, medium dense		3.6	
40		9 18 20	S4	SP	F-c SAND, red-brown, grey-brown, moist, dense, trace interbedded clay lens (0.25 inch thick)			
45		16 21 21	S5		no clay lenses present		4.2	
50		20 23 23	S6					
					BORING TERMINATED AT 51.5 FEET No groundwater encountered Boring backfilled with soil cuttings			
55								
60								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/24/2021

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/6 in.	SAMPLES: Sample Number	USCS Symbol	BORING NO.: B-6 / MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Older Alluvium: Disced in upper one foot			
		9 12 16	R1	ML	Sandy SILT, brown, moist, very stiff	3.1	112.8	
5		6 20 30	R2		red-brown, moist, hard	7.3	117.2	
		20 18 14	R3	SM	Silty f SAND, red-brown, moist, medium dense	6.2	105.5	
10		3 5 8	R4	SP	F SAND with some SILT, olive brown, moist, medium dense	3.1	107.5	
15		17 27 36	R5	SM	Silty f SAND with trace CLAY, red-brown, moist, dense			
20		18 35 30	R6		Strace caliche stringers	6.9	104.2	
					BORING TERMINATED AT 21.5 FEET No groundwater encountered Boring backfilled with soil cuttings			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/24/2021

BORING NO.: B-7

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/6 in.	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Older Alluvium: Disced in upper one foot			
	Ring	7 15 16	R1	ML	Sandy SILT, red-brown, moist, very stiff	3.9	110.9	
5	Ring	18 19 20	R2			4.4	107.1	
	Ring	9 10 11	R3	SM	Silty f-c SAND, brown, moist, medium dense, trace roothairs	2.4	115.7	HC
10	Ring	8 16 18	R4	SP	F-c SAND, light grey-brown, slightly moist, medium dense			
15	Ring	13 24 32	R5		dense	1.8	119.8	
20	Ring	15 37 47	R6	SC-SM	Silty to clayey SAND, red-brown, moist, very dense			
					BORING TERMINATED AT 21.5 FEET			
25					No groundwater encountered Boring backfilled with soil cuttings			
30								

LEGEND

Sample type: Ring, SPT, Small Bulk, Large Bulk, No Recovery, Water Table

Lab testing: AL = Atterberg Limits; SR = Sulfate/Resisitivity Test; EI = Expansion Index; SH = Shear Test; SA = Sieve Analysis; HC= Consolidation; RV = R-Value Test; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/24/2021

BORING NO.: B-8

Depth (ft)	Sample Type	Blows/6 in.	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Water Content (%)	Dry Density (pcf)	Others
					Older Alluvium:			
					Disced in upper one foot			
		10 17 30	R1	ML	Sandy SILT, brown, moist, hard, trace caliche stringers	4.7	111.9	
		21 27 34	R2		red-brown	7.1	123.0	
5		6 9 11	R3	SM	Silty f-c SAND, red-brown, slightly moist, medium dense	2.2	109.2	
10		19 25 30	R5			8.2	114.9	
15		13 16 21	R5	SP	F-c SAND with trace SILT, gray-brown, slightly moist, medium dense			
20		50-6"		ML	Sandy SILT, red-brown, moist, hard, trace caliche stringers	8.5	116.4	
					BORING TERMINATED AT 20.5 FEET			
					No groundwater encountered			
					Boring backfilled with soil cuttings			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/19/2021

BORING NO.: I-1

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/6 in.	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Older Alluvium: Disced in upper one foot			
				ML	Sandy SILT, brown, slightly moist to moist			
5					**BORING TERMINATED AT 5 FEET**			
					No groundwater encountered			
					Boring set with pipe, sock, and gravel			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/19/2021

BORING NO.: I-2

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/6 in.	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Older Alluvium: Disced in upper one foot			
				ML	Sandy SILT, brown, slightly moist to moist			
5					**BORING TERMINATED AT 5 FEET**			
					No groundwater encountered			
					Boring set with pipe, sock, and gravel			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/19/2021

BORING NO.: I-3

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/6 in.	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Older Alluvium:			
					Disced in upper one foot			
				ML	Sandy SILT, brown, slightly moist to moist			
					red-brown			
5					**BORING TERMINATED AT 5 FEET**			
					No groundwater encountered			
					Boring set with pipe, sock, and gravel			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/19/2021

BORING NO.: I-4

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/6 in.	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Older Alluvium:			
					Disced in upper one foot			
				ML	Sandy SILT, brown, slightly moist to moist			
					red-brown			
5					**BORING TERMINATED AT 5 FEET**			
					No groundwater encountered			
					Boring set with pipe, sock, and gravel			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/19/2021

BORING NO.: I-5

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/6 in.	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Older Alluvium: Disced in upper one foot			
				ML	Sandy SILT, brown, slightly moist to moist			
5					**BORING TERMINATED AT 5 FEET**			
					No groundwater encountered			
					Boring set with pipe, sock, and gravel			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/19/2021

BORING NO.: I-6

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/6 in.	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Older Alluvium:			
					Disced in upper one foot			
				ML	Sandy SILT, brown, slightly moist to moist			
5					**BORING TERMINATED AT 5 FEET**			
					No groundwater encountered			
					Boring set with pipe, sock, and gravel			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/19/2021

BORING NO.: I-7

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/6 in.	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Older Alluvium:			
					Disced in upper one foot			
				ML	Sandy SILT, brown, slightly moist to moist			
					red-brown			
5					**BORING TERMINATED AT 5 FEET**			
					No groundwater encountered			
					Boring set with pipe, sock, and gravel			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Oakdale Communities	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	JD
PROJECT NAME:	Darwin Court	**DRILL METHOD:**	HSA	**OPERATOR:**	Miguel
PROJECT NO.:	2950-CR	**HAMMER:**	140 lbs - 30 in	**RIG TYPE:**	CME 75
LOCATION:	Moreno Valley, CA			**DATE:**	11/19/2021

BORING NO.: I-8

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/6 in.	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Older Alluvium:			
					Disced in upper one foot			
				ML	Sandy SILT, brown, slightly moist to moist			
					red-brown			
5					**BORING TERMINATED AT 5 FEET**			
					No groundwater encountered			
					Boring set with pipe, sock, and gravel			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

APPENDIX B

RESULTS OF LABORATORY TESTING

Multi-Family Residential Development
Darwin Court Project
Moreno Valley, Riverside County, California
Project No. 2950-CR

GEOTEK

SUMMARY OF LABORATORY TESTING

Classification

Soils were classified visually in general accordance with the Unified Soil Classification System (ASTM Test Method D 2487). The soil classifications are shown on the logs of borings in Appendix A.

Collapse Test

Collapse tests were performed on selected samples of the site soils in general accordance with ASTM D 5333 test procedures. The results of this test are presented graphically in Appendix B.

Direct Shear

Shear testing was performed in a direct shear machine of the strain-control type in general accordance with ASTM D 3080 test procedures. The rate of deformation was approximately 0.035 inch per minute. The sample was sheared under varying confining loads in order to determine the coulomb shear strength parameters, angle of internal friction and cohesion. The tests were performed on soil samples remolded to approximately 90 percent of maximum dry density as determined by ASTM D 1557 test procedures. The shear test results are presented in Appendix B.

Expansion Index

Expansion Index testing was performed two soil samples. Testing was performed in general accordance with ASTM Test Method D 4829. The results of the testing are provided below and in Appendix B.

Boring No.	Depth (ft.)	Description	Expansion Index	Classification
B-2	0-5	Sandy Silt (ML)	10	Very Low
B-8	0-5	Sandy Silt (ML)	3	Very Low

In-Situ Moisture and Density

The natural water content of sampled soils was determined in general accordance with ASTM D 2216 test procedures on samples of the materials recovered from the subsurface exploration. In addition, in-place dry density of the sampled soils was determined in general accordance with ASTM D 2937 test procedures on relatively undisturbed samples to measure the unit weight of the subsurface soils. Results of these tests are shown on the boring logs at the appropriate sample depths in Appendix A.

Moisture-Density Relationship

Laboratory testing was performed on two samples collected during the subsurface exploration. The laboratory maximum dry density and optimum moisture content for the soil type was determined in general accordance with ASTM D 1557 test procedures. The results are presented in Appendix B.

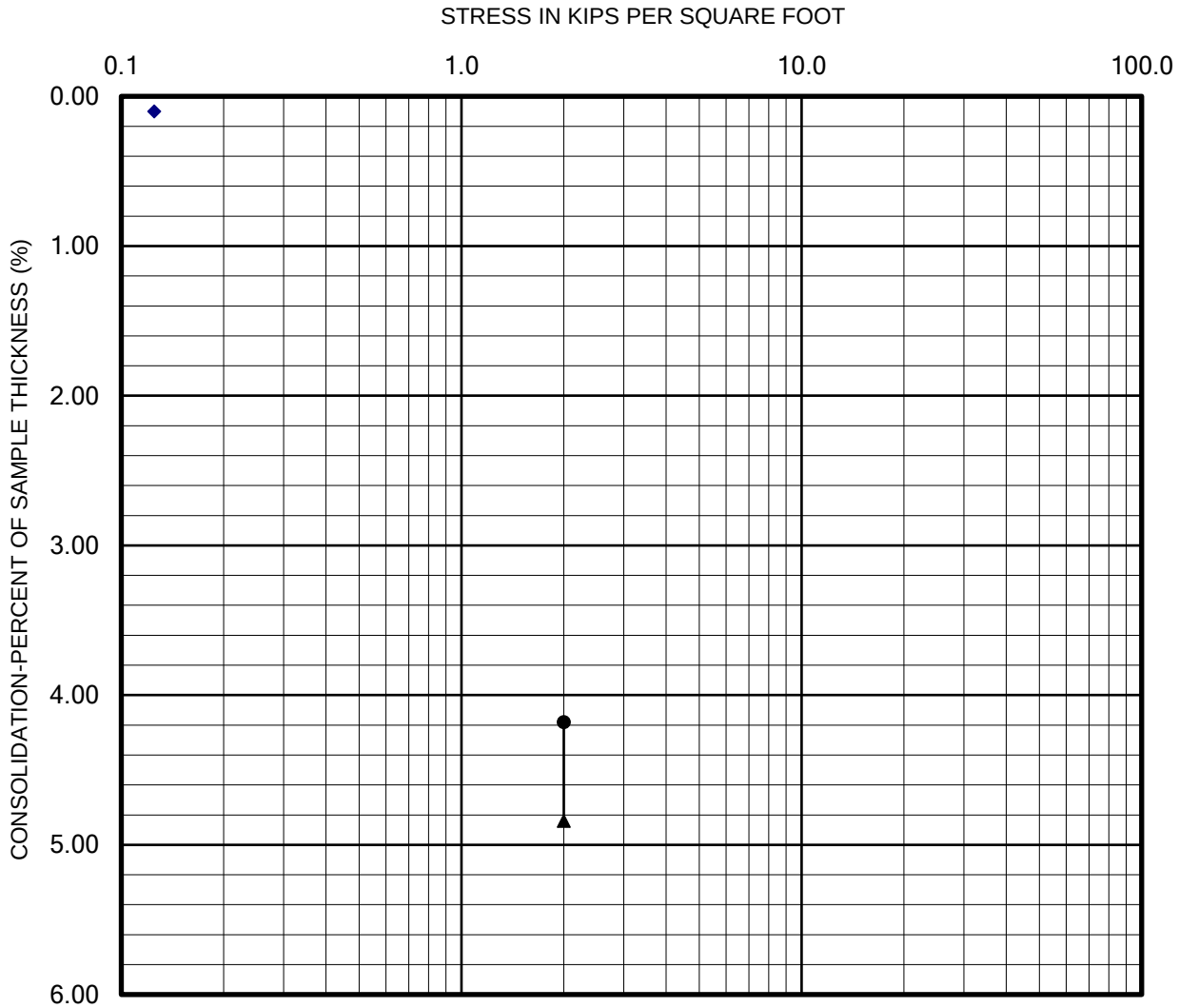
R-Value

One sample of the site soils was tested to determine its R-value characteristics in accordance with California Test Method 301. The test results are provided in Appendix B.

Sulfate Content, Resistivity and Chloride Content

Testing to determine the water-soluble sulfate content was performed by others in general accordance with ASTM D4327 test procedures. Resistivity testing was completed by others in general accordance with ASTM G187 test procedures. Testing to determine the chloride content was performed by others in general accordance with ASTM D4327 test procedures. The results of the testing are provided below and in Appendix B.

Boring No.	Depth (ft.)	pH ASTM D4972	Chloride ASTM D4327 (mg/kg)	Sulfate ASTM D4327 (% by weight)	Resistivity ASTM G187 (ohm-cm)
B-3	0-5	8.7	35.2	0.0001	4,020
B-5	0-5	7.9	63.9	0.0003	2,747



Seating Cycle
Loading Prior to Inundation
Loading After Inundation
Rebound Cycle

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4546

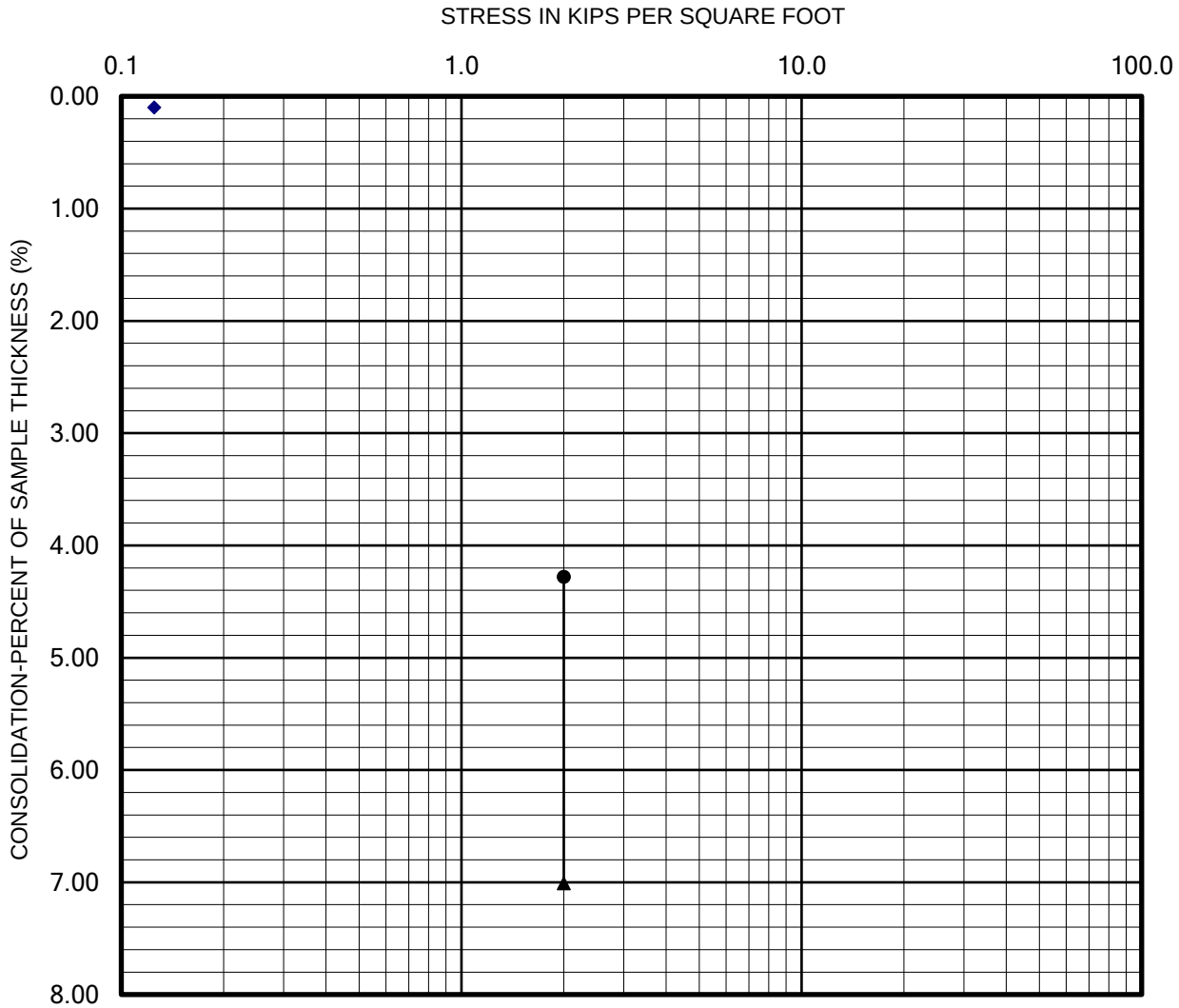
GEOTEK

CHECKED BY: DA	Lab: Corona
PROJECT NO.: 2950-CR	Date: 12/14/202

COLLAPSE REPORT

Sample: B-3 @ 5 feet

Plate C-1



Seating Cycle
Loading Prior to Inundation
Loading After Inundation
Rebound Cycle

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4546

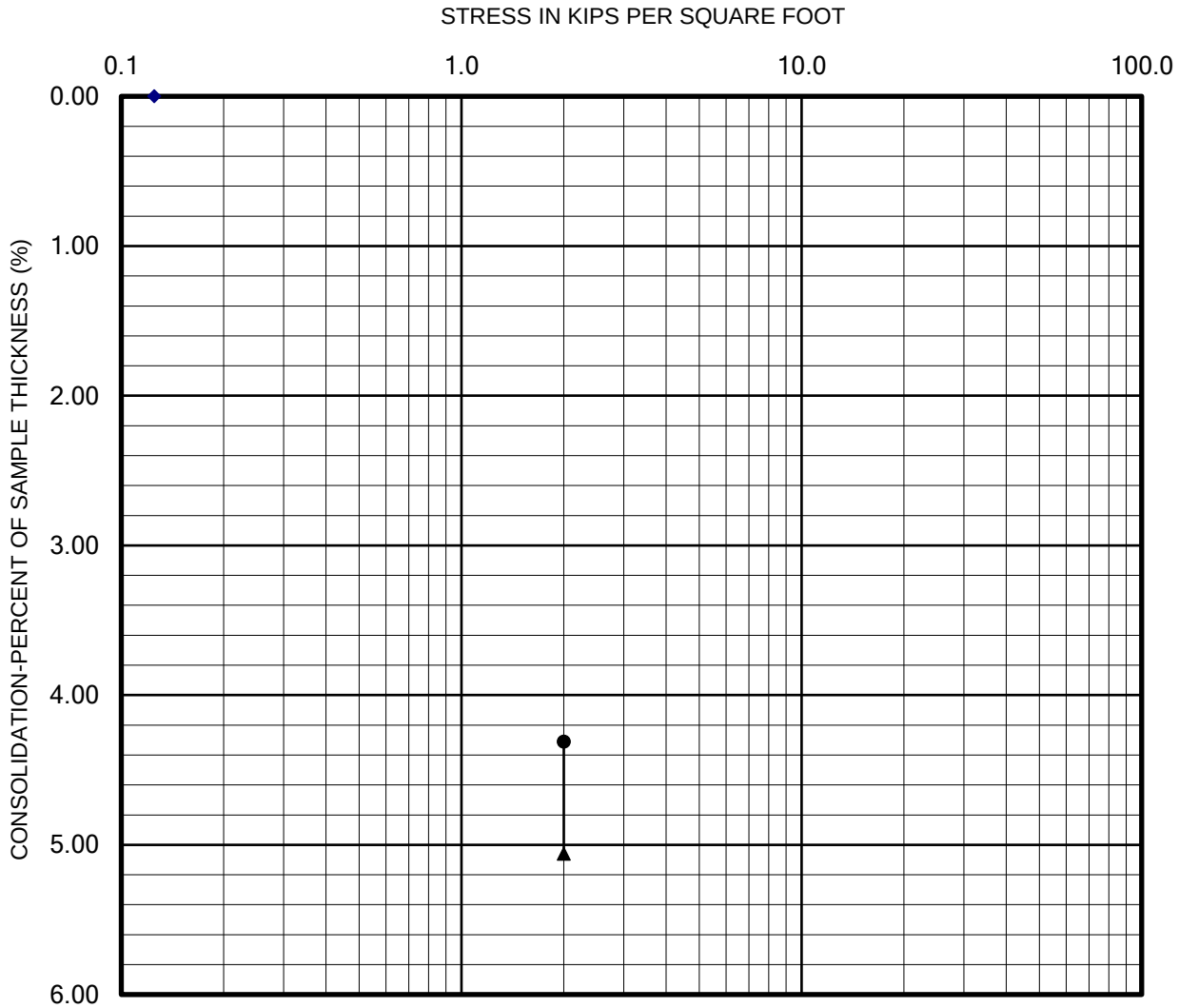
GEOTEK

COLLAPSE REPORT

Sample: B-5 @ 3 feet

Plate C-2

CHECKED BY: DA	Lab: Corona
PROJECT NO.: 2950-CR	Date: 12/14/202



Seating Cycle
Loading Prior to Inundation
Loading After Inundation
Rebound Cycle

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4546

GEOTEK

CHECKED BY: DA	Lab: Corona
PROJECT NO.: 2950-CR	Date: 12/14/202

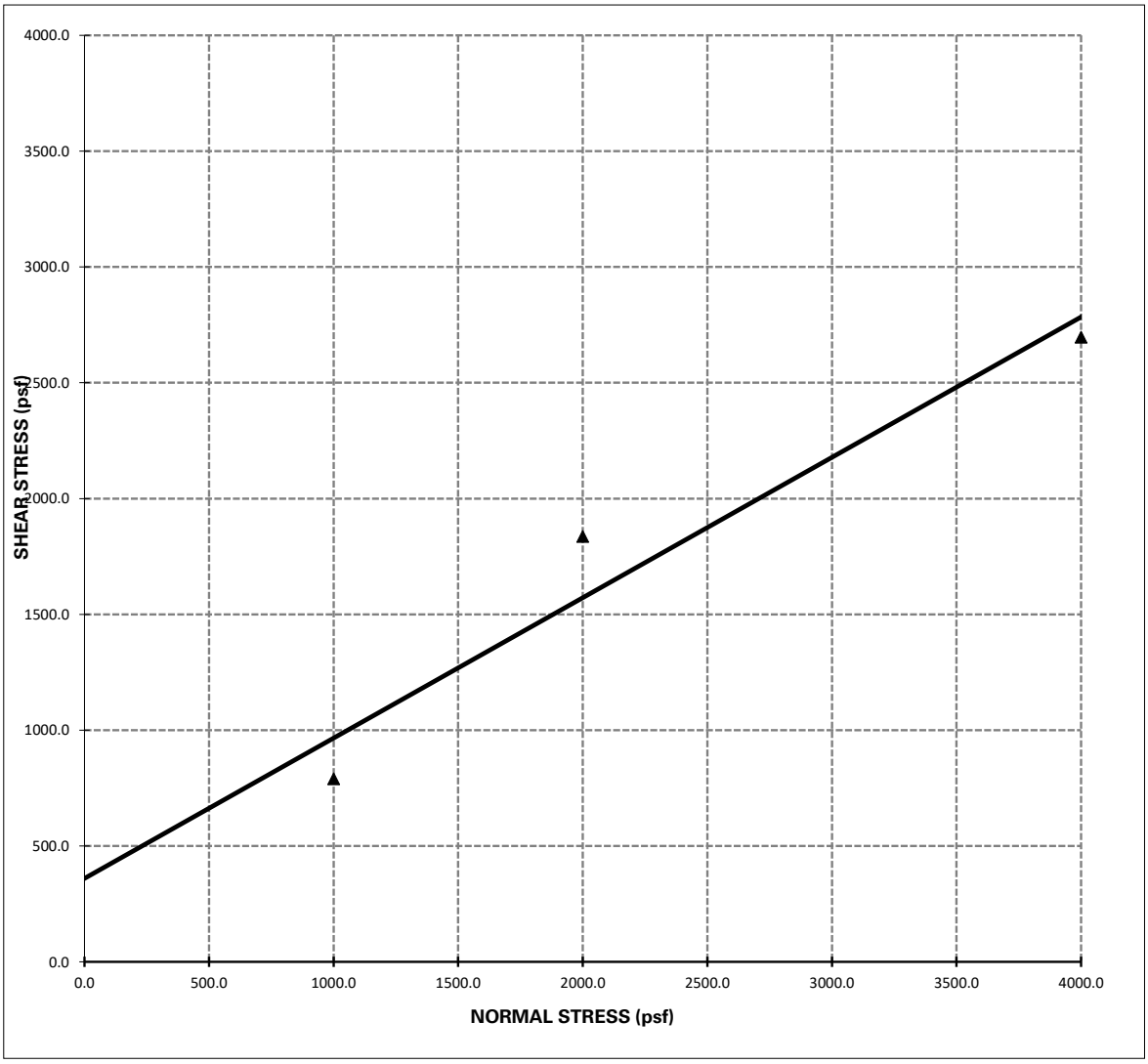
COLLAPSE REPORT

Sample: B-7 @ 6 feet

Plate C-3

DIRECT SHEAR TEST

Project Name:	Oakdale Communities	***Sample Location:***	B-8 @ 0-5 feet
Project Number:	Darwin Court Project	***Date Tested:***	12/14/2021



Shear Strength: Φ = **31°** **C = 360 psf**

Notes: 1 - The soil specimen used in the shear box was a ring sample remolded to approximately 90% relative compaction from a bulk sample collected during the field investigation.

2 - The above reflect direct shear strength at saturated conditions.

3 - The tests were run at a shear rate of 0.01 in/min.

GEOTEK

EXPANSION INDEX TEST

(ASTM D4829)

Client:	Oakdale Communities	***Tested/ Checked By:***	ADLC Lab No Corona
Project Number:	2950-CR	***Date Tested:***	12/8/2021
Project Location:	Darwin Court Project, Moreno Valley	***Sample Source:***	B-2 @ 0-5 feet
		Sample Description:	

Ring #:_____ Ring Dia. : 4.01" Ring Ht.:1"

DENSITY DETERMINATION

A	Weight of compacted sample & ring (gm)	784.3
B	Weight of ring (gm)	362.3
C	Net weight of sample (gm)	**422.0**
D	Wet Density, lb / ft3 (C*0.3016)	**127.3**
E	Dry Density, lb / ft3 (D/1.F)	**118.2**

SATURATION DETERMINATION

F	Moisture Content, %	7.7
G	Specific Gravity, assumed	**2.70**
H	Unit Wt. of Water @ 20°C, (pcf)	**62.4**
I	% Saturation	**48.8**

READINGS

DATE	TIME	READING	
12/8/2021		0.2060	Initial
12/8/2021		0.2040	10 min/Dry
12/9/2021		0.2140	Final

FINAL MOISTURE

Final Weight of wet sample & tare	% Moisture
806.1	**12.9**

EXPANSION INDEX = 10

GEOTEK

EXPANSION INDEX TEST

(ASTM D4829)

Client:	Oakdale Communities	***Tested/ Checked By:***	ADLC Lab No Corona
Project Number:	2950-CR	***Date Tested:***	12/8/2021
Project Location:	Darwin Court Project, Moreno Valley	***Sample Source:***	B-8 @ 0-5 feet
		Sample Description:	

Ring #:_____ Ring Dia. : 4.01" Ring Ht.:1"

DENSITY DETERMINATION

A	Weight of compacted sample & ring (gm)	801.3
B	Weight of ring (gm)	366.4
C	Net weight of sample (gm)	**434.9**
D	Wet Density, lb / ft3 (C*0.3016)	**131.2**
E	Dry Density, lb / ft3 (D/1.F)	**122.4**

SATURATION DETERMINATION

F	Moisture Content, %	7.2
G	Specific Gravity, assumed	**2.70**
H	Unit Wt. of Water @ 20°C, (pcf)	**62.4**
I	% Saturation	**51.6**

READINGS

DATE	TIME	READING	
12/8/2021		0.8050	Initial
12/8/2021		0.8050	10 min/Dry
12/9/2021		0.8080	Final

FINAL MOISTURE

Final Weight of wet sample & tare	% Moisture
817.0	**10.8**

EXPANSION INDEX = 3

GEOTEK

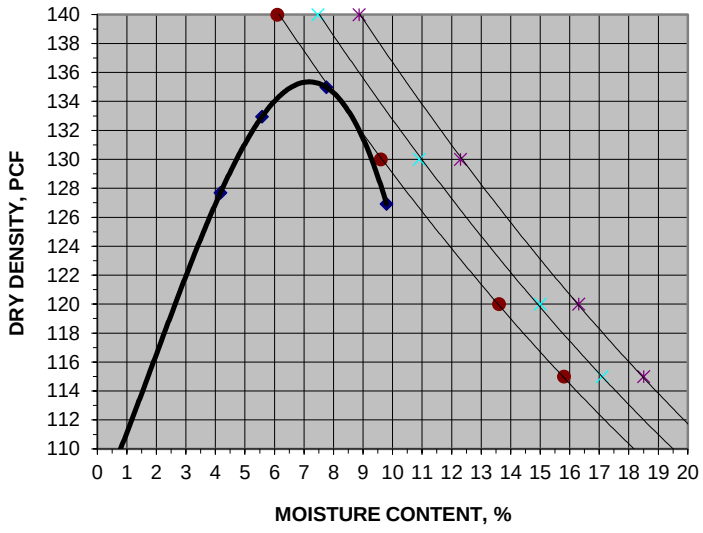
MOISTURE/DENSITY RELATIONSHIP

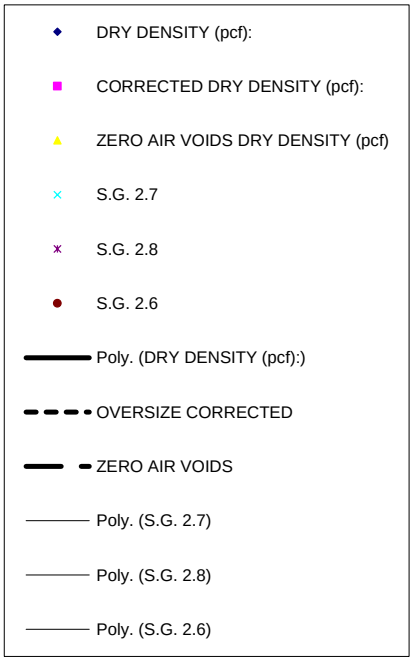
Client:	Oakdale Communities	**Job No.:**	2950-CR
Project:	Darwin Court Project	**Lab No.:**	Corona
Location:	Moreno Valley		
Material Type:	Gray brown fine to medium sand with silt		
Material Supplier:	-		
Material Source:	-		
Sample Location:	B-2 @ 0-5 feet		
	-		
Sampled By:	JD	**Date Sampled:**	12/9/2021
Received By:	ADLC	**Date Received:**	12/10/2021
Tested By:	JD/BL	**Date Tested:**	12/13/2021
Reviewed By:	DA	**Date Reviewed:**	12/14/2021

Test Procedure: ASTM D1557 **Method:** A

Oversized Material (%): 1.9 **Correction Required:** [ ] yes [x] no

MOISTURE/DENSITY RELATIONSHIP CURVE





MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	135.5	**@ Optimum Moisture, %**	7.0
Corrected Maximum Dry Density, pcf		**@ Optimum Moisture, %**	

MATERIAL DESCRIPTION

Grain Size Distribution:

	% Gravel (retained on No. 4)
	% Sand (Passing No. 4, Retained on No. 200)
	% Silt and Clay (Passing No. 200)

Atterberg Limits:

	Liquid Limit, %
	Plastic Limit, %
	Plasticity Index, %

Classification:

Unified Soils Classification:

AASHTO Soils Classification:

GEOTEK

MOISTURE/DENSITY RELATIONSHIP

Client: Oakdale Communities
Project: Darwin Court Project
Location: Moreno Valley
Material Type: Gray brown silty sand
Material Supplier: -
Material Source: -
Sample Location: B-5 @ 0-5 feet
-

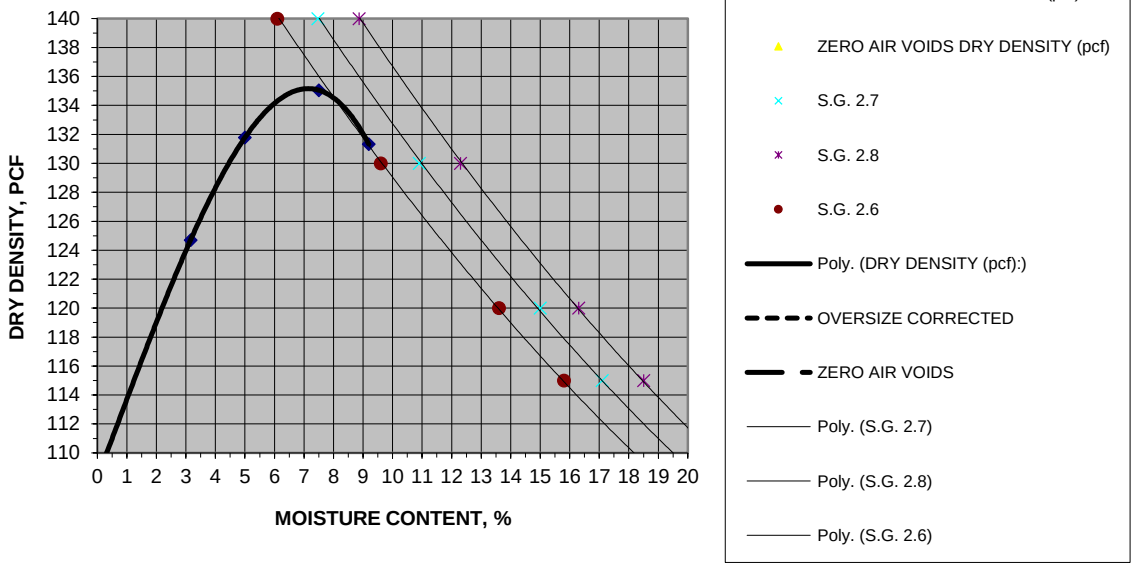
Job No.: 2950-CR
Lab No.: Corona

Sampled By: JD
Received By: ADLC
Tested By: JD/BL
Reviewed By: DA

Date Sampled: 12/9/2021
Date Received: 12/10/2021
Date Tested: 12/13/2021
Date Reviewed: 12/14/2021

Test Procedure: ASTM D1557 **Method:** A
Oversized Material (%): 2.0 **Correction Required:** [ ] yes [x] no

MOISTURE/DENSITY RELATIONSHIP CURVE



MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	135.5	**@ Optimum Moisture, %**	7.0
Corrected Maximum Dry Density, pcf		**@ Optimum Moisture, %**	

MATERIAL DESCRIPTION

Grain Size Distribution:

	% Gravel (retained on No. 4)
	% Sand (Passing No. 4, Retained on No. 200)
	% Silt and Clay (Passing No. 200)

Atterberg Limits:

	Liquid Limit, %
	Plastic Limit, %
	Plasticity Index, %

Classification:

Unified Soils Classification: _____
AASHTO Soils Classification: _____

GEOTEK

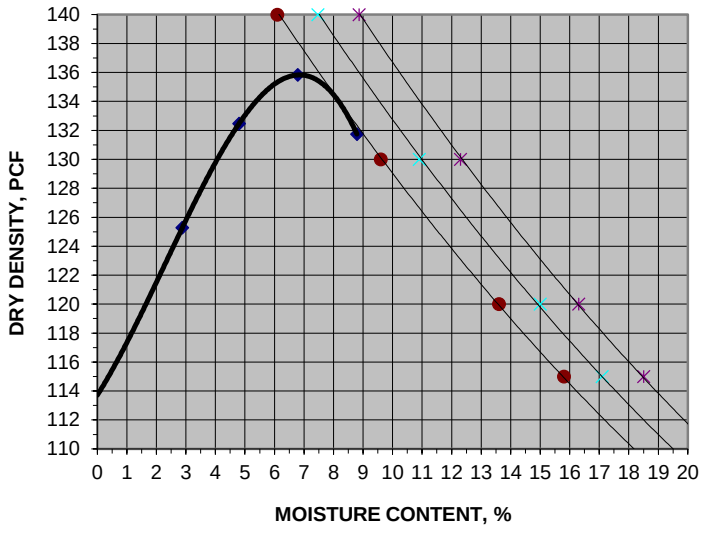
MOISTURE/DENSITY RELATIONSHIP

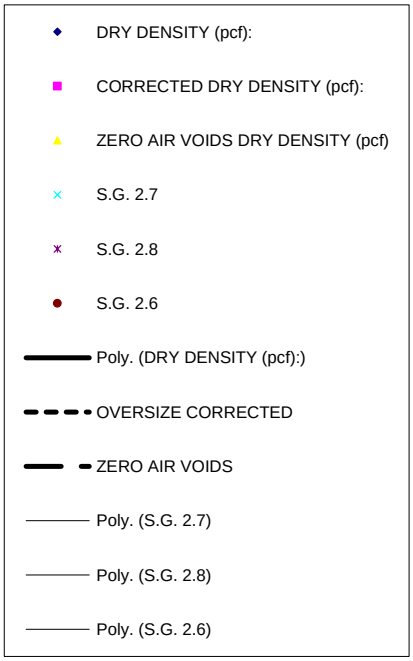
Client:	Oakdale Communities	**Job No.:**	2950-CR
Project:	Darwin Court Project	**Lab No.:**	Corona
Location:	Moreno Valley		
Material Type:	Gray brown silty sand		
Material Supplier:	-		
Material Source:	-		
Sample Location:	B-8 @ 0-5 feet		
	-		
Sampled By:	JD	**Date Sampled:**	12/9/2021
Received By:	ADLC	**Date Received:**	12/10/2021
Tested By:	JD/BL	**Date Tested:**	12/13/2021
Reviewed By:	DA	**Date Reviewed:**	12/14/2021

Test Procedure: ASTM D1557 **Method:** A

Oversized Material (%): 2.0 **Correction Required:** [ ] yes [x] no

MOISTURE/DENSITY RELATIONSHIP CURVE





MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	136.0	**@ Optimum Moisture, %**	7.0
Corrected Maximum Dry Density, pcf		**@ Optimum Moisture, %**	

MATERIAL DESCRIPTION

Grain Size Distribution:

	% Gravel (retained on No. 4)
	% Sand (Passing No. 4, Retained on No. 200)
	% Silt and Clay (Passing No. 200)

Atterberg Limits:

	Liquid Limit, %
	Plastic Limit, %
	Plasticity Index, %

Classification:

Unified Soils Classification:

AASHTO Soils Classification:

Results Only Soil Testing for Darwin Court Project, Moreno Valley

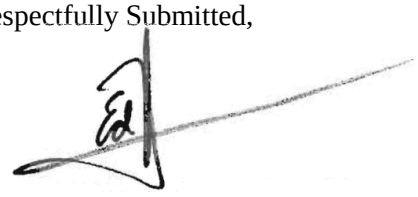
December 2, 2021

Prepared for:

Kyle McHargue
GeoTek, Inc.
1548 North Maple Street
Corona, CA 92280
kmchargue@geotekusa.com

Project X Job#: S211201D
Client Job or PO#: 2950-CR Oakdale Communities

Respectfully Submitted,



Eduardo Hernandez, M.Sc., P.E.
Sr. Corrosion Consultant
NACE Corrosion Technologist #16592
Professional Engineer
California No. M37102
ehernandez@projectxcorrosion.com



Soil Analysis Lab Results

Client: GeoTek, Inc.
Job Name: Darwin Court Project, Moreno Valley
Client Job Number: 2950-CR Oakdale Communities
Project X Job Number: S211201D
December 2, 2021

	Method	ASTM D4327		ASTM D4327		ASTM G187		ASTM D4972	ASTM G200	ASTM D4658	ASTM D4327	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D4327	ASTM D4327
Bore# / Description	**Depth**	**Sulfates** SO_4^{2-}		**Chlorides** Cl^-		**Resistivity** As Rec'd | Minimum		**pH**	**Redox**	**Sulfide** S^{2-}	**Nitrate** NO_3^-	**Ammonium** NH_4^+	**Lithium** Li^+	**Sodium** Na^+	**Potassium** K^+	**Magnesium** Mg^{2+}	**Calcium** Ca^{2+}	**Fluoride** F_2^{--}	**Phosphate** PO_4^{3-}
	(ft)	(mg/kg)	(wt%)	(mg/kg)	(wt%)	(Ohm-cm)	(Ohm-cm)		(mV)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
2950-CR B5 @	0-5	3.3	0.0003	63.9	0.0064	80,400	2,747	7.9	241	0.04	0.9	ND	0.03	53.9	3.2	36.4	38.7	2.6	323.8
2950-CR B3@	0-5	1.2	0.0001	35.2	0.0035	167,500	4,020	8.7	257	0.17	1.0	0.8	0.03	81.8	20.9	35.3	26.9	5.7	278.3

Cations and Anions, except Sulfide and Bicarbonate, tested with Ion Chromatography
mg/kg = milligrams per kilogram (parts per million) of dry soil weight
ND = 0 = Not Detected | NT = Not Tested | Unk = Unknown
Chemical Analysis performed on 1:3 Soil-To-Water extract
PPM = mg/kg (soil) = mg/L (Liquid)

Project X
Corrosion Engineering
Corrosion Control - Soil, Water, and Metallurgy Lab

Lab Request Sheet Chain of Custody
Phone: (213) 928-7213 · Fax (951) 226-1720 · www.projectxcorrosion.com

Ship Samples To: 29990 Technology Dr, Suite 13, Murrieta, CA 92563

Project X Job Number: S211201D GEOTEK 2950-CR DARWIN 2FULL

IMPORTANT: Please complete Project and Sample Identification Data as you would like it to appear in report & include this form with samples.

Company Name:	Geotek USA	Contact Name:	Kyle McHargue
Mailing Address:	1548 N. Maple Ave. Corona, CA	Phone No:	951-206-5443
Accounting Contact:		Contact Email:	kmchargue@geotekusa.com
Client Project No:	Oakdale Communities	Invoice Email:	
P.O. #:		Project Name:	Darwin Court Project, Moreno Valley

(Business Days) Turn Around Time: 3-5 Day Standard ✓ | 3 Day Guarantee 50% mark-up | 2 Day RUSH 100% mark-up

Results By: ☐ Phone ☐ Fax ☑ Email

Date & Received by : RD 12-1-21 12/1/21

Default Method

Special Instructions:

ANALYSIS REQUESTED (Please circle)

	SAMPLE ID - BORE #		DEPTH (ft)	DATE COLLECTED
1	2950-CR	B5@	0-5	
2	2950-CR	B3@	0-5	
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

7
8

Geo Quad				Full Corrosion Series														Full Corrosion Series	Reports										
Soil Resistivity	pH	Sulfate	Chloride	Redox Potential	Sulfide	Ammonia	Nitrate	Flouride	Phosphate	Lithium	Sodium	Potassium	Magnesium	Calcium	BiCarbonate				Soil Corrosivity Evaluation Report	Water Corrosivity Mini Report	Moisture Content	Total Alkalinity	Thermal Resistivity	(ANC) Alk Neutr Cap	(SRB) Sulfate Reducing	Puckorius Index	XRF Elemental Analysis	Water Hardness
Caltrans CTM643	Caltrans CTM643	Caltrans CTM417	Caltrans CTM422																		ASTM D2216							
AASHTO T288	AASHTO T 289	AASHTO T 290	AASHTO T 291	SM 2580B		SM 4500-NH3	SM 4500-NO3														SM 2320B		ASTM D5334				ASTM E1621	ASTM E132	ASTM A751
ASTM G187	ASTM G 51	ASTM D4327	ASTM D4327	ASTM G200	SM 4500-S2	ASTM D4327	ASTM D4327	SM 2320B	ASTM D4327	ASTM D4327	ASTM D4327	ASTM D4327	ASTM D4327	ASTM D4327	ASTM D4327	SM 2320B						IEEE 442		HACH BART				
																		✓											

*Req: Min. 3 Samples, site map, and groundwater info

• ANALYSIS
• DESIGN

LaBelle • Marvin
PROFESSIONAL PAVEMENT ENGINEERING
A CALIFORNIA CORPORATION

• SOILS, ASPHALT TECHNOLOGY

December 8, 2021

Mr. Kyle McHargue
GeoTek Inc.
1548 North Maple Street
Corona, California 92880

Project No. 47834

Attention Mr. McHargue:
Laboratory testing of the bulk soil sample delivered to our laboratory on 12/1/2021 has been completed.

Reference:	W.O. # 2950-CR
Project:	Oakdale Communities, Darwin Court
Sample:	B-5 @ 0'-5' Bulk

Data sheets are transmitted herewith for your use and information. Any untested portion of the samples will be retained for a period of sixty (60) days prior to disposal. The opportunity to be of service is appreciated, and should you have any questions, kindly call.

Very truly yours,

REGISTERED PROFESSIONAL ENGINEER
STEVEN R. MARVIN
NO. 30659
CIVIL
STATE OF CALIFORNIA

Steven R. Marvin
RCE 30659

SRM:tw
Enclosures

2700 S. GRAND AVENUE • SANTA ANA, CA 92705-5404 • (714) 546-3468 • FAX (714) 546-5841
INFO@LABELLEMARVIN.COM

R - VALUE DATA SHEET

LaBelle Marvin

PROJECT No. 47834

DATE: 12/8/2021

BORING NO. B-5 @ 0'-5' Bulk

Oakdale Communities, Darwin Court

W.O.# 2950-CR

SAMPLE DESCRIPTION: Brown Silty Fine Sand

R-VALUE TESTING DATA | CA TEST 301			
	SPECIMEN ID		
	a	b	c
Mold ID Number	7	8	9
Water added, grams	63	43	50
Initial Test Water, %	9.5	7.6	8.3
Compact Gage Pressure,psi	60	350	180
Exudation Pressure, psi	216	692	542
Height Sample, Inches	2.50	2.41	2.40
Gross Weight Mold, grams	3105	3084	2910
Tare Weight Mold, grams	1951	1947	1770
Sample Wet Weight, grams	1154	1137	1140
Expansion, Inches x 10exp-4	14	51	31
Stability 2,000 lbs (160psi)	27 / 60	18 / 33	20 / 38
Turns Displacement	4.98	3.91	4.22
R-Value Uncorrected	46	71	66
R-Value Corrected	46	70	64
Dry Density, pcf	127.7	132.8	132.9

DESIGN CALCULATION DATA

Traffic Index	Assumed:	4.0	4.0	4.0
G.E. by Stability		0.55	0.31	0.37
G. E. by Expansion		0.47	1.70	1.03

Equilibrium R-Value	**50** by EXPANSION	Examined & Checked: 12 /8/ 21
REMARKS:	Gf = 1.25 0.0% Retained on the 3/4" Sieve.	REGISTERED PROFESSIONAL ENGINEER STEVEN R. MARVIN NO. 30659 CIVIL STATE OF CALIFORNIA Steven R. Marvin, RCE 30659

The data above is based upon processing and testing samples as received from the field. Test procedures in accordance with latest revisions to Department of Transportation, State of California, Materials & Research Test Method No. 301.

LaBelle Marvin

R-VALUE GRAPHICAL PRESENTATION

PROJECT NO. 47834

DATE: 12 /8/ 2021

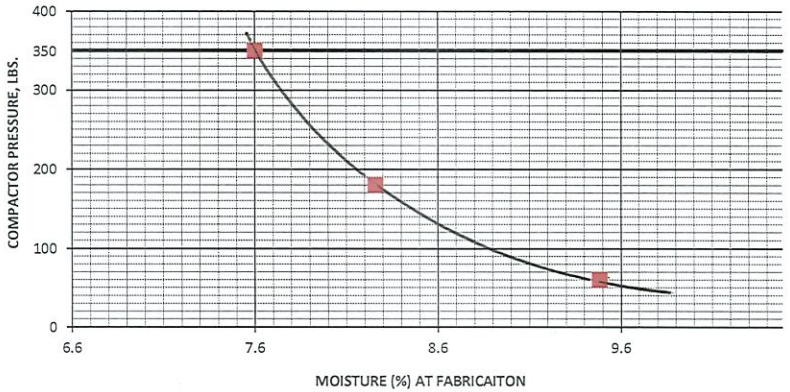
REMARKS:

BORING NO. B-5 @ 0'-5' Bulk

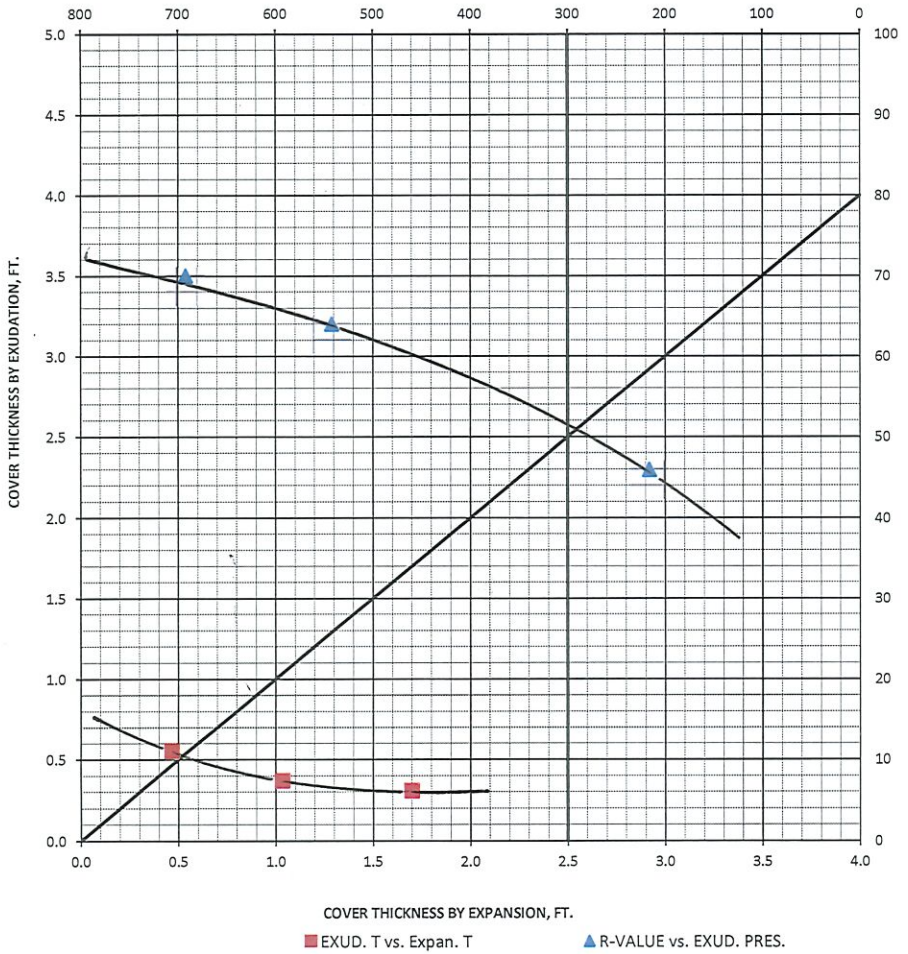
Oakdale Communities, Darwin Court

W.O.# 2950-CR

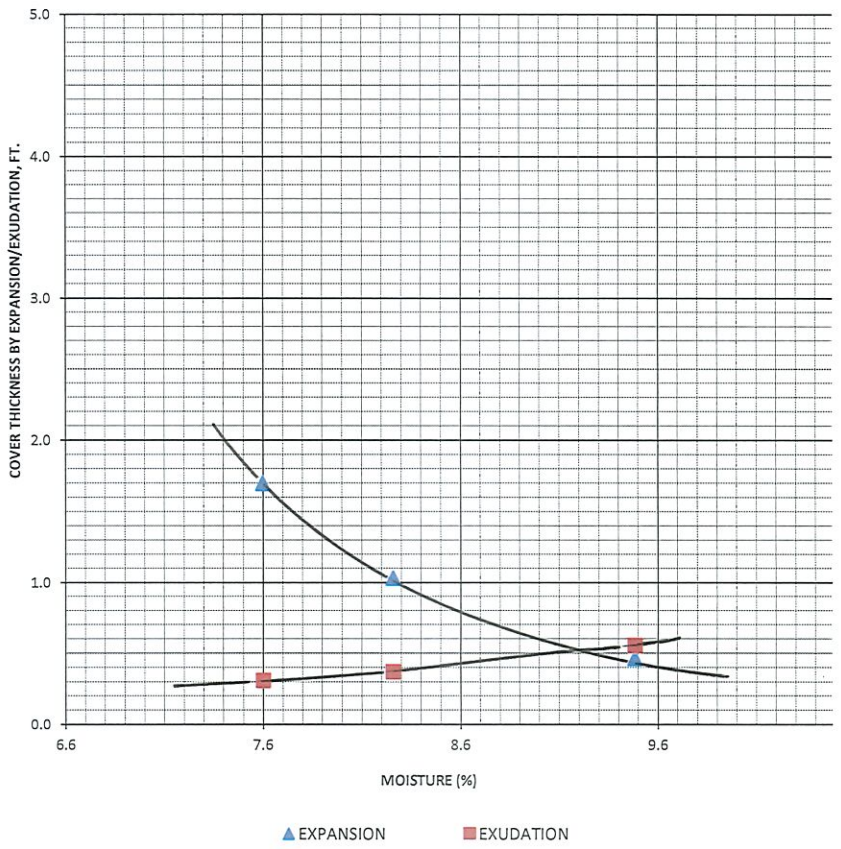
COMPACTOR PRESSURE vs MOISTURE %



COVER THICKNESS BY EXUDATION vs COVER THICKNESS BY EXPANSION



COVER THICKNESS vs MOISTURE %



APPENDIX C

PERCOLATION DATA SHEETS & PORCHET CALCULATIONS

Multi-Family Residential Development

Darwin Court Project

Moreno Valley, Riverside County, California

Project No. 2950-CR

GEOTEK

Client:	**Oakdale Communities**
Project:	**Darwin Court Project**
Project No:	**2950-CR**
Date:	**12/10/2021**

Boring No. **I-1**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	44
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	40
Total Test Hole Depth, D_T =	60

Equation - $I_t = \dfrac{\Delta H\ (60r)}{\Delta t\ (r+2H_{avg})}$

$H_O = D_T - D_O$ =	20
$H_F = D_T - D_F$ =	16
$\Delta H = \Delta D = H_O - H_F$ =	4
$H_{avg} = (H_O+H_F)/2$ =	18

I_t = 0.80 **Inches per Hour**

GEOTEK

Client:	**Oakdale Communities**
Project:	**Darwin Court Project**
Project No:	**2950-CR**
Date:	**12/10/2021**

Boring No. **I-2**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	44
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	40
Total Test Hole Depth, D_T =	60

Equation - $I_t = \dfrac{\Delta H\ (60r)}{\Delta t\ (r+2H_{avg})}$

$H_O = D_T - D_O$ =	20
$H_F = D_T - D_F$ =	16
$\Delta H = \Delta D = H_O - H_F$ =	4
$H_{avg} = (H_O+H_F)/2$ =	18

I_t = 0.80 **Inches per Hour**

GEOTEK

Client:	**Oakdale Communities**
Project:	**Darwin Court Project**
Project No:	**2950-CR**
Date:	**12/10/2021**

Boring No. **I-3**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	44.25
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	40
Total Test Hole Depth, D_T =	60

Equation - $I_t = \dfrac{\Delta H\ (60r)}{\Delta t\ (r+2H_{avg})}$

$H_O = D_T - D_O$ =	20
$H_F = D_T - D_F$ =	15.75
$\Delta H = \Delta D = H_O - H_F$ =	4.25
$H_{avg} = (H_O+H_F)/2$ =	17.875

I_t = 0.86 **Inches per Hour**

GEOTEK

Client:	**Oakdale Communities**
Project:	**Darwin Court Project**
Project No:	**2950-CR**
Date:	**12/10/2021**

Boring No. **I-4**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	44.25
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	40
Total Test Hole Depth, D_T =	60

Equation - $I_t = \dfrac{\Delta H\,(60r)}{\Delta t\,(r+2H_{avg})}$

$H_O = D_T - D_O$ =	20
$H_F = D_T - D_F$ =	15.75
$\Delta H = \Delta D = H_O - H_F$ =	4.25
$H_{avg} = (H_O+H_F)/2$ =	17.875

I_t = 0.86 **Inches per Hour**

GEOTEK

Client:	**Oakdale Communities**
Project:	**Darwin Court Project**
Project No:	**2950-CR**
Date:	**12/10/2021**

Boring No. **I-5**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	43.5
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	40
Total Test Hole Depth, D_T =	60

Equation - $I_t = \dfrac{\Delta H\ (60r)}{\Delta t\ (r+2H_{avg})}$

$H_O = D_T - D_O$ =	20
$H_F = D_T - D_F$ =	16.5
$\Delta H = \Delta D = H_O - H_F$ =	3.5
$Havg = (H_O+H_F)/2$ =	18.25

I_t = 0.69 **Inches per Hour**

GEOTEK

Client:	**Oakdale Communities**
Project:	**Darwin Court Project**
Project No:	**2950-CR**
Date:	**12/10/2021**

Boring No. **I-6**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	44
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	40
Total Test Hole Depth, D_T =	60

Equation - $I_t = \dfrac{\Delta H\ (60r)}{\Delta t\ (r+2H_{avg})}$

$H_O = D_T - D_O$ =	20
$H_F = D_T - D_F$ =	16
$\Delta H = \Delta D = H_O - H_F$ =	4
$H_{avg} = (H_O+H_F)/2$ =	18

I_t = 0.80 **Inches per Hour**

GEOTEK

Client:	**Oakdale Communities**
Project:	**Darwin Court Project**
Project No:	**2950-CR**
Date:	**12/10/2021**

Boring No. **I-7**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	44.25
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	40
Total Test Hole Depth, D_T =	60

Equation - $I_t = \dfrac{\Delta H\,(60r)}{\Delta t\,(r+2H_{avg})}$

$H_O = D_T - D_O$ =	20
$H_F = D_T - D_F$ =	15.75
$\Delta H = \Delta D = H_O - H_F$ =	4.25
$H_{avg} = (H_O+H_F)/2$ =	17.875

I_t = 0.86 **Inches per Hour**

GEOTEK

Client:	**Oakdale Communities**
Project:	**Darwin Court Project**
Project No:	**2950-CR**
Date:	**12/10/2021**

Boring No. **I-8**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	44.5
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	40
Total Test Hole Depth, D_T =	60

Equation - $I_t = \dfrac{\Delta H\,(60r)}{\Delta t\,(r+2H_{avg})}$

$H_O = D_T - D_O$ =	20
$H_F = D_T - D_F$ =	15.5
$\Delta H = \Delta D = H_O - H_F$ =	4.5
$H_{avg} = (H_O+H_F)/2$ =	17.75

I_t = 0.91 **Inches per Hour**

GEOTEK

PERCOLATION DATA SHEET

Project: Darwin Court **Job No.: 2950-CR.**

Test Hole No.: I-I Tested By: JD, Date: 11/22/21.

Depth of Hole As Drilled: 60 Before Test: 60 After Test: 60.

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
								Prewater 5 gallons 11/21/2021
1	7:14AM 7:39AM	25	60	20	14.75	5.25	4.76	
2	7:41AM 8:06AM	25	60	20	14.75	5.25	4.76	
3	8:08AM 8:38AM	30	60	20	14.75	5.25	5.71	
4	8:40AM 9:10AM	30	60	20	14.75	5.25	5.71	
5	9:12AM 9:42AM	30	60	20	15	5	6.00	
6	9:44AM 10:14AM	30	60	20	15	5	6.00	
7	10:16AM 10:46AM	30	60	20	15.5	4.5	6.67	
8	10:48AM 11:18AM	30	60	20	15.5	4.5	6.67	
9	11:20AM 11:50AM	30	60	20	15.5	4.5	6.67	
10	11:52AM 12:22PM	30	60	20	15.75	4.25	7.06	
11	12:24PM 12:54PM	30	60	20	15.75	4.25	7.06	
12	12:56PM 1:26PM	30	60	20	16	4	7.50	
13	1:28PM 1:58PM	30	60	20	16	4	7.50	
14	2:00PM 2:30PM	30	60	20	16	4	7.50	

PERCOLATION DATA SHEET

Project: Darwin Court **Job No.: 2950-CR.**

Test Hole No.: I-2 Tested By: JD, Date: 11/22/21.

Depth of Hole As Drilled: 60 Before Test: 60 After Test: 60.

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
								Prewater 5 gallons 11/21/2021
1	7:21AM 7:46AM	25	60	20	14.5	5.5	4.55	
2	7:48AM 8:13AM	25	60	20	14.5	5.5	4.55	
3	8:15AM 8:45AM	30	60	20	14	6	5.00	
4	8:47AM 9:17AM	30	60	20	14	6	5.00	
5	9:19AM 9:49AM	30	60	20	14.75	5.25	5.71	
6	9:51AM 10:21AM	30	60	20	15.25	4.75	6.32	
7	10:23AM 10:53AM	30	60	20	15.25	4.75	6.32	
8	10:55AM 11:25AM	30	60	20	15.5	4.5	6.67	
	11:27AM 11:57AM	30	60	20	15.5	4.5	6.67	
	11:59AM 12:29PM	30	60	20	15.5	4.5	6.67	
	12:31PM 1:01PM	30	60	20	16	4	7.50	
	1:03PM 1:33PM	30	60	20	16	4	7.50	
	1:35PM 2:05PM	30	60	20	16	4	7.50	
	2:07PM 2:37PM	30	60	20	16	4	7.50	

PERCOLATION DATA SHEET

Project: Darwin Court **Job No.: 2950-CR.**

Test Hole No.: I-3 Tested By: JD, Date: 11/22/21.

Depth of Hole As Drilled: 60 Before Test: 60 After Test: 60.

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
								Prewater 5 gallons 11/21/2021
1	7:28AM 7:53AM	25	60	20	12.5	7.5	3.33	
2	7:55AM 8:20AM	25	60	20	14.5	5.5	4.55	
3	8:22AM 8:52AM	30	60	20	14	6	5.00	
4	8:54AM 9:24AM	30	60	20	14	6	5.00	
5	9:26AM 9:56AM	30	60	20	14.75	5.25	5.71	
6	9:58AM 10:28AM	30	60	20	15.25	4.75	6.32	
7	10:30AM 11:00AM	30	60	20	15.25	4.75	6.32	
8	11:02AM 11:32AM	30	60	20	15.5	4.5	6.67	
	11:34AM 12:04PM	30	60	20	15.5	4.5	6.67	
	12:06PM 12:36PM	30	60	20	15.5	4.5	6.67	
	12:38PM 1:08PM	30	60	20	15.75	4.25	7.06	
	1:10PM 1:40PM	30	60	20	15.75	4.25	7.06	
	1:42PM 2:12PM	30	60	20	15.75	4.25	7.06	
	2:14PM 2:44PM	30	60	20	15.75	4.25	7.06	

PERCOLATION DATA SHEET

Project: Darwin Court **Job No.: 2950-CR.**

Test Hole No.: I-4 Tested By: JD, Date: 11/22/21.

Depth of Hole As Drilled: 60 Before Test: 60 After Test: 60.

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
								Prewater 5 gallons 11/21/2021
1	7:35AM 8:00AM	25	60	20	14.25	5.75	4.35	
2	8:02AM 8:27AM	25	60	20	14.5	5.5	4.55	
3	8:29AM 8:59AM	30	60	20	14.75	5.25	5.71	
4	9:01AM 9:31AM	30	60	20	14.75	5.25	5.71	
5	9:33AM 10:03AM	30	60	20	14.75	5.25	5.71	
6	10:05AM 10:35AM	30	60	20	15.25	4.75	6.32	
7	10:37AM 11:07AM	30	60	20	15.25	4.75	6.32	
8	11:09AM 11:39AM	30	60	20	15.25	4.75	6.32	
	11:41AM 12:11PM	30	60	20	15.5	4.5	6.67	
	12:13PM 12:43PM	30	60	20	15.5	4.5	6.67	
	12:45PM 1:15PM	30	60	20	15.5	4.5	6.67	
	1:17PM 1:47PM	30	60	20	15.5	4.5	6.67	
	1:49PM 2:19PM	30	60	20	15.75	4.25	7.06	
	2:21PM 2:51PM	30	60	20	15.75	4.25	7.06	

PERCOLATION DATA SHEET

Project: Darwin Court **Job No.: 2950-CR.**

Test Hole No.: I-5 Tested By: JD, Date: 11/23/21.

Depth of Hole As Drilled: 60 Before Test: 60 After Test: 60.

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
								Prewater 5 gallons 11/22/2021
1	6:57AM 7:22AM	25	60	20	13.25	6.75	3.70	
2	7:24AM 7:49AM	25	60	20	14.75	5.25	4.76	
3	7:51AM 8:21AM	30	60	20	14.75	5.25	5.71	
4	8:23AM 8:53AM	30	60	20	15.25	4.75	6.32	
5	8:55AM 9:25AM	30	60	20	15.25	4.75	6.32	
6	9:27AM 9:57AM	30	60	20	15.5	4.5	6.67	
7	9:59AM 10:29AM	30	60	20	15.5	4.5	6.67	
8	10:31AM 11:01AM	30	60	20	15.75	4.25	7.06	
9	11:03AM 11:33AM	30	60	20	16	4	7.50	
10	11:35AM 12:05PM	30	60	20	16.25	3.75	8.00	
11	12:07PM 12:37PM	30	60	20	16.5	3.5	8.57	
12	12:39PM 1:09PM	30	60	20	16.25	3.75	8.00	
13	1:11PM 1:41PM	30	60	20	16.5	3.5	8.57	
14	1:43PM 2:13PM	30	60	20	16.5	3.5	8.57	

PERCOLATION DATA SHEET

Project: Darwin Court **Job No.: 2950-CR.**

Test Hole No.: I-6 Tested By: JD, Date: 11/23/21.

Depth of Hole As Drilled: 60 Before Test: 60 After Test: 60.

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
								Prewater 5 gallons 11/22/2021
1	7:04AM 7:29AM	25	60	20	14.25	5.75	4.35	
2	7:31AM 7:56AM	25	60	20	14.25	5.75	4.35	
3	7:58AM 8:28AM	30	60	20	14.25	5.75	5.22	
4	8:30AM 9:00AM	30	60	20	14.75	5.25	5.71	
5	9:02AM 9:32AM	30	60	20	15	5	6.00	
6	9:34AM 10:04AM	30	60	20	15	5	6.00	
7	10:06AM 10:36AM	30	60	20	15.25	4.75	6.32	
8	10:38AM 11:08AM	30	60	20	15.25	4.75	6.32	
9	11:10AM 11:40AM	30	60	20	15.5	4.5	6.67	
10	11:42AM 12:12PM	30	60	20	15.5	4.5	6.67	
11	12:14PM 12:44PM	30	60	20	15.75	4.25	7.06	
12	12:46PM 1:16PM	30	60	20	16	4	7.50	
13	1:18PM 1:48PM	30	60	20	16	4	7.50	
14	1:50PM 2:20PM	30	60	20	16	4	7.50	

PERCOLATION DATA SHEET

Project: Darwin Court **Job No.: 2950-CR.**

Test Hole No.: I-7 Tested By: JD, Date: 11/23/21.

Depth of Hole As Drilled: 60 Before Test: 60 After Test: 60.

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
								Prewater 5 gallons 11/22/2021
1	7:11AM 7:36AM	25	60	20	15	5	5.00	
2	7:38AM 8:03AM	25	60	20	14.75	5.25	4.76	
3	8:05AM 8:35AM	30	60	20	14.25	5.75	5.22	
4	8:37AM 9:07AM	30	60	20	14.5	5.5	5.45	
5	9:09AM 9:39AM	30	60	20	15	5	6.00	
6	9:41AM 10:11AM	30	60	20	15.25	4.75	6.32	
7	10:13AM 10:43AM	30	60	20	15.25	4.75	6.32	
8	10:45AM 11:15AM	30	60	20	15.5	4.5	6.67	
9	11:17AM 11:47AM	30	60	20	15.5	4.5	6.67	
10	11:49AM 12:19PM	30	60	20	15.5	4.5	6.67	
11	12:21PM 12:51PM	30	60	20	15.75	4.25	7.06	
12	12:53PM 1:23PM	30	60	20	15.75	4.25	7.06	
13	1:25PM 1:55PM	30	60	20	15.75	4.25	7.06	
14	1:57PM 2:27PM	30	60	20	15.75	4.25	7.06	

PERCOLATION DATA SHEET

Project: Darwin Court **Job No.: 2950-CR.**

Test Hole No.: I-8 Tested By: JD, Date: 11/23/21.

Depth of Hole As Drilled: 60 Before Test: 60 After Test: 60.

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
								Prewater 5 gallons 11/22/2021
1	7:18AM 7:43AM	25	60	20	14.5	5.5	4.55	
2	7:45AM 8:10AM	25	60	20	15	5	5.00	
3	8:12AM 8:42AM	30	60	20	14	6	5.00	
4	8:44AM 9:14AM	30	60	20	14.5	5.5	5.45	
5	9:16AM 9:46AM	30	60	20	14.75	5.25	5.71	
6	9:48AM 10:18AM	30	60	20	15.25	4.75	6.32	
7	10:20AM 10:50AM	30	60	20	15	5	6.00	
8	10:52AM 11:22AM	30	60	20	15.25	4.75	6.32	
9	11:24AM 11:54AM	30	60	20	15.5	4.5	6.67	
10	11:56AM 12:26PM	30	60	20	15.5	4.5	6.67	
11	12:28PM 12:58PM	30	60	20	15.5	4.5	6.67	
12	1:00PM 1:30PM	30	60	20	15.5	4.5	6.67	
13	1:32PM 2:02PM	30	60	20	15.5	4.5	6.67	
14	2:04PM 2:34PM	30	60	20	15.5	4.5	6.67	

APPENDIX D

SEISMIC SETTLEMENT ANALYSIS

Multi-Family Residential Development

Darwin Court Project

Moreno Valley, Riverside County, California

Project No. 2950-CR

GEOTEK

****
LIQUEFACTION ANALYSIS CALCULATION DETAILS

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Input File Name: UNTITLED
Title: Darwin Court Project
Subtitle: Seismic Settlement

Input Data:
Surface Elev.=1563
Hole No.=B-5
Depth of Hole=50.00 ft
Water Table during Earthquake= 100.00 ft
Water Table during In-Situ Testing= 100.00 ft
Max. Acceleration=0.81 g
Earthquake Magnitude=7.30
No-Liquefiable Soils: CL, OL are Non-Liq. Soil
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=User)
10. Average two input data between two Depths: Yes*
* Recommended Options

In-Situ Test Data:

Depth ft	SPT	Gamma pcf	Fines %
1.00	50.00	130.00	60.00
3.00	50.00	130.00	60.00
5.00	16.00	124.00	25.00
7.50	23.00	117.00	25.00
10.00	21.00	115.00	5.00
15.00	53.00	134.00	25.00
20.00	50.00	134.00	35.00

25.00	46.00	125.00	60.00
30.00	45.00	130.00	25.00
35.00	57.00	125.00	5.00
40.00	38.00	125.00	5.00
45.00	42.00	125.00	5.00
50.00	46.00	125.00	5.00

Output Results:

Calculation segment, dz=0.050 ft

User defined Print Interval, dp=1.00 ft

Peak Ground Acceleration (PGA), a_max = 0.81g

CSR Calculation:

Depth	gamma	sigma	gamma'	sigma'	rd	mZ	a(z)	CSR	x fs1	=CSRfs
ft	pcf	atm	pcf	atm		g	g			
1.00	130.00	0.061	130.00	0.061	1.00	0.000	0.815	0.53	1.00	0.53
2.00	130.00	0.123	130.00	0.123	1.00	0.000	0.815	0.53	1.00	0.53
3.00	130.00	0.184	130.00	0.184	0.99	0.000	0.815	0.53	1.00	0.53
4.00	127.00	0.245	127.00	0.245	0.99	0.000	0.815	0.52	1.00	0.52
5.00	124.00	0.304	124.00	0.304	0.99	0.000	0.815	0.52	1.00	0.52
6.00	121.20	0.362	121.20	0.362	0.99	0.000	0.815	0.52	1.00	0.52
7.00	118.40	0.419	118.40	0.419	0.98	0.000	0.815	0.52	1.00	0.52
8.00	116.60	0.474	116.60	0.474	0.98	0.000	0.815	0.52	1.00	0.52
9.00	115.80	0.529	115.80	0.529	0.98	0.000	0.815	0.52	1.00	0.52
10.00	115.00	0.584	115.00	0.584	0.98	0.000	0.815	0.52	1.00	0.52
11.00	118.80	0.639	118.80	0.639	0.97	0.000	0.815	0.52	1.00	0.52
12.00	122.60	0.696	122.60	0.696	0.97	0.000	0.815	0.51	1.00	0.51
13.00	126.40	0.755	126.40	0.755	0.97	0.000	0.815	0.51	1.00	0.51
14.00	130.20	0.815	130.20	0.815	0.97	0.000	0.815	0.51	1.00	0.51

15.00	134.00	0.878	134.00	0.878	0.97	0.000	0.815	0.51	1.00
0.51									
16.00	134.00	0.941	134.00	0.941	0.96	0.000	0.815	0.51	1.00
0.51									
17.00	134.00	1.004	134.00	1.004	0.96	0.000	0.815	0.51	1.00
0.51									
18.00	134.00	1.068	134.00	1.068	0.96	0.000	0.815	0.51	1.00
0.51									
19.00	134.00	1.131	134.00	1.131	0.96	0.000	0.815	0.51	1.00
0.51									
20.00	134.00	1.194	134.00	1.194	0.95	0.000	0.815	0.51	1.00
0.51									
21.00	132.20	1.257	132.20	1.257	0.95	0.000	0.815	0.50	1.00
0.50									
22.00	130.40	1.319	130.40	1.319	0.95	0.000	0.815	0.50	1.00
0.50									
23.00	128.60	1.381	128.60	1.381	0.95	0.000	0.815	0.50	1.00
0.50									
24.00	126.80	1.441	126.80	1.441	0.94	0.000	0.815	0.50	1.00
0.50									
25.00	125.00	1.501	125.00	1.501	0.94	0.000	0.815	0.50	1.00
0.50									
26.00	126.00	1.560	126.00	1.560	0.94	0.000	0.815	0.50	1.00
0.50									
27.00	127.00	1.620	127.00	1.620	0.94	0.000	0.815	0.50	1.00
0.50									
28.00	128.00	1.680	128.00	1.680	0.93	0.000	0.815	0.50	1.00
0.50									
29.00	129.00	1.741	129.00	1.741	0.93	0.000	0.815	0.49	1.00
0.49									
30.00	130.00	1.802	130.00	1.802	0.93	0.000	0.815	0.49	1.00
0.49									
31.00	129.00	1.863	129.00	1.863	0.92	0.000	0.815	0.49	1.00
0.49									
32.00	128.00	1.924	128.00	1.924	0.91	0.000	0.815	0.48	1.00
0.48									
33.00	127.00	1.984	127.00	1.984	0.91	0.000	0.815	0.48	1.00
0.48									
34.00	126.00	2.044	126.00	2.044	0.90	0.000	0.815	0.48	1.00
0.48									
35.00	125.00	2.103	125.00	2.103	0.89	0.000	0.815	0.47	1.00
0.47									
36.00	125.00	2.162	125.00	2.162	0.88	0.000	0.815	0.47	1.00
0.47									
37.00	125.00	2.221	125.00	2.221	0.87	0.000	0.815	0.46	1.00
0.46									
38.00	125.00	2.280	125.00	2.280	0.86	0.000	0.815	0.46	1.00
0.46									
39.00	125.00	2.339	125.00	2.339	0.86	0.000	0.815	0.45	1.00
0.45									

40.00	125.00	2.398	125.00	2.398	0.85	0.000	0.815	0.45	1.00 0.45
41.00	125.00	2.457	125.00	2.457	0.84	0.000	0.815	0.45	1.00 0.45
42.00	125.00	2.516	125.00	2.516	0.83	0.000	0.815	0.44	1.00 0.44
43.00	125.00	2.576	125.00	2.576	0.82	0.000	0.815	0.44	1.00 0.44
44.00	125.00	2.635	125.00	2.635	0.82	0.000	0.815	0.43	1.00 0.43
45.00	125.00	2.694	125.00	2.694	0.81	0.000	0.815	0.43	1.00 0.43
46.00	125.00	2.753	125.00	2.753	0.80	0.000	0.815	0.42	1.00 0.42
47.00	125.00	2.812	125.00	2.812	0.79	0.000	0.815	0.42	1.00 0.42
48.00	125.00	2.871	125.00	2.871	0.78	0.000	0.815	0.42	1.00 0.42
49.00	125.00	2.930	125.00	2.930	0.78	0.000	0.815	0.41	1.00 0.41
50.00	125.00	2.989	125.00	2.989	0.77	0.000	0.815	0.41	1.00 0.41

CSR is based on water table at 100.00 during earthquake

CRR Calculation from SPT or BPT data:

Depth	SPT	Cebs	Cr	sigma'	Cn	(N1)60	Fines	d(N1)60	(N1)60f	CRR7.5
ft				atm			%			
1.00	50.00	1.25	0.75	0.061	1.70	79.69	60.00	20.94	100.63	0.50
2.00	50.00	1.25	0.75	0.123	1.70	79.69	60.00	20.94	100.63	0.50
3.00	50.00	1.25	0.75	0.184	1.70	79.69	60.00	20.94	100.63	0.50
4.00	33.00	1.25	0.75	0.245	1.70	52.59	42.50	15.52	68.11	0.50
5.00	16.00	1.25	0.75	0.304	1.70	25.50	25.00	7.22	32.72	0.50
6.00	18.80	1.25	0.75	0.362	1.66	29.28	25.00	7.66	36.94	0.50
7.00	21.60	1.25	0.75	0.419	1.54	31.28	25.00	7.89	39.17	0.50
8.00	22.60	1.25	0.75	0.474	1.45	30.76	21.00	6.43	37.19	0.50

	9.00	21.80	1.25	0.85	0.529	1.37	31.84	13.00	3.06
34.90	0.50								
	10.00	21.00	1.25	0.85	0.584	1.31	29.20	5.00	0.04
29.24	0.39								
	11.00	27.40	1.25	0.85	0.639	1.25	36.42	9.00	1.18
37.59	0.50								
	12.00	33.80	1.25	0.85	0.696	1.20	43.04	13.00	3.48
46.52	0.50								
	13.00	40.20	1.25	0.85	0.755	1.15	49.16	17.00	5.97
55.13	0.50								
	14.00	46.60	1.25	0.85	0.815	1.11	54.83	21.00	8.51
63.34	0.50								
	15.00	53.00	1.25	0.95	0.878	1.07	67.17	25.00	12.01
79.19	0.50								
	16.00	52.40	1.25	0.95	0.941	1.03	64.14	27.00	12.84
76.98	0.50								
	17.00	51.80	1.25	0.95	1.004	1.00	61.38	29.00	13.61
74.98	0.50								
	18.00	51.20	1.25	0.95	1.068	0.97	58.84	31.00	14.34
73.18	0.50								
	19.00	50.60	1.25	0.95	1.131	0.94	56.50	33.00	15.03
71.53	0.50								
	20.00	50.00	1.25	0.95	1.194	0.91	54.33	35.00	15.68
70.01	0.50								
	21.00	49.20	1.25	0.95	1.257	0.89	52.10	40.00	15.42
67.52	0.50								
	22.00	48.40	1.25	0.95	1.319	0.87	50.04	45.00	15.01
65.04	0.50								
	23.00	47.60	1.25	0.95	1.381	0.85	48.11	50.00	14.62
62.73	0.50								
	24.00	46.80	1.25	0.95	1.441	0.83	46.30	55.00	14.26
60.56	0.50								
	25.00	46.00	1.25	0.95	1.501	0.82	44.59	60.00	13.92
58.51	0.50								
	26.00	45.80	1.25	0.95	1.560	0.80	43.55	53.00	13.71
57.26	0.50								
	27.00	45.60	1.25	0.95	1.620	0.79	42.55	46.00	13.51
56.06	0.50								
	28.00	45.40	1.25	1.00	1.680	0.77	43.79	39.00	13.76
57.54	0.50								
	29.00	45.20	1.25	1.00	1.741	0.76	42.83	32.00	12.15
54.98	0.50								
	30.00	45.00	1.25	1.00	1.802	0.75	41.91	25.00	9.11
51.02	0.50								
	31.00	47.40	1.25	1.00	1.863	0.73	43.41	21.00	7.52
50.93	0.50								
	32.00	49.80	1.25	1.00	1.924	0.72	44.88	17.00	5.71
50.59	0.50								
	33.00	52.20	1.25	1.00	1.984	0.71	46.33	13.00	3.60
49.92	0.50								

34.00	54.60	1.25	1.00	2.044	0.70	47.74	9.00	1.37
49.11	0.50							
35.00	57.00	1.25	1.00	2.103	0.69	49.13	5.00	0.06
49.19	0.50							
36.00	53.20	1.25	1.00	2.162	0.68	45.23	5.00	0.00
45.23	0.50							
37.00	49.40	1.25	1.00	2.221	0.67	41.43	5.00	0.00
41.43	0.50							
38.00	45.60	1.25	1.00	2.280	0.66	37.75	5.00	0.00
37.75	0.50							
39.00	41.80	1.25	1.00	2.339	0.65	34.16	5.00	0.00
34.16	0.50							
40.00	38.00	1.25	1.00	2.398	0.65	30.67	5.00	0.00
30.67	0.50							
41.00	38.80	1.25	1.00	2.457	0.64	30.94	5.00	0.00
30.94	0.50							
42.00	39.60	1.25	1.00	2.516	0.63	31.20	5.00	0.00
31.20	0.50							
43.00	40.40	1.25	1.00	2.576	0.62	31.47	5.00	0.00
31.47	0.50							
44.00	41.20	1.25	1.00	2.635	0.62	31.73	5.00	0.00
31.73	0.50							
45.00	42.00	1.25	1.00	2.694	0.61	31.99	5.00	0.00
31.99	0.50							
46.00	42.80	1.25	1.00	2.753	0.60	32.25	5.00	0.00
32.25	0.50							
47.00	43.60	1.25	1.00	2.812	0.60	32.50	5.00	0.00
32.50	0.50							
48.00	44.40	1.25	1.00	2.871	0.59	32.76	5.00	0.00
32.76	0.50							
49.00	45.20	1.25	1.00	2.930	0.58	33.01	5.00	0.00
33.01	0.50							
50.00	46.00	1.25	1.00	2.989	0.58	33.26	5.00	0.00
33.26	0.50							

CRR is based on water table at 100.00 during In-Situ Testing

Factor of Safety, - Earthquake Magnitude= 7.30:

Depth	sigC'	CRR7.5	x Ksig	=CRRv	x MSF	=CRRm	CSRfs	F.S.=CRRm/CSRfs
ft	atm							
1.00	0.04	0.50	1.00	0.50	1.07	0.54	0.53	5.00
2.00	0.08	0.50	1.00	0.50	1.07	0.54	0.53	5.00
3.00	0.12	0.50	1.00	0.50	1.07	0.54	0.53	5.00
4.00	0.16	0.50	1.00	0.50	1.07	0.54	0.52	5.00
5.00	0.20	0.50	1.00	0.50	1.07	0.54	0.52	5.00
6.00	0.24	0.50	1.00	0.50	1.07	0.54	0.52	5.00

7.00	0.27	0.50	1.00	0.50	1.07	0.54	0.52	5.00
8.00	0.31	0.50	1.00	0.50	1.07	0.54	0.52	5.00
9.00	0.34	0.50	1.00	0.50	1.07	0.54	0.52	5.00
10.00	0.38	0.39	1.00	0.39	1.07	0.41	0.52	5.00
11.00	0.42	0.50	1.00	0.50	1.07	0.54	0.52	5.00
12.00	0.45	0.50	1.00	0.50	1.07	0.54	0.51	5.00
13.00	0.49	0.50	1.00	0.50	1.07	0.54	0.51	5.00
14.00	0.53	0.50	1.00	0.50	1.07	0.54	0.51	5.00
15.00	0.57	0.50	1.00	0.50	1.07	0.54	0.51	5.00
16.00	0.61	0.50	1.00	0.50	1.07	0.54	0.51	5.00
17.00	0.65	0.50	1.00	0.50	1.07	0.54	0.51	5.00
18.00	0.69	0.50	1.00	0.50	1.07	0.54	0.51	5.00
19.00	0.74	0.50	1.00	0.50	1.07	0.54	0.51	5.00
20.00	0.78	0.50	1.00	0.50	1.07	0.54	0.51	5.00
21.00	0.82	0.50	1.00	0.50	1.07	0.54	0.50	5.00
22.00	0.86	0.50	1.00	0.50	1.07	0.54	0.50	5.00
23.00	0.90	0.50	1.00	0.50	1.07	0.54	0.50	5.00
24.00	0.94	0.50	1.00	0.50	1.07	0.54	0.50	5.00
25.00	0.98	0.50	1.00	0.50	1.07	0.54	0.50	5.00
26.00	1.01	0.50	1.00	0.50	1.07	0.54	0.50	5.00
27.00	1.05	0.50	1.00	0.50	1.07	0.53	0.50	5.00
28.00	1.09	0.50	0.99	0.50	1.07	0.53	0.50	5.00
29.00	1.13	0.50	0.99	0.49	1.07	0.53	0.49	5.00
30.00	1.17	0.50	0.98	0.49	1.07	0.52	0.49	5.00
31.00	1.21	0.50	0.97	0.49	1.07	0.52	0.49	5.00
32.00	1.25	0.50	0.97	0.48	1.07	0.52	0.48	5.00
33.00	1.29	0.50	0.96	0.48	1.07	0.52	0.48	5.00
34.00	1.33	0.50	0.96	0.48	1.07	0.51	0.48	5.00
35.00	1.37	0.50	0.95	0.48	1.07	0.51	0.47	5.00
36.00	1.41	0.50	0.95	0.47	1.07	0.51	0.47	5.00
37.00	1.44	0.50	0.94	0.47	1.07	0.50	0.46	5.00
38.00	1.48	0.50	0.94	0.47	1.07	0.50	0.46	5.00
39.00	1.52	0.50	0.93	0.47	1.07	0.50	0.45	5.00
40.00	1.56	0.50	0.93	0.46	1.07	0.50	0.45	5.00
41.00	1.60	0.50	0.92	0.46	1.07	0.49	0.45	5.00
42.00	1.64	0.50	0.92	0.46	1.07	0.49	0.44	5.00
43.00	1.67	0.50	0.91	0.46	1.07	0.49	0.44	5.00
44.00	1.71	0.50	0.91	0.45	1.07	0.48	0.43	5.00
45.00	1.75	0.50	0.90	0.45	1.07	0.48	0.43	5.00
46.00	1.79	0.50	0.90	0.45	1.07	0.48	0.42	5.00
47.00	1.83	0.50	0.89	0.45	1.07	0.48	0.42	5.00
48.00	1.87	0.50	0.89	0.44	1.07	0.48	0.42	5.00
49.00	1.90	0.50	0.88	0.44	1.07	0.47	0.41	5.00
50.00	1.94	0.50	0.88	0.44	1.07	0.47	0.41	5.00

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* F.S.<1: Liquefaction Potential Zone. (If above water table: F.S.=5)
^ No-liquefiable Soils or above Water Table.
(F.S. is limited to 5, CRR is limited to 2,   CSR is limited to 2)

CPT convert to SPT for Settlement Analysis:
Fines Correction for Settlement Analysis:

Depth ft	Ic	qc/N60	qc1 atm	(N1)60	Fines %	d(N1)60	(N1)60s
1.00	-	-	-	100.00	60.00	0.00	100.00
2.00	-	-	-	100.00	60.00	0.00	100.00
3.00	-	-	-	100.00	60.00	0.00	100.00
4.00	-	-	-	68.11	42.50	0.00	68.11
5.00	-	-	-	32.72	25.00	0.00	32.72
6.00	-	-	-	36.94	25.00	0.00	36.94
7.00	-	-	-	39.17	25.00	0.00	39.17
8.00	-	-	-	37.19	21.00	0.00	37.19
9.00	-	-	-	34.90	13.00	0.00	34.90
10.00	-	-	-	29.24	5.00	0.00	29.24
11.00	-	-	-	37.59	9.00	0.00	37.59
12.00	-	-	-	46.52	13.00	0.00	46.52
13.00	-	-	-	55.13	17.00	0.00	55.13
14.00	-	-	-	63.34	21.00	0.00	63.34
15.00	-	-	-	79.19	25.00	0.00	79.19
16.00	-	-	-	76.98	27.00	0.00	76.98
17.00	-	-	-	74.98	29.00	0.00	74.98
18.00	-	-	-	73.18	31.00	0.00	73.18
19.00	-	-	-	71.53	33.00	0.00	71.53
20.00	-	-	-	70.01	35.00	0.00	70.01
21.00	-	-	-	67.52	40.00	0.00	67.52
22.00	-	-	-	65.04	45.00	0.00	65.04
23.00	-	-	-	62.73	50.00	0.00	62.73
24.00	-	-	-	60.56	55.00	0.00	60.56
25.00	-	-	-	58.51	60.00	0.00	58.51
26.00	-	-	-	57.26	53.00	0.00	57.26
27.00	-	-	-	56.06	46.00	0.00	56.06
28.00	-	-	-	57.54	39.00	0.00	57.54
29.00	-	-	-	54.98	32.00	0.00	54.98
30.00	-	-	-	51.02	25.00	0.00	51.02
31.00	-	-	-	50.93	21.00	0.00	50.93
32.00	-	-	-	50.59	17.00	0.00	50.59
33.00	-	-	-	49.92	13.00	0.00	49.92
34.00	-	-	-	49.11	9.00	0.00	49.11
35.00	-	-	-	49.19	5.00	0.00	49.19
36.00	-	-	-	45.23	5.00	0.00	45.23
37.00	-	-	-	41.43	5.00	0.00	41.43
38.00	-	-	-	37.75	5.00	0.00	37.75
39.00	-	-	-	34.16	5.00	0.00	34.16
40.00	-	-	-	30.67	5.00	0.00	30.67
41.00	-	-	-	30.94	5.00	0.00	30.94
42.00	-	-	-	31.20	5.00	0.00	31.20
43.00	-	-	-	31.47	5.00	0.00	31.47
44.00	-	-	-	31.73	5.00	0.00	31.73
45.00	-	-	-	31.99	5.00	0.00	31.99

46.00	-	-	-	32.25	5.00	0.00	32.25
47.00	-	-	-	32.50	5.00	0.00	32.50
48.00	-	-	-	32.76	5.00	0.00	32.76
49.00	-	-	-	33.01	5.00	0.00	33.01
50.00	-	-	-	33.26	5.00	0.00	33.26

(N1)60s has been fines corrected in liquefaction analysis, therefore d(N1)60=0.
Fines=NoLiq means the soils are not liquefiable.

Settlement of Saturated Sands:
Settlement Analysis Method: Ishihara / Yoshimine

Depth	CSRsf	/ MSF*	=CSRm	F.S.	Fines	(N1)60s	Dr	ec	dsz	dsp	S
ft					%		%	%	in.	in.	in.

No Settlement of Saturated Sands

Settlement of Saturated Sands=0.000 in.
qc1 and (N1)60 is after fines correction in liquefaction analysis
dsz is per each segment, dz=0.05 ft
dsp is per each print interval, dp=1.00 ft
S is cumulated settlement at this depth

Settlement of Unsaturated Sands:

Depth	sigma'	sigC'	(N1)60s	CSRsf	Gmax	g*Ge/Gm	g_eff	ec7.5	Cec	ec	dsz	dsp	S
ft	atm	atm			atm			%		%	in.	in.	in.
49.95	2.99	1.94	33.25	0.41	2001.05	6.1E-4	0.2129	0.1023	1.01	0.1032	1.24E-3	0.001	0.001
49.00	2.93	1.90	33.01	0.41	1977.42	6.1E-4	0.2147	0.1045	1.01	0.1054	1.26E-3	0.024	0.025
48.00	2.87	1.87	32.76	0.42	1952.39	6.1E-4	0.2164	0.1067	1.01	0.1076	1.29E-3	0.026	0.051
47.00	2.81	1.83	32.50	0.42	1927.20	6.1E-4	0.2179	0.1090	1.01	0.1099	1.32E-3	0.026	0.077
46.00	2.75	1.79	32.25	0.42	1901.84	6.1E-4	0.2193	0.1112	1.01	0.1121	1.35E-3	0.027	0.103
45.00	2.69	1.75	31.99	0.43	1876.30	6.1E-4	0.2206	0.1133	1.01	0.1143	1.37E-3	0.027	0.131

44.00	2.63	1.71	31.73	0.43	1850.59	6.2E-4	0.2216	0.1154	1.01	0.1164
1.40E-3	0.028	0.158								
43.00	2.58	1.67	31.47	0.44	1824.70	6.2E-4	0.2225	0.1174	1.01	0.1184
1.42E-3	0.028	0.186								
42.00	2.52	1.64	31.20	0.44	1798.61	6.2E-4	0.2231	0.1194	1.01	0.1204
1.44E-3	0.029	0.215								
41.00	2.46	1.60	30.94	0.45	1772.34	6.2E-4	0.2236	0.1213	1.01	0.1223
1.47E-3	0.029	0.244								
40.00	2.40	1.56	30.67	0.45	1745.88	6.2E-4	0.2238	0.1231	1.01	0.1241
1.49E-3	0.030	0.274								
39.00	2.34	1.52	34.16	0.45	1787.26	5.9E-4	0.2006	0.0916	1.01	0.0924
1.11E-3	0.026	0.299								
38.00	2.28	1.48	37.75	0.46	1824.17	5.7E-4	0.3682	0.1357	1.01	0.1368
1.64E-3	0.028	0.328								
37.00	2.22	1.44	41.43	0.46	1857.12	5.5E-4	0.3190	0.1009	1.01	0.1017
1.22E-3	0.027	0.355								
36.00	2.16	1.41	45.23	0.47	1886.48	5.3E-4	0.2800	0.0886	1.01	0.0893
1.07E-3	0.023	0.378								
35.00	2.10	1.37	49.19	0.47	1913.35	5.2E-4	0.2481	0.0785	1.01	0.0791
9.49E-4	0.020	0.398								
34.00	2.04	1.33	49.11	0.48	1885.12	5.2E-4	0.2440	0.0772	1.01	0.0778
9.34E-4	0.019	0.417								
33.00	1.98	1.29	49.92	0.48	1867.51	5.1E-4	0.2344	0.0741	1.01	0.0747
8.97E-4	0.018	0.435								
32.00	1.92	1.25	50.59	0.48	1847.10	5.0E-4	0.2256	0.0713	1.01	0.0719
8.63E-4	0.018	0.453								
31.00	1.86	1.21	50.93	0.49	1821.77	5.0E-4	0.2184	0.0691	1.01	0.0696
8.36E-4	0.017	0.470								
30.00	1.80	1.17	51.02	0.49	1792.57	5.0E-4	0.2123	0.0671	1.01	0.0677
8.12E-4	0.016	0.486								
29.00	1.74	1.13	54.98	0.49	1806.33	4.8E-4	0.1862	0.0589	1.01	0.0594
7.13E-4	0.015	0.501								
28.00	1.68	1.09	57.54	0.50	1801.69	4.6E-4	0.1692	0.0535	1.01	0.0540
6.47E-4	0.013	0.515								
27.00	1.62	1.05	56.06	0.50	1753.77	4.6E-4	0.1655	0.0523	1.01	0.0528
6.34E-4	0.013	0.528								
26.00	1.56	1.01	57.26	0.50	1733.26	4.5E-4	0.1543	0.0488	1.01	0.0492
5.90E-4	0.012	0.540								
25.00	1.50	0.98	58.51	0.50	1712.32	4.4E-4	0.1437	0.0455	1.01	0.0458
5.50E-4	0.011	0.551								
24.00	1.44	0.94	60.56	0.50	1697.31	4.2E-4	0.1323	0.0418	1.01	0.0422
5.06E-4	0.011	0.562								
23.00	1.38	0.90	62.73	0.50	1680.99	4.1E-4	0.1216	0.0384	1.01	0.0388
4.65E-4	0.010	0.572								
22.00	1.32	0.86	65.04	0.50	1663.26	4.0E-4	0.1116	0.0353	1.01	0.0356
4.27E-4	0.009	0.580								
21.00	1.26	0.82	67.52	0.50	1644.03	3.9E-4	0.1022	0.0323	1.01	0.0326
3.91E-4	0.008	0.589								
20.00	1.19	0.78	70.01	0.51	1621.78	3.7E-4	0.0936	0.0296	1.01	0.0299
3.58E-4	0.007	0.596								

19.00	1.13	0.74	71.53	0.51	1589.49	3.6E-4	0.1738	0.0550	1.01	
0.0554	6.65E-4	0.010	0.606							
18.00	1.07	0.69	73.18	0.51	1556.14	3.5E-4	0.1509	0.0477	1.01	
0.0481	5.77E-4	0.012	0.618							
17.00	1.00	0.65	74.98	0.51	1521.61	3.4E-4	0.1307	0.0413	1.01	
0.0417	5.00E-4	0.011	0.629							
16.00	0.94	0.61	76.98	0.51	1485.79	3.2E-4	0.1131	0.0358	1.01	
0.0361	4.33E-4	0.009	0.638							
15.00	0.88	0.57	79.19	0.51	1448.54	3.1E-4	0.0977	0.0309	1.01	
0.0311	3.74E-4	0.008	0.646							
14.00	0.82	0.53	63.34	0.51	1296.04	3.2E-4	0.1123	0.0355	1.01	
0.0358	4.30E-4	0.008	0.654							
13.00	0.75	0.49	55.13	0.51	1190.64	3.3E-4	0.1165	0.0368	1.01	
0.0372	4.46E-4	0.009	0.663							
12.00	0.70	0.45	46.52	0.51	1080.50	3.3E-4	0.1247	0.0394	1.01	
0.0398	4.77E-4	0.009	0.672							
11.00	0.64	0.42	37.59	0.52	964.41	3.4E-4	0.1404	0.0522	1.01	
0.0527	6.32E-4	0.010	0.683							
10.00	0.58	0.38	29.24	0.52	847.80	3.6E-4	0.1659	0.0981	1.01	
0.0990	1.19E-3	0.018	0.701							
9.00	0.53	0.34	34.90	0.52	856.24	3.2E-4	0.9238	0.4049	1.01	
0.4083	4.90E-3	0.036	0.737							
8.00	0.47	0.31	37.19	0.52	827.97	3.0E-4	0.3240	0.1237	1.01	
0.1248	1.50E-3	0.044	0.781							
7.00	0.42	0.27	39.17	0.52	791.65	2.8E-4	0.1466	0.0491	1.01	
0.0495	5.94E-4	0.016	0.797							
6.00	0.36	0.24	36.94	0.52	721.93	2.6E-4	0.0997	0.0387	1.01	
0.0390	4.68E-4	0.011	0.808							
5.00	0.30	0.20	32.72	0.52	635.51	2.5E-4	0.0763	0.0377	1.01	
0.0380	4.57E-4	0.009	0.817							
4.00	0.25	0.16	68.11	0.52	727.89	1.8E-4	0.0331	0.0105	1.01	
0.0106	1.27E-4	0.004	0.820							
3.00	0.18	0.12	100.00	0.53	717.34	1.4E-4	0.0252	0.0080	1.01	
0.0080	9.64E-5	0.002	0.822							
2.00	0.12	0.08	100.00	0.53	585.71	1.1E-4	0.0232	0.0073	1.01	
0.0074	8.88E-5	0.002	0.824							
1.00	0.06	0.04	100.00	0.53	414.16	7.8E-5	0.0136	0.0043	1.01	
0.0043	5.19E-5	0.001	0.826							

Settlement of Unsaturated Sands=0.826 in.
dsz is per each segment, dz=0.05 ft
dsp is per each print interval, dp=1.00 ft
S is cumulated settlement at this depth

Total Settlement of Saturated and Unsaturated Sands=0.826 in.
Differential Settlement=0.413 to 0.545 in.

Units: Unit: qc, fs, Stress or Pressure = atm (1.0581tsf); Unit Weight =

pcf; Depth = ft; Settlement = in.

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1 atm (atmosphere) = 1.0581 tsf(1 tsf = 1 ton/ft2 = 2 kip/ft2)
1 atm (atmosphere) = 101.325 kPa(1 kPa = 1 kN/m2 = 0.001 Mpa)

SPT	Field data from Standard Penetration Test (SPT)
BPT	Field data from Becker Penetration Test (BPT)
qc	Field data from Cone Penetration Test (CPT) [atm (tsf)]
fs	Friction from CPT testing [atm (tsf)]
Rf	Ratio of fs/qc (%)
gamma	Total unit weight of soil
gamma'	Effective unit weight of soil
Fines	Fines content [%]
D50	Mean grain size
Dr	Relative Density
sigma	Total vertical stress [atm]
sigma'	Effective vertical stress [atm]
sigC'	Effective confining pressure [atm]
rd	Acceleration reduction coefficient by Seed
a_max.	Peak Ground Acceleration (PGA) in ground surface
mZ	Linear acceleration reduction coefficient X depth
a_min.	Minimum acceleration under linear reduction, mZ
CRRv	CRR after overburden stress correction, CRRv=CRR7.5 * Ksig
CRR7.5	Cyclic resistance ratio (M=7.5)
Ksig	Overburden stress correction factor for CRR7.5
CRRm	After magnitude scaling correction CRRm=CRRv * MSF
MSF	Magnitude scaling factor from M=7.5 to user input M
CSR	Cyclic stress ratio induced by earthquake
CSRfs	CSRfs=CSR*fs1 (Default fs1=1)
fs1	First CSR curve in graphic defined in #9 of Advanced page
fs2	2nd CSR curve in graphic defined in #9 of Advanced page
F.S.	Calculated factor of safety against liquefaction

F.S.=CRRm/CSRsf

Cebs	Energy Ratio, Borehole Dia., and Sampling Method Corrections
Cr	Rod Length Corrections
Cn	Overburden Pressure Correction
(N1)60	SPT after corrections, (N1)60=SPT * Cr * Cn * Cebs
d(N1)60	Fines correction of SPT
(N1)60f	(N1)60 after fines corrections, (N1)60f=(N1)60 + d(N1)60
Cq	Overburden stress correction factor
qc1	CPT after Overburden stress correction
dqc1	Fines correction of CPT
qc1f	CPT after Fines and Overburden correction, qc1f=qc1 + dqc1
qc1n	CPT after normalization in Robertson's method
Kc	Fine correction factor in Robertson's Method
qc1f	CPT after Fines correction in Robertson's Method
Ic	Soil type index in Suzuki's and Robertson's Methods
(N1)60s	(N1)60 after settlement fines corrections
CSRm	After magnitude scaling correction for Settlement

calculation CSRm=CSRsf / MSF*

CSRfs Cyclic stress ratio induced by earthquake with user inputed fs

MSF* Scaling factor from CSR, MSF*=1, based on Item 2 of Page C.

ec	Volumetric strain for saturated sands
dz	Calculation segment, dz=0.050 ft
dsz	Settlement in each segment, dz
dp	User defined print interval
dsp	Settlement in each print interval, dp
Gmax	Shear Modulus at low strain
g_eff	gamma_eff, Effective shear Strain
g*Ge/Gm	gamma_eff * G_eff/G_max, Strain-modulus ratio
ec7.5	Volumetric Strain for magnitude=7.5
Cec	Magnitude correction factor for any magnitude
ec	Volumetric strain for unsaturated sands, ec=Cec * ec7.5
NoLiq	No-Liquefy Soils

References:

1. NCEER Workshop on Evaluation of Liquefaction Resistance of Soils. Youd, T.L., and Idriss, I.M., eds., Technical Report NCEER 97-0022.

SP117. Southern California Earthquake Center. Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California. University of Southern California. March 1999.

2. RECENT ADVANCES IN SOIL LIQUEFACTION ENGINEERING AND SEISMIC SITE RESPONSE EVALUATION, Paper No. SPL-2, PROCEEDINGS: Fourth International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, San Diego, CA, March 2001.

3. RECENT ADVANCES IN SOIL LIQUEFACTION ENGINEERING: A UNIFIED AND CONSISTENT FRAMEWORK, Earthquake Engineering Research Center, Report No. EERC 2003-06 by R.B Seed and etc. April 2003.

Note: Print Interval you selected does not show complete results. To get complete results, you should select 'Segment' in Print Interval (Item 12, Page C).

APPENDIX E

GENERAL EARTHWORK GRADING GUIDELINES

Multi-Family Residential Development
Darwin Court Project
Moreno Valley, Riverside County, California
Project No. 2950-CR

GEOTEK

GENERAL GRADING GUIDELINES

Guidelines presented herein are intended to address general construction procedures for earthwork construction. Specific situations and conditions often arise which cannot reasonably be discussed in general guidelines, when anticipated these are discussed in the text of the report. Often unanticipated conditions are encountered which may necessitate modification or changes to these guidelines. It is our hope that these will assist the contractor to more efficiently complete the project by providing a reasonable understanding of the procedures that would be expected during earthwork and the testing and observation used to evaluate those procedures.

General

Grading should be performed to at least the minimum requirements of governing agencies, Chapters 18 and 33 of the California Building Code, CBC (2019) and the guidelines presented below.

Preconstruction Meeting

A preconstruction meeting should be held prior to site earthwork. Any questions the contractor has regarding our recommendations, general site conditions, apparent discrepancies between reported and actual conditions and/or differences in procedures the contractor intends to use should be brought up at that meeting. The contractor (including the main onsite representative) should review our report and these guidelines in advance of the meeting. Any comments the contractor may have regarding these guidelines should be brought up at that meeting.

Grading Observation and Testing

1. Observation of the fill placement should be provided by our representative during grading. Verbal communication during the course of each day will be used to inform the contractor of test results. The contractor should receive a copy of the "Daily Field Report" indicating results of field density tests that day. If our representative does not provide the contractor with these reports, our office should be notified.
2. Testing and observation procedures are, by their nature, specific to the work or area observed and location of the tests taken, variability may occur in other locations. The contractor is responsible for the uniformity of the grading operations; our observations and test results are intended to evaluate the contractor's overall level of efforts during grading. The contractor's personnel are the only individuals participating in all aspect of site work. Compaction testing and observation should not be considered as relieving the contractor's responsibility to properly compact the fill.
3. Cleanouts, processed ground to receive fill, key excavations, and subdrains should be observed by our representative prior to placing any fill. It will be the contractor's responsibility to notify our representative or office when such areas are ready for observation.
4. Density tests may be made on the surface material to receive fill, as considered warranted by this firm.
5. In general, density tests would be made at maximum intervals of two feet of fill height or every 1,000 cubic yards of fill placed. Criteria will vary depending on soil conditions and size of the fill. More frequent testing may be performed. In any case, an adequate number of field density tests should be made to evaluate the required compaction and moisture content is generally being obtained.

6. Laboratory testing to support field test procedures will be performed, as considered warranted, based on conditions encountered (e.g. change of material sources, types, etc.) Every effort will be made to process samples in the laboratory as quickly as possible and in progress construction projects are our first priority. However, laboratory workloads may cause in delays and some soils may require a **minimum of 48 to 72 hours to complete test procedures**. Whenever possible, our representative(s) should be informed in advance of operational changes that might result in different source areas for materials.
7. Procedures for testing of fill slopes are as follows:
   a) Density tests should be taken periodically during grading on the flat surface of the fill, three to five feet horizontally from the face of the slope.
   b) If a method other than over building and cutting back to the compacted core is to be employed, slope compaction testing during construction should include testing the outer six inches to three feet in the slope face to determine if the required compaction is being achieved.
8. Finish grade testing of slopes and pad surfaces should be performed after construction is complete.

Site Clearing

1. All vegetation, and other deleterious materials, should be removed from the site. If material is not immediately removed from the site it should be stockpiled in a designated area(s) well outside of all current work areas and delineated with flagging or other means. Site clearing should be performed in advance of any grading in a specific area.
2. Efforts should be made by the contractor to remove all organic or other deleterious material from the fill, as even the most diligent efforts may result in the incorporation of some materials. This is especially important when grading is occurring near the natural grade. All equipment operators should be aware of these efforts. Laborers may be required as root pickers.
3. Nonorganic debris or concrete may be placed in deeper fill areas provided the procedures used are observed and found acceptable by our representative.

Treatment of Existing Ground

1. Following site clearing, all surficial deposits of topsoil, alluvium and colluvium should be removed unless otherwise specifically indicated in the text of this report.
2. In some cases, removal may be recommended to a specified depth (e.g. flat sites where partial alluvial removals may be sufficient). The contractor should not exceed these depths unless directed otherwise by our representative.
3. Groundwater existing in alluvial areas may make excavation difficult. Deeper removals than indicated in the text of the report may be necessary due to saturation during winter months.
4. Subsequent to removals, the natural ground should be processed to a depth of six inches, moistened to near optimum moisture conditions and compacted to fill standards.
5. Exploratory back hoe or dozer trenches still remaining after site removal should be excavated and filled with compacted fill if they can be located.

Fill Placement

1. Unless otherwise indicated, all site soil may be reused for compacted fill; however, some special processing or handling may be required (see text of report).

2. Material used in the compacting process should be evenly spread, moisture conditioned, processed, and compacted in thin lifts six (6) to eight (8) inches in compacted thickness to obtain a uniformly dense layer. The fill should be placed and compacted on a nearly horizontal plane, unless otherwise found acceptable by our representative.
3. If the moisture content or relative density varies from that recommended by this firm, the contractor should rework the fill until it is in accordance with the following:
   a) Moisture content of the fill should be at or above optimum moisture. Moisture should be evenly distributed without wet and dry pockets. Pre-watering of cut or removal areas should be considered in addition to watering during fill placement, particularly in clay or dry surficial soils. The ability of the contractor to obtain the proper moisture content will control production rates.
   b) Each six-inch layer should be compacted to at least 90 percent of the maximum dry density in compliance with the testing method specified by the controlling governmental agency. In most cases, the testing method is ASTM Test Designation D 1557.
4. Rock fragments less than eight inches in diameter may be utilized in the fill, provided:
   a) They are not placed in concentrated pockets;
   b) There is a sufficient percentage of fine-grained material to surround the rocks;
   c) The distribution of the rocks is observed by, and acceptable to, our representative.
5. Rocks exceeding eight (8) inches in diameter should be taken off site, broken into smaller fragments, or placed in accordance with recommendations of this firm in areas designated suitable for rock disposal. On projects where significant large quantities of oversized materials are anticipated, alternate guidelines for placement may be included. If significant oversize materials are encountered during construction, these guidelines should be requested.
6. In clay soil, dry or large chunks or blocks are common. If in excess of eight (8) inches minimum dimension, then they are considered as oversized. Sheepsfoot compactors or other suitable methods should be used to break up blocks. When dry, they should be moisture conditioned to provide a uniform condition with the surrounding fill.

Slope Construction

1. The contractor should obtain a minimum relative compaction of 90 percent out to the finished slope face of fill slopes. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment.
2. Slopes trimmed to the compacted core should be overbuilt by at least three (3) feet with compaction efforts out to the edge of the false slope. Failure to properly compact the outer edge results in trimming not exposing the compacted core and additional compaction after trimming may be necessary.
3. If fill slopes are built "at grade" using direct compaction methods, then the slope construction should be performed so that a constant gradient is maintained throughout construction. Soil should not be "spilled" over the slope face nor should slopes be "pushed out" to obtain grades. Compaction equipment should compact each lift along the immediate top of slope. Slopes should be back rolled or otherwise compacted at approximately every 4 feet vertically as the slope is built.
4. Corners and bends in slopes should have special attention during construction as these are the most difficult areas to obtain proper compaction.
5. Cut slopes should be cut to the finished surface. Excessive undercutting and smoothing of the face with fill may necessitate stabilization.

UTILITY TRENCH CONSTRUCTION AND BACKFILL

Utility trench excavation and backfill is the contractors responsibility. The geotechnical consultant typically provides periodic observation and testing of these operations. While efforts are made to make sufficient observations and tests to verify that the contractors' methods and procedures are adequate to achieve proper compaction, it is typically impractical to observe all backfill procedures. As such, it is critical that the contractor use consistent backfill procedures.

Compaction methods vary for trench compaction and experience indicates many methods can be successful. However, procedures that "worked" on previous projects may or may not prove effective on a given site. The contractor(s) should outline the procedures proposed, so that we may discuss them **prior** to construction. We will offer comments based on our knowledge of site conditions and experience.

1. Utility trench backfill in slopes, structural areas, in streets and beneath flat work or hardscape should be brought to at least optimum moisture and compacted to at least 90 percent of the laboratory standard. Soil should be moisture conditioned prior to placing in the trench.
2. Flooding and jetting are not typically recommended or acceptable for native soils. Flooding or jetting may be used with select sand having a Sand Equivalent (SE) of 30 or higher. This is typically limited to the following uses:
   a) shallow (12 + inches) under slab interior trenches and,
   b) as bedding in pipe zone.

   The water should be allowed to dissipate prior to pouring slabs or completing trench compaction.
3. Care should be taken not to place soils at high moisture content within the upper three feet of the trench backfill in street areas, as overly wet soils may impact subgrade preparation. Moisture may be reduced to 2% below optimum moisture in areas to be paved within the upper three feet below sub grade.
4. Sand backfill should not be allowed in exterior trenches adjacent to and within an area extending below a 1:1 projection from the outside bottom edge of a footing, unless it is similar to the surrounding soil.
5. Trench compaction testing is generally at the discretion of the geotechnical consultant. Testing frequency will be based on trench depth and the contractors procedures. A probing rod would be used to assess the consistency of compaction between tested areas and untested areas. If zones are found that are considered less compact than other areas, this would be brought to the contractors attention.

JOB SAFETY

General

Personnel safety is a primary concern on all job sites. The following summaries are safety considerations for use by all our employees on multi-employer construction sites. On ground personnel are at highest risk of injury and possible fatality on grading construction projects. The company recognizes that construction activities will vary on each site and that job site safety is the contractor's responsibility. However, it is, imperative that all personnel be safety conscious to avoid accidents and potential injury.

In an effort to minimize risks associated with geotechnical testing and observation, the following precautions are to be implemented for the safety of our field personnel on grading and construction projects.

1. Safety Meetings: Our field personnel are directed to attend the contractor's regularly scheduled safety meetings.
2. Safety Vests: Safety vests are provided for and are to be worn by our personnel while on the job site.
3. Safety Flags: Safety flags are provided to our field technicians; one is to be affixed to the vehicle when on site, the other is to be placed atop the spoil pile on all test pits.

In the event that the contractor's representative observes any of our personnel not following the above, we request that it be brought to the attention of our office.

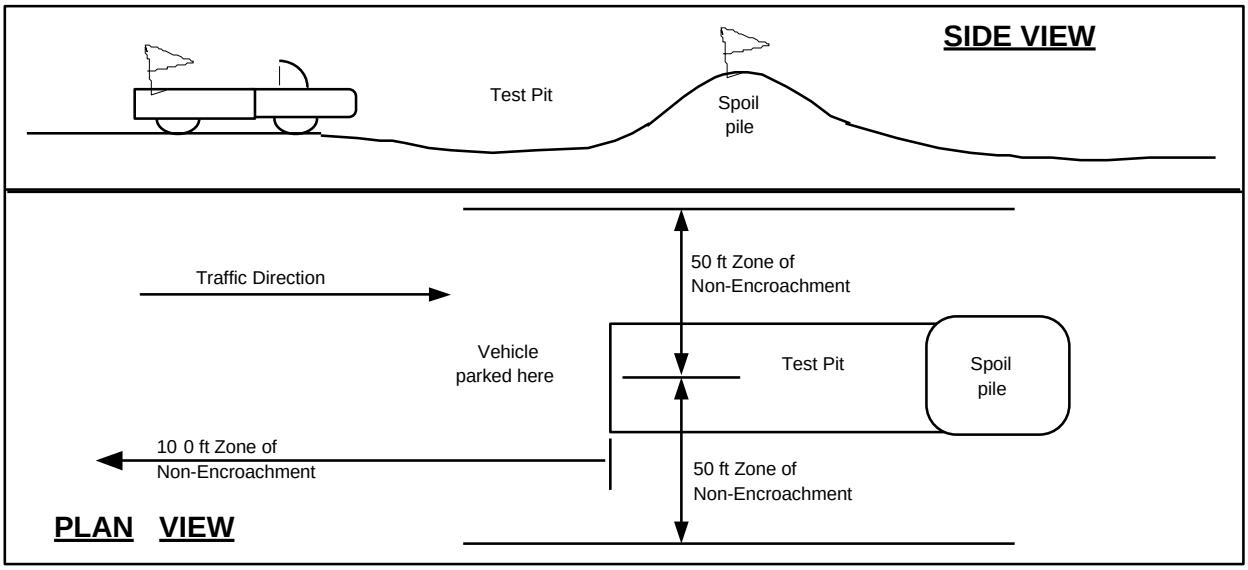
Test Pits Location, Orientation and Clearance

The technician is responsible for selecting test pit locations. The primary concern is the technician's safety. However, it is necessary to take sufficient tests at various locations to obtain a representative sampling of the fill. As such, efforts will be made to coordinate locations with the grading contractors authorized representatives (e.g. dump man, operator, supervisor, grade checker, etc.), and to select locations following or behind the established traffic pattern, preferably outside of current traffic. The contractors authorized representative should direct excavation of the pit and safety during the test period. Again, safety is the paramount concern.

Test pits should be excavated so that the spoil pile is placed away from oncoming traffic. The technician's vehicle is to be placed next to the test pit, opposite the spoil pile. This necessitates that the fill be maintained in a drivable condition. Alternatively, the contractor may opt to park a piece of equipment in front of test pits, particularly in small fill areas or those with limited access.

A zone of non-encroachment should be established for all test pits (see diagram below). No grading equipment should enter this zone during the test procedure. The zone should extend outward to the sides approximately 50 feet from the center of the test pit and 100 feet in the direction of traffic flow. This zone is established both for safety and to avoid excessive ground vibration, which typically decreases test results.

TEST PIT SAFETY PLAN



Slope Tests

When taking slope tests, the technician should park their vehicle directly above or below the test location on the slope. The contractor's representative should effectively keep all equipment at a safe operation distance (e.g. 50 feet) away from the slope during testing.

The technician is directed to withdraw from the active portion of the fill as soon as possible following testing. The technician's vehicle should be parked at the perimeter of the fill in a highly visible location.

Trench Safety

It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed. Trenches for all utilities should be excavated in accordance with CAL-OSHA and any other applicable safety standards. Safe conditions will be required to enable compaction testing of the trench backfill.

All utility trench excavations in excess of 5 feet deep, which a person enters, are to be shored or laid back. Trench access should be provided in accordance with OSHA standards. Our personnel are directed not to enter any trench by being lowered or "riding down" on the equipment.

Our personnel are directed not to enter any excavation which;

1. is 5 feet or deeper unless shored or laid back,
2. exit points or ladders are not provided,
3. displays any evidence of instability, has any loose rock or other debris which could fall into the trench, or
4. displays any other evidence of any unsafe conditions regardless of depth.

If the contractor fails to provide safe access to trenches for compaction testing, our company policy requires that the soil technician withdraws and notifies their supervisor. The contractors representative will then be contacted in an effort to effect a solution. All backfill not tested due to safety concerns or other reasons is subject to reprocessing and/or removal.

Procedures

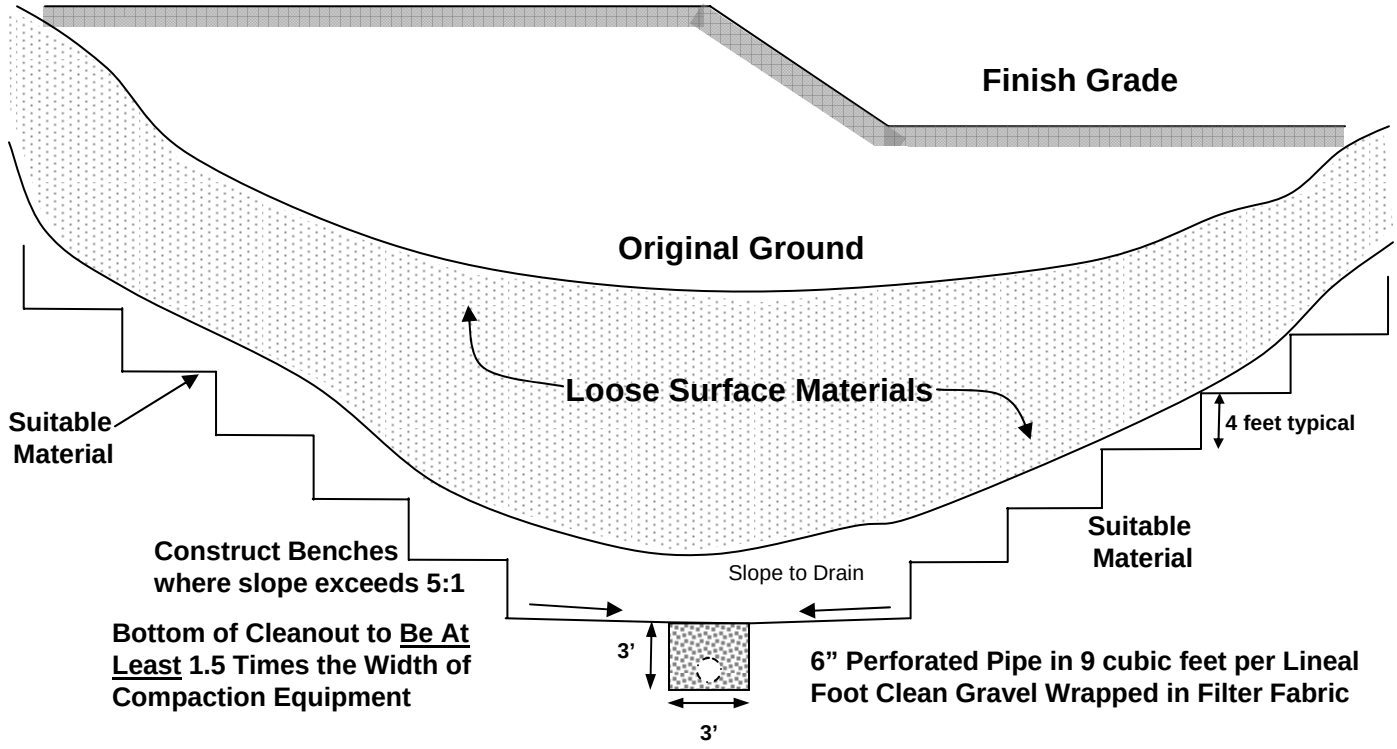
In the event that the technician's safety is jeopardized or compromised as a result of the contractor's failure to comply with any of the above, the technician is directed to inform both the developer's and contractor's representatives. If the condition is not rectified, the technician is required, by company policy, to immediately withdraw and notify their supervisor. The contractor's representative will then be contacted in an effort to effect a solution. No further testing will be performed until the situation is rectified. Any fill placed in the interim can be considered unacceptable and subject to reprocessing, recompaction or removal.

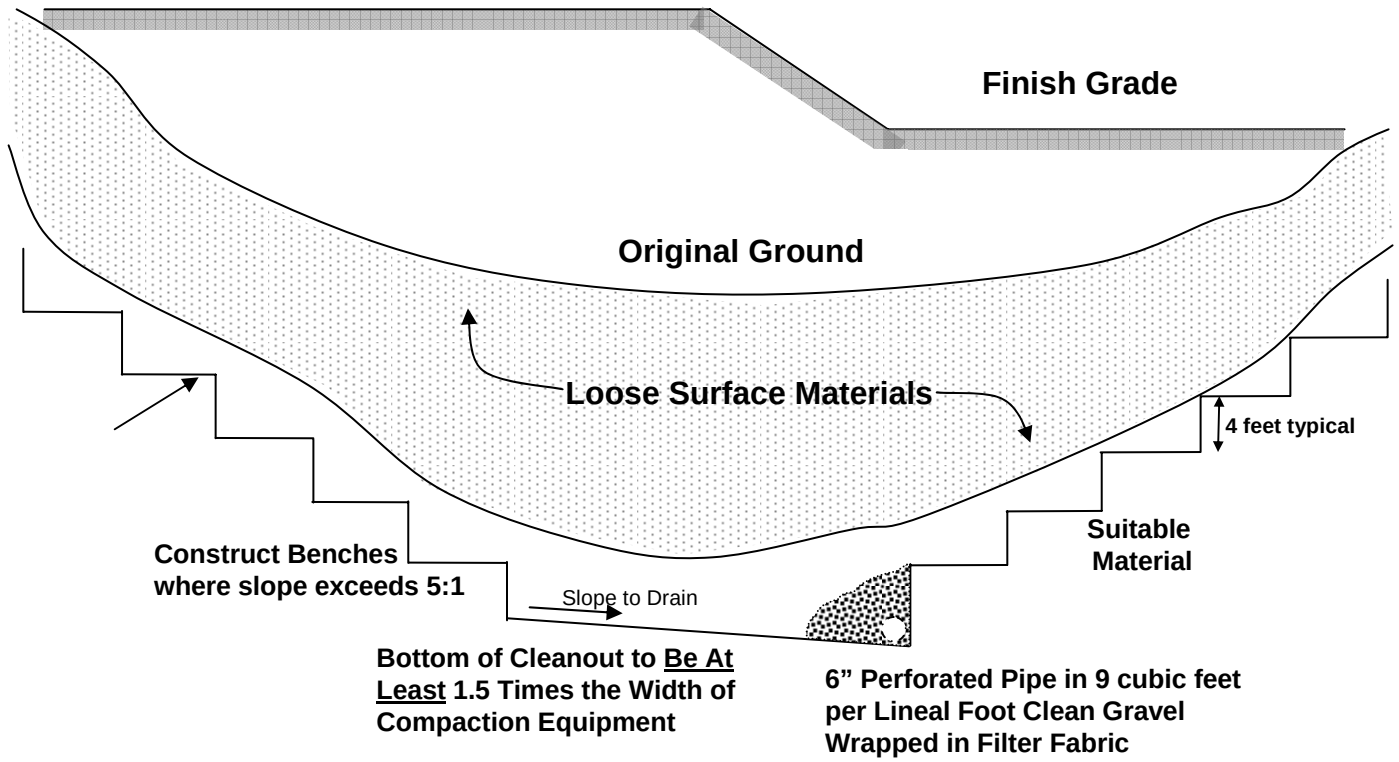
In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor bring this to technicians attention and notify our project manager or office. Effective communication and coordination between the contractors' representative and the field technician(s) is strongly encouraged in order to implement the above safety program and safety in general.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures particularly the zone of non-encroachment.

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ALTERNATES





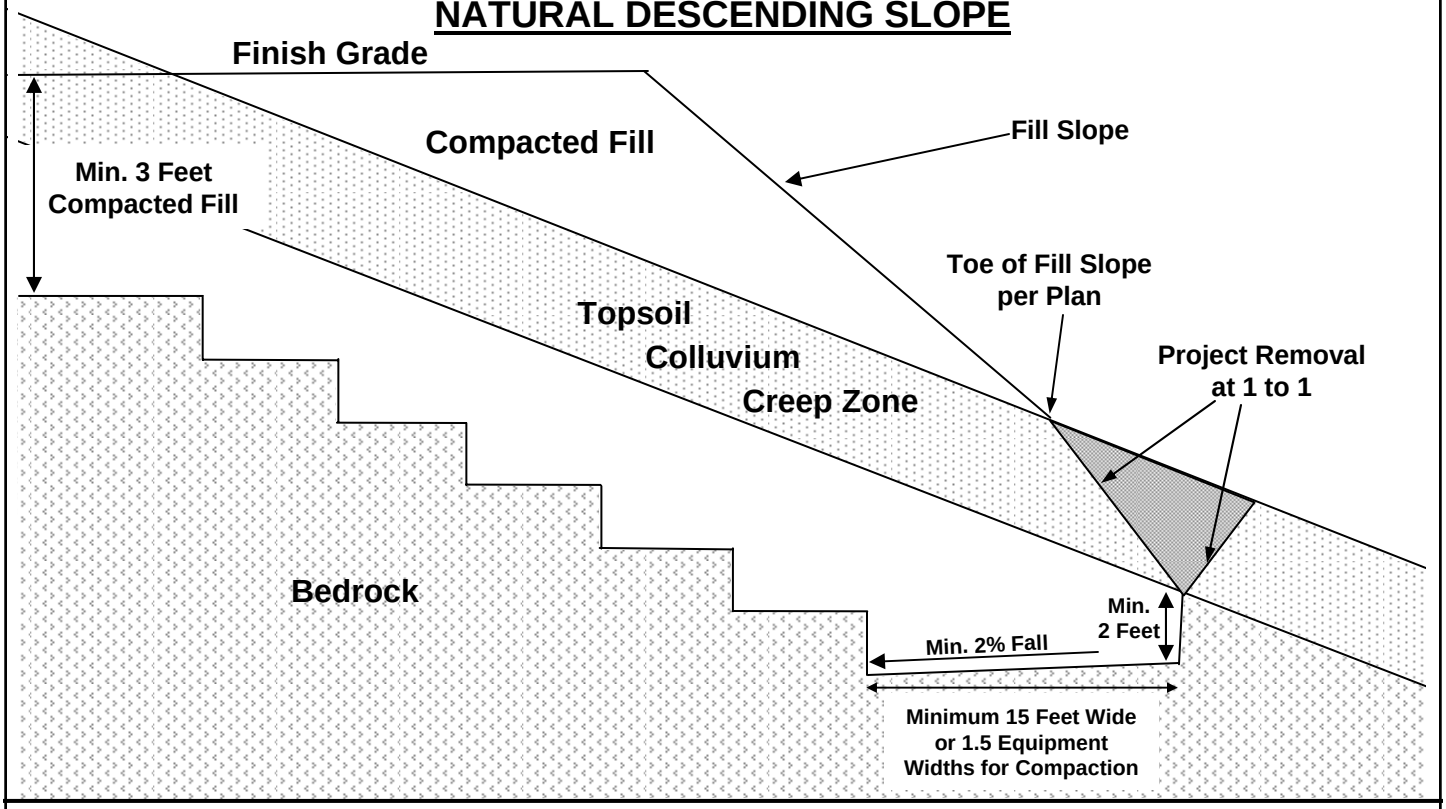
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TYPICAL CANYON CLEANOUT

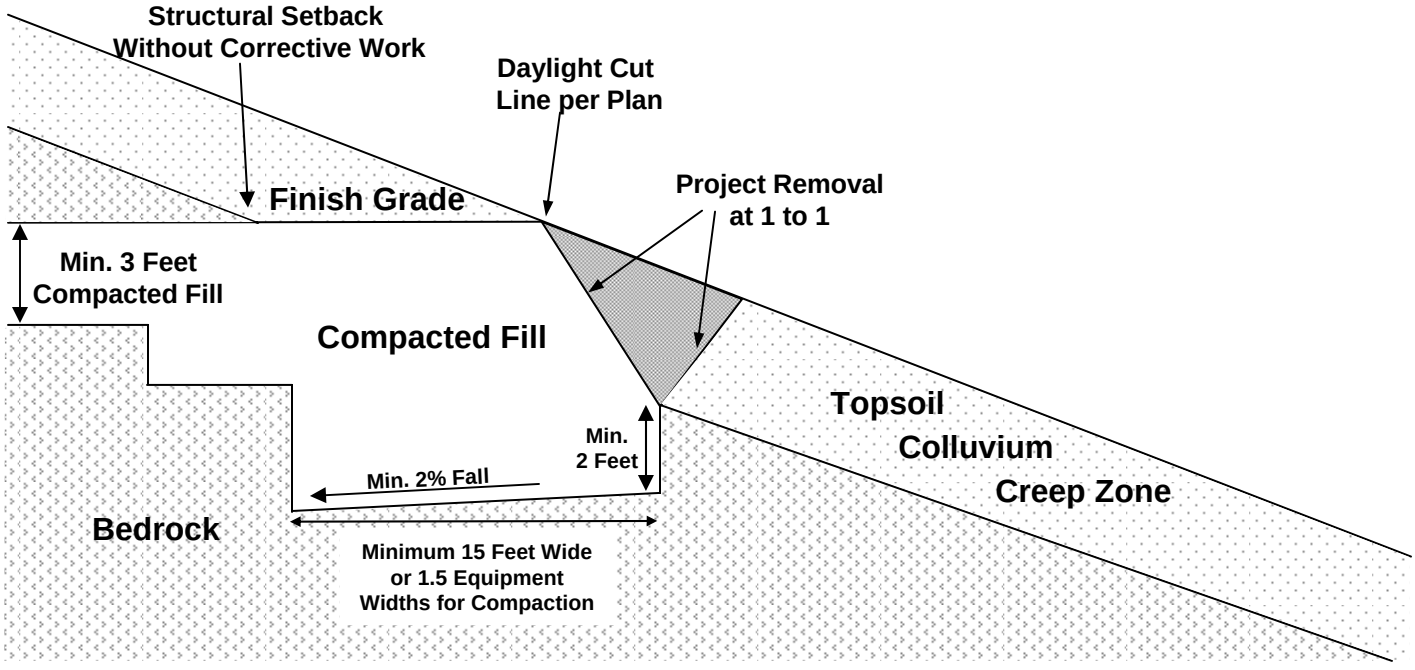
STANDARD GRADING GUIDELINES

PLATE G-1

TYPICAL FILL SLOPE OVER NATURAL DESCENDING SLOPE



DAYLIGHT CUT AREA OVER NATURAL DESCENDING SLOPE



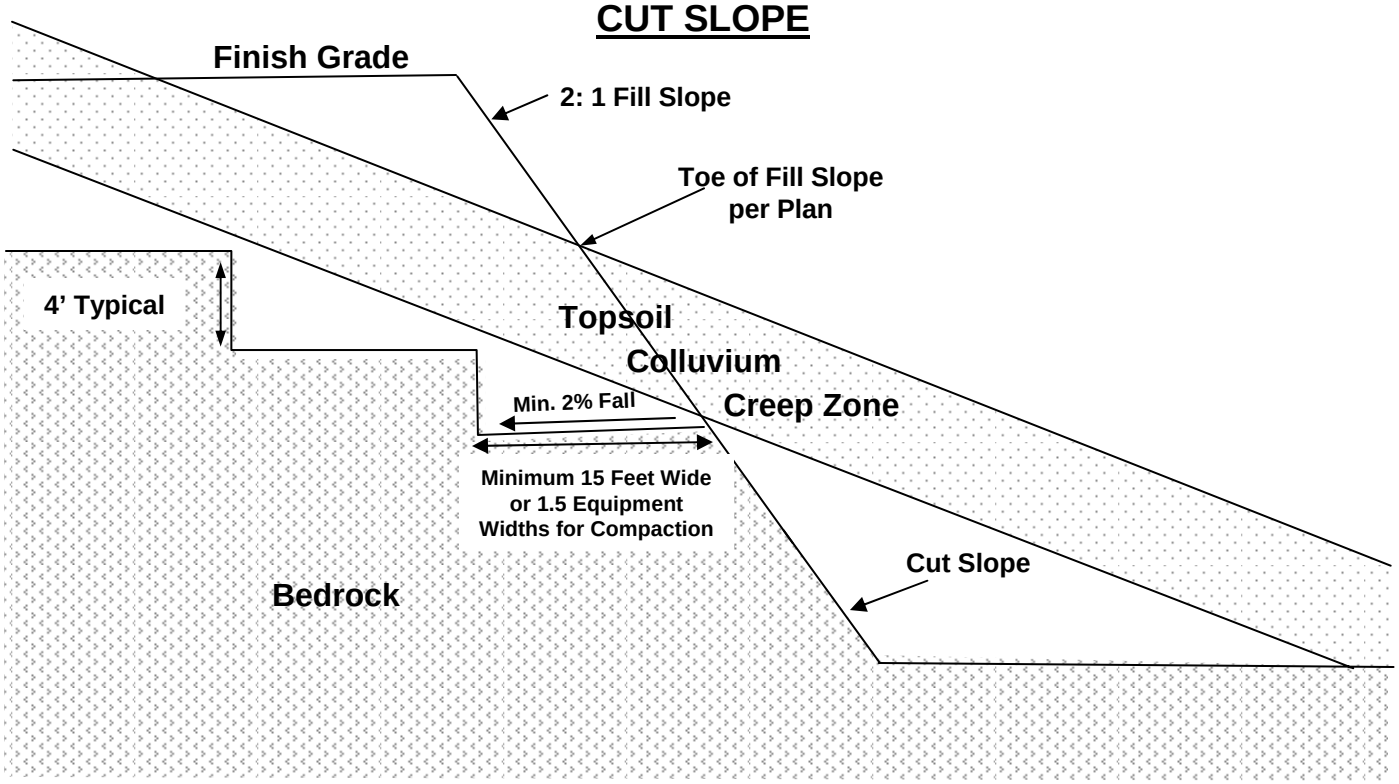
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TREATMENT ABOVE NATURAL SLOPES

STANDARD GRADING GUIDELINES

PLATE G-2

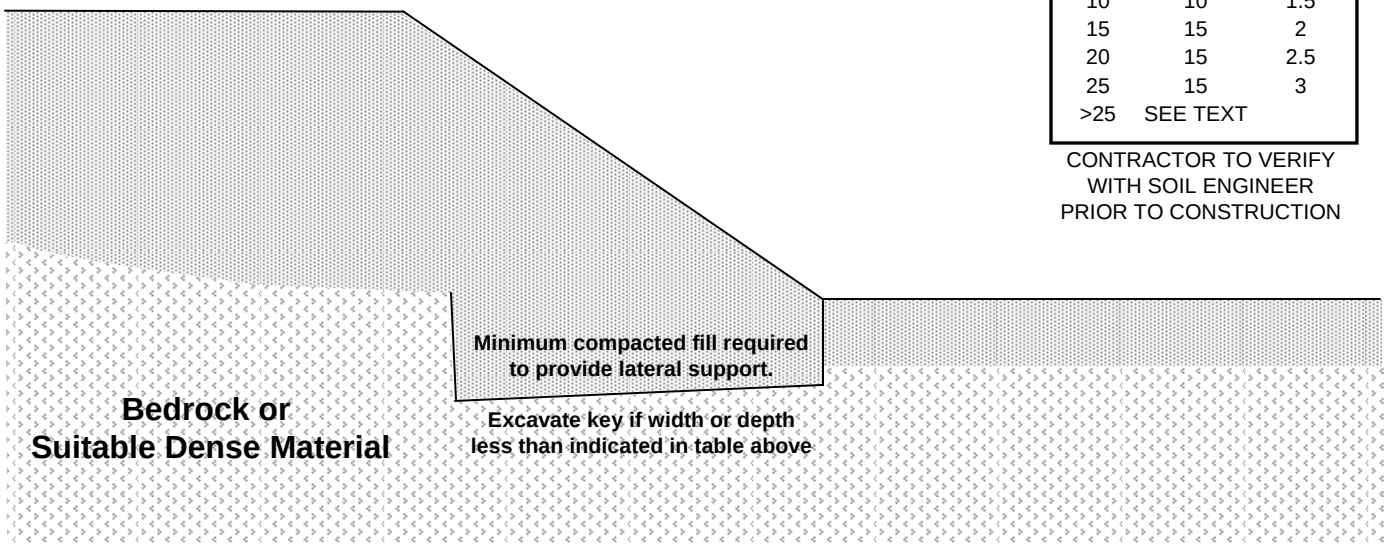
TYPICAL FILL SLOPE OVER CUT SLOPE



TYPICAL FILL SLOPE

SLOPE HEIGHT	MIN. KEY WIDTH	MIN. KEY DEPTH
5	7	1
10	10	1.5
15	15	2
20	15	2.5
25	15	3
>25	SEE TEXT	

CONTRACTOR TO VERIFY WITH SOIL ENGINEER PRIOR TO CONSTRUCTION



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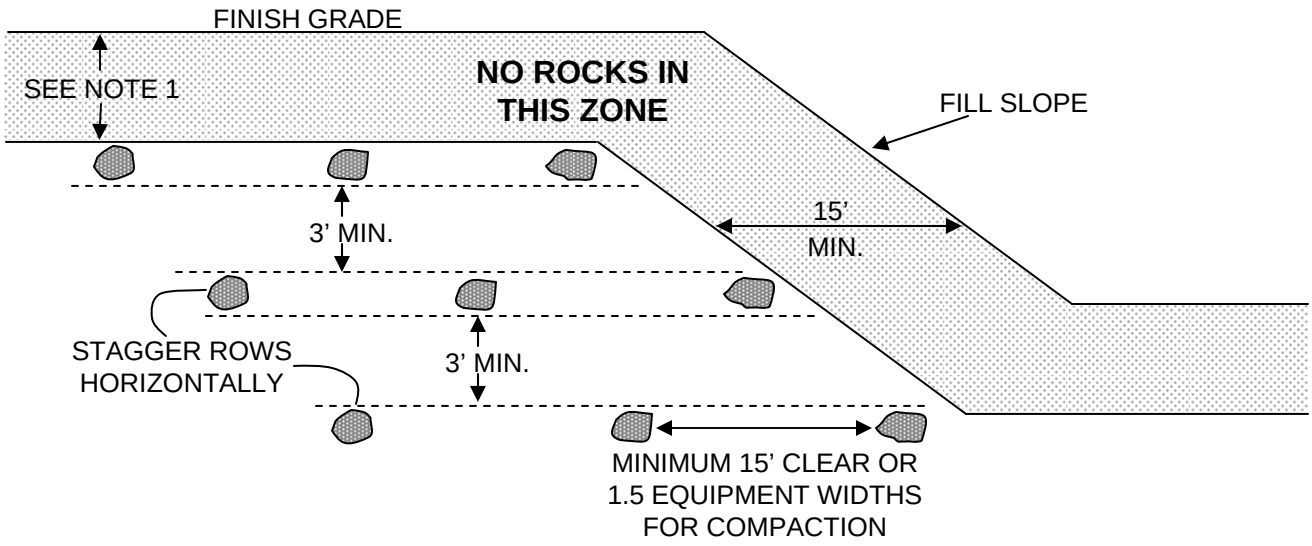
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COMMON FILL SLOPE KEYS

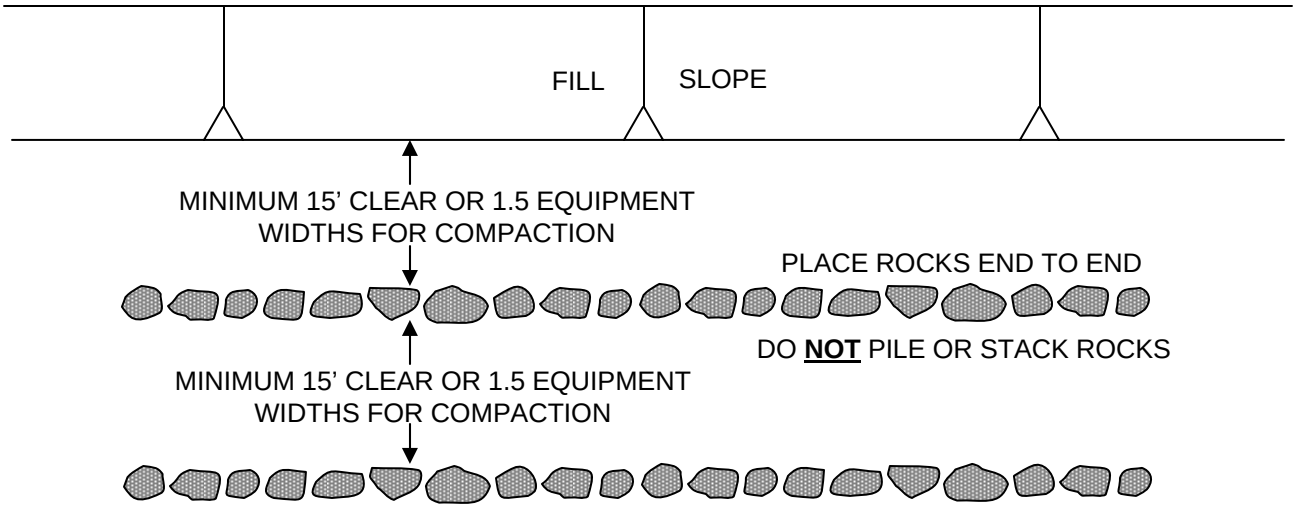
STANDARD GRADING GUIDELINES

PLATE G-3

CROSS SECTIONAL VIEW



PLAN VIEW



NOTES:

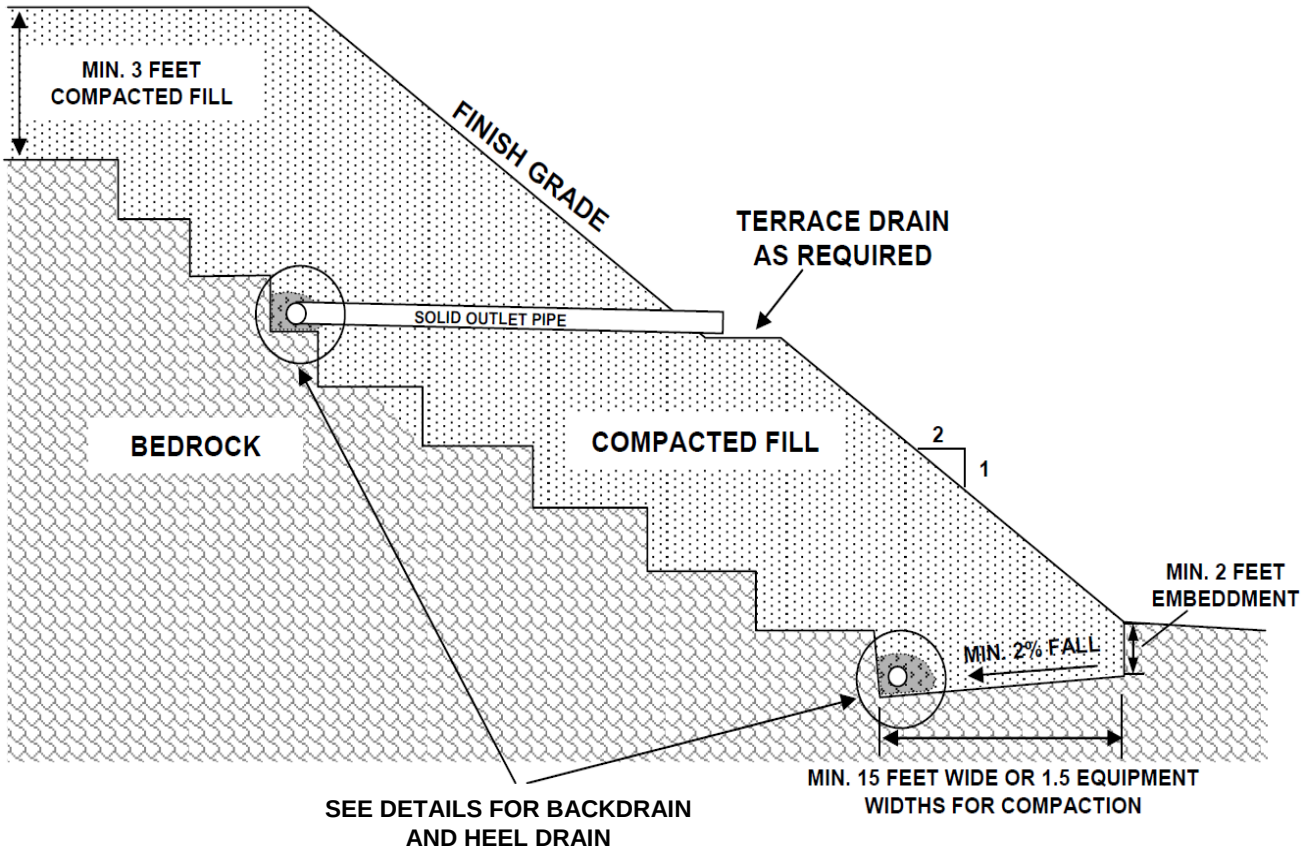
1) SOIL FILL OVER WINDROW SHOULE BE 7 FEET OR PER JURISDUICTIONAL STANDARDS AND SUFFICIENT FOR FUTURE EXCAVATIONS TO AVOID ROCKS
2) MAXIMUM ROCK SIZE IN WINDROWS IS 4 FEET IN DIAMETER
3) SOIL AROUND WINDROWS TO BE SANDY MATERIAL SUBJECT TO SOIL ENGINEER ACCEPTANCE
4) SPACING AND CLEARANCES MUST BE SUFFICIENT TO ALLOW FOR PROPER COMPACTION
5) INDIVDUAL LARGE ROCKS MAY BE BURIED IN PITS.

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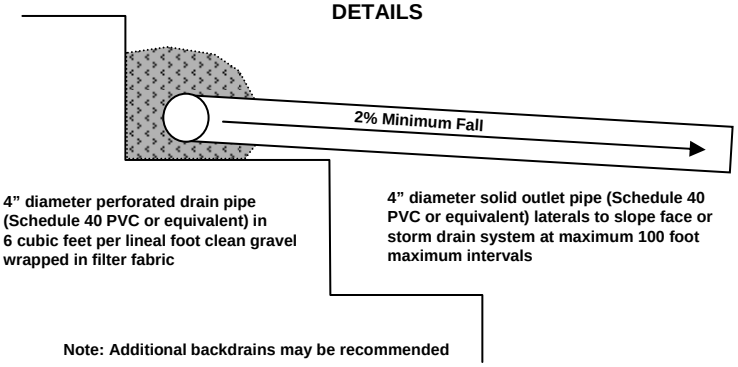
ROCK BURIAL DETAILS

STANDARD GRADING GUIDELINES

PLATE G-4



BACKDRAIN DETAILS



4" diameter perforated drain pipe (Schedule 40 PVC or equivalent) in 6 cubic feet per lineal foot clean gravel wrapped in filter fabric

4" diameter solid outlet pipe (Schedule 40 PVC or equivalent) laterals to slope face or storm drain system at maximum 100 foot maximum intervals

Note: Additional backdrains may be recommended

HEEL DRAIN DETAILS



6" diameter perforated drain pipe in 6 cubic feet per lineal foot clean gravel wrapped in filter fabric, outlet pipe to gravity flow with 2% minimum fall

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Appendix 4: Historical Site Conditions

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

Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation

Biofiltration and Bioretention Systems

LID compliance is met with a biotreatment systems, with localized EcoStreams throughout the site, all of which are subsequently tributary to a downstream underground RTank detention system. These localized EcoStream basins treat required pollutants of concern, including Phosphorus. Said EcoStreams are sized for this biofiltration based upon BMP Design Flow Rates (Q_{BMP}) for each Drainage Management Area (DMA) per worksheets hereon within Appendix 6. Additionally, bioretention is provided both through evapotranspiration from plantings within plantable EcoStream basins. The RTank system is sealed and contains non perforated maintenance port covers that will not allow inlet or outlet to the system by mosquitoes. Further, the upstream stormwater is captured through biofiltration basins that will prevent mosquito access to the storm drain system. Please see portion of report about infiltration – based on site infiltration testing and the fill condition of the site, infiltration is infeasible for this project.

In order to quantify the project's Design Capture Volume (DCV), Design Volumes (V_{BMP}) for each DMA were calculated per worksheets hereon within Appendix 6.

For DMAs 1.3-1.5, an EcoStream was not feasible for biofiltration due to the lack of adjacent storm drain and depth. Green street swales were designed curb adjacent in order to capture the water from the public street and provide treatment through a Green Street BMP.

Rocas Grandes II
3816
2/10/2025

Rocas Grandes II WQMP Calculations

Pre-Project Drainage

Basin ID	Total Area (ac)	Impervious Area (Soil B) (sq-ft)	Impervious Area (Soil C) (sq-ft)	Pervious Area (Soil B) (sq-ft)	Pervious Area (Soil C) (sq-ft)	% Impervious	% Pervious	Weighted Runoff Coef C:
2.0	0.12	0	0	0	5321	0%	100%	0.79
2.1	8.52	0	0	197421	173713	0%	100%	0.74
3.0	0.08	0	0	0	3696	0%	100%	0.79
3.1	8.83	0	0	195747	188897	0%	100%	0.74
Total	17.56	0	0	393168	371627			

Runoff Coefficient Table		
Soil Type	B	C
Impervious	0.9	0.9
Pervious (landscape)	0.69	0.79

Post-Project Drainage

Basin ID	Total Area (ac)	Impervious Area (Soil B) (sq-ft)	Impervious Area (Soil C) (sq-ft)	Pervious Area (Soil B) (sq-ft)	Pervious Area (Soil C) (sq-ft)	% Impervious	% Pervious	Weighted Runoff Coef C:
1.0	0.98		39627		3210	93%	7%	0.89
1.1	0.87	13859	18854	2631	2760	86%	14%	0.88
1.3	0.11	4048		663		86%	14%	0.87
1.4	0.21	5822		3256		64%	36%	0.82
1.5	0.39	11531		5433		68%	32%	0.83
2.0	0.63		20285		7300	74%	26%	0.87
2.1	1.20		46586		5668	89%	11%	0.89
2.2	0.56		19828		4634	81%	19%	0.88
2.3	1.21		46361		6360	88%	12%	0.89
2.4	0.50	7347	6236	1794	6570	62%	38%	0.85
2.5	0.51	61	16147	158	5670	74%	26%	0.87
2.6	1.42	54091	231	7468		88%	12%	0.87
2.7	1.51	56130	1804	8008		88%	12%	0.87
2.8	1.20	43970		8399		84%	16%	0.87
2.9	0.31	10639		2912		79%	21%	0.85
3.0	0.46		16191		3679	81%	19%	0.88
3.1	0.62		22380		4541	83%	17%	0.88
3.2	0.57		20497		4533	82%	18%	0.88
3.3	0.53		20515		2560	89%	11%	0.89
3.4	0.63		22591		4736	83%	17%	0.88
3.5	0.41	840	14347	783	1912	85%	15%	0.88

3.6	0.88		26319		12188	68%	32%	0.87
3.7	0.59	22218	1155	2484	30	90%	10%	0.88
3.8	0.36	12927		2645		83%	17%	0.86
3.9	0.57	23371		1399		94%	6%	0.89
4	1.33	49802		7981		86%	14%	0.87
4.1	0.45	14784		4776		76%	24%	0.85
4.2	0.62	19745		7221		73%	27%	0.84
4.3	0.42	15100		3074		83%	17%	0.86
	0.00					#DIV/0!	#DIV/0!	#DIV/0!
	0.00					#DIV/0!	#DIV/0!	#DIV/0!

Santa Ana Watershed - BMP Design Flow Rate, Q_{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: PLSA | Date: 2/5/2025

Designed by: M.F. | Case No:

Company Project Number/Name: 3816 Rocas Grandes II

BMP Identification

BMP NAME / ID: Stormgarden #1.0

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity: I = 0.20 in/hr

Drainage Management Area Tabulation

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

DMAs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
1.0	*39627*	*Concrete or Asphalt*	*1.00*	*0.89*	*35347.3*			
1.0	*3210*	*Natural (C Soil)*	*0.30*	*0.225*	*722.8*			

Santa Ana Watershed - BMP Design Flow Rate, Q_{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**)*

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Drainage Management Area Tabulation

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

	DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
DMAs	*1.1*	*31954*	*Concrete or Asphalt*	*1.00*	*0.89*	*28503*			
	1.1	*5391*	*Natural (C Soil)*	*0.30*	*0.225*	*1213.9*			

Santa Ana Watershed - BMP Design Flow Rate, Q_{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	PLSA	Date	2/5/2025
Designed by	M.F.	Case No	
Company Project Number/Name	3816 Rocas Grandes II		

BMP Identification

BMP NAME / ID: Ecostream #2.0

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity I = 0.20 in/hr

Drainage Management Area Tabulation

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

DMAs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
2.0	*275866*	*Concrete or Asphalt*	*1.00*	*0.89*	*246072.5*			
2.0	*53630*	*Natural (C Soil)*	*0.30*	*0.225*	*12075.7*			

Santa Ana Watershed - BMP Design Flow Rate, Q_{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	PLSA	Date	2/5/2025
Designed by	M.F.	Case No	
Company Project Number/Name	3816 Rocas Grandes II		

BMP Identification

BMP NAME / ID: Ecostream #2.1

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity I = 0.20 in/hr

Drainage Management Area Tabulation

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

DMAs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
2.1	*43970*	*Concrete or Asphalt*	*1.00*	*0.89*	*39221.2*			
2.1	*8399*	*Natural (C Soil)*	*0.30*	*0.225*	*1891.2*			

Santa Ana Watershed - BMP Design Flow Rate, Q_{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	PLSA	Date	2/5/2025
Designed by	M.F.	Case No	
Company Project Number/Name	3816 Rocas Grandes II		

BMP Identification

BMP NAME / ID: Ecostream #3.0

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity I = 0.20 in/hr

Drainage Management Area Tabulation

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

DMAs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
3.0	*143680*	*Concrete or Asphalt*	*1.00*	*0.89*	*128162.6*			
3.0	*34932*	*Natural (C Soil)*	*0.30*	*0.225*	*7865.5*			

Santa Ana Watershed - BMP Design Flow Rate, Q_{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	PLSA	Date	2/5/2025
Designed by	M.F.	Case No	
Company Project Number/Name	3816 Rocas Grandes II		

BMP Identification

BMP NAME / ID: Ecostream #3.1

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity I = 0.20 in/hr

Drainage Management Area Tabulation

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

DMAs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
3.1	*59671*	*Concrete or Asphalt*	*1.00*	*0.89*	*53226.5*			
3.1	*6558*	*Natural (C Soil)*	*0.30*	*0.225*	*1476.6*			

Santa Ana Watershed - BMP Design Flow Rate, Q_{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	PLSA	Date	2/5/2025
Designed by	M.F.	Case No	
Company Project Number/Name	3816 Rocas Grandes II		

BMP Identification

BMP NAME / ID: Ecostream #3.2

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity I = 0.20 in/hr

Drainage Management Area Tabulation

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

DMAs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
3.2	*83331*	*Concrete or Asphalt*	*1.00*	*0.89*	*74331.3*			
3.2	*19978*	*Natural (C Soil)*	*0.30*	*0.225*	*4498.4*			

Santa Ana Watershed - BMP Design Flow Rate, Q_{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	PLSA	Date	2/5/2025
Designed by	M.F.	Case No	
Company Project Number/Name	3816 Rocas Grandes II		

BMP Identification

BMP NAME / ID: Ecostream #3.4

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity I = 0.20 in/hr

Drainage Management Area Tabulation

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

DMAs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
3.4	*15100*	*Concrete or Asphalt*	*1.00*	*0.89*	*13469.2*			
3.4	*3074*	*Natural (C Soil)*	*0.30*	*0.225*	*692.2*			

Santa Ana Watershed - BMP Design Flow Rate, Q_{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	PLSA	Date	2/5/2025
Designed by	M.F.	Case No	
Company Project Number/Name	3816 Rocas Grandes II		

BMP Identification

BMP NAME / ID: Ecostream #4.0

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

Design Rainfall Intensity I = 0.20 in/hr

Drainage Management Area Tabulation

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

DMAs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type (use pull-down menu)	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Rainfall Intensity (in/hr)*	*Design Flow Rate (cfs)*	*Proposed Flow Rate (cfs)*
4.0	*10639*	*Concrete or Asphalt*	*1.00*	*0.89*	*9490*			
4.0	*2912*	*Natural (C Soil)*	*0.30*	*0.225*	*655.7*			

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	PLSA	Date	2/5/2025
Designed by	M.F.	Case No	
Company Project Number/Name	3816 Rocas Grandes II		

BMP Identification

BMP NAME / ID: EcoStream #1.0

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}= 0.66 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)*
1	*39627*	*Concrete or Asphalt*	*1.00*	*0.89*	*35347.3*			
1	*3210*	*Natural (C Soil)*	*0.30*	*0.23*	*722.8*			
	42837	***Total***			**36070.1**	**0.66**	***1983.9***	

Proposed Volume must be greater than the Design Capture Volume

Notes:

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	PLSA	Date	2/5/2025
Designed by	M.F.	Case No	
Company Project Number/Name	3816 Rocas Grandes II		

BMP Identification

BMP NAME / ID: EcoStream #1.1

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.66 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)*
1.1	*31954*	*Concrete or Asphalt*	*1.00*	*0.89*	*28503*			
1.1	*5391*	*Natural (C Soil)*	*0.30*	*0.23*	*1213.9*			
	37345		***Total***		**29716.9**	**0.66**	***1634.4***	

Proposed Volume must be greater than the Design Capture Volume

Notes:

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	PLSA	Date	2/5/2025
Designed by	M.F.	Case No	
Company Project Number/Name	3816 Rocas Grandes II		

BMP Identification

BMP NAME / ID: EcoStream #2.0

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}= 0.66 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)*
2	*275866*	*Concrete or Asphalt*	*1.00*	*0.89*	*246072.5*			
2	*53630*	*Natural (C Soil)*	*0.30*	*0.23*	*12075.7*			
	329496		***Total***		**258148.2**	**0.66**	***14198.2***	

Proposed Volume must be greater than the Design Capture Volume

Notes:

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	PLSA	Date	2/5/2025
Designed by	M.F.	Case No	
Company Project Number/Name	3816 Rocas Grandes II		

BMP Identification

BMP NAME / ID: EcoStream #2.1

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.66 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)*
2.1	*43970*	*Concrete or Asphalt*	*1.00*	*0.89*	*39221.2*			
2.1	*8399*	*Natural (C Soil)*	*0.30*	*0.23*	*1891.2*			
	52369	***Total***			**41112.4**	**0.66**	***2261.2***	

Proposed Volume must be greater than the Design Capture Volume

Notes:

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	PLSA	Date	2/5/2025
Designed by	M.F.	Case No	
Company Project Number/Name	3816 Rocas Grandes II		

BMP Identification

BMP NAME / ID: EcoStream #3.0

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}= 0.66 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)*
3	*143680*	*Concrete or Asphalt*	*1.00*	*0.89*	*128162.6*			
3	*34932*	*Natural (C Soil)*	*0.30*	*0.23*	*7865.5*			

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	PLSA	Date	2/5/2025
Designed by	M.F.	Case No	
Company Project Number/Name	3816 Rocas Grandes II		

BMP Identification

BMP NAME / ID: EcoStream #3.1

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.66 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)*
3.1	*59671*	*Concrete or Asphalt*	*1.00*	*0.89*	*53226.5*			
3.1	*6558*	*Natural (C Soil)*	*0.30*	*0.23*	*1476.6*			

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	PLSA	Date	2/5/2025
Designed by	M.F.	Case No	
Company Project Number/Name	3816 Rocas Grandes II		

BMP Identification

BMP NAME / ID: EcoStream #3.2

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}= 0.66 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)*
3.2	*83331*	*Concrete or Asphalt*	*1.00*	*0.89*	*74331.3*			
3.2	*19978*	*Natural (C Soil)*	*0.30*	*0.23*	*4498.4*			

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	PLSA	Date	2/5/2025
Designed by	M.F.	Case No	
Company Project Number/Name	3816 Rocas Grandes II		

BMP Identification

BMP NAME / ID: EcoStream #3.3

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}= 0.66 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)*
3.3	*15100*	*Concrete or Asphalt*	*1.00*	*0.89*	*13469.2*			
3.3	*3074*	*Natural (C Soil)*	*0.30*	*0.23*	*692.2*			
	18174		***Total***		**14161.4**	**0.66**	***778.9***	

Proposed Volume must be greater than the Design Capture Volume

Notes:

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	PLSA	Date	2/5/2025
Designed by	M.F.	Case No	
Company Project Number/Name	3816 Rocas Grandes II		

BMP Identification

BMP NAME / ID: EcoStream #4.0

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}= 0.66 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)*
4	*10639*	*Concrete or Asphalt*	*1.00*	*0.89*	*9490*			
4	*2912*	*Natural (C Soil)*	*0.30*	*0.23*	*655.7*			
	13551		***Total***		**10145.7**	**0.66**	***558***	

Proposed Volume must be greater than the Design Capture Volume

Notes:

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern


Riverside County SWCT²
Stormwater & Water Conservation Tracking Tool
WQMP report is only available at zoom level 16 or greater.
MORENO VALLEY
Identified Features
Riverside County Flood Control …
Leaflet | Original Feature Class was created by the Riverside County Transportation Department (RCDT). State of California

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

Storm Water Operations & Maintenance Plan
for
Rocas Grandes Apartments II

Southeast of Alessandro Blvd & Darwin Dr
Moreno Valley, CA

PREPARED FOR:
SEC Alesandro Darwin, LLC
320 South Cedros Ave., Suite 400
Solana Beach, CA 92075

PREPARED BY:

34270 Pacific Coast Highway, Suite B
Dana Point, CA 92629
(949) 661.6695 plsaengineering.com

DATE:
February 2025

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3.0 Summary of Drainage Management Areas and Stormwater BMP's
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4.4 Record Keeping
4.5 Inspection and Maintenance Frequency Matrix

Appendix A – Training, Inspection and Maintenance Logs
Appendix B - Storm Water Mitigation Site Plan
Appendix C - Source Control BMP Information Sheets
Appendix D - Treatment Control BMP Manual

1.0 Responsible Party

This Operation and Maintenance (O&M) Plan addresses the requirements for the implementation of long-term operation and maintenance associated with the proposed permanent storm water BMPs constructed for the Rocas Grandes Apartments project.

The responsible party for the long-term Operation and Maintenance of the onsite BMPs is the Homeowners Association of Rocas Grandes Apartments II (HOA)

2.0 Project Description

The Rocas Grandes Apartments II project is located northeast of the intersection of Darwin Drive and Lasselle St in the City of Moreno Valley. The site is 17.55 acres.
The site is APN 486-280-002 and -004.

The project consists of 460 apartment and townhome units in 19 buildings. The subdivision will include apartment and townhome buildings, leasing office and clubhouse/pool building private access streets and parking lots, open space, associated utilities, hardscape, and landscape, and StormGarden biofiltration basins designed to provide pollutant control for the project's onsite storm water runoff to satisfy local requirements. It is the intent of the developer that at subdivision buildout, the storm water StormGarden biofiltration basins will be constructed and will be maintained by the HOA.

The project area consists of hydrologic soil group B and C. The project will not have slopes steeper than 2:1. All slopes will include slope protection for construction and post- construction.

3.0 Summary of Drainage Management Areas and Stormwater BMP's

Refer to Appendix B for the Storm Water Mitigation Site Plan.

4.0 General Operation and Maintenance Activities

4.1 Employee Training Program

The BMP maintenance is the responsibility of the HOA. The HOA will be responsible to train personnel in the practices of maintenance and record keeping of the permanent BMPs. All applicable employees will be trained in a timely fashion, and at a minimum will be trained within six months of hiring. Training shall include but not be limited to training for the inspection of all source control and treatment control BMP's.

4.2 Inspection Program

At a minimum, the BMPs shall be inspected annually or following significant rain events. Inspections shall be conducted by trained staff. An inspection form shall be completed with each inspection.

4.3 Maintenance Program

The cost and expense of maintaining the storm water permanent BMPs shall be the responsibility of the HOA. A Maintenance Log will be filled out and kept for each maintenance service.

4.4 Record Keeping

The HOA will be the source for record keeping. Training, Inspection and Maintenance Logs shall be kept for a minimum of five years.

4.5 O&M INSPECTION AND MAINTENANCE FREQUENCY MATRIX

BEST MANAGEMENT PRACTICES (BMPs)	INSPECTION FREQUENCY	MAINTENANCE REPAIR PROGRAM
Source Control BMPs		
1. Education for Property owner, tenants and occupants, Maintenance staffs, contracted maintenance crews.	Training and education program must be provided within 6 months of hire date and Materials are included in the Project WQMP.	Educational materials and training will be provided to Property owner, tenants and occupants, Maintenance staff members, and contracted maintenance crews if any, including education materials and restrictions to reduce pollutants from reaching the storm drain system.
2. Activity Restriction	Daily activity of Operation	The project will establish the following policies prohibiting activities during operations: - Prohibit discharge of fertilizer, pesticide, or animal waste to street or storm drain. - Prohibit blowing or sweeping of debris (leaf litter, grass clippings, litter, etc.) into street or storm drain. - Require dumpster lid to be closed at all times. - Prohibit discharge of paint or masonry waste to street or storm drain. - Prohibit vehicle washing, maintenance or repair on premises.
3. Common Area Landscape Management	Quarterly, as seasonal changes.	The HOA management shall direct maintenance staff to employ landscaping practices be consistent with the County of Riverside requirements for use of fertilizer, pesticides, and County ordinances for water conservation

4. Drainage Facility Inspection and Maintenance	Inspect semiannually for beginning (October) and end of the wet season (April).	HOA Maintenance personnel shall remove debris/sediments if necessary, within the inlet area.
5. MS4 Stenciling and Signage	As needed to clearly depict signage.	Replace or repaint as needed.
6. Protect Slopes and Channels	Inspect semiannually and before and after storm events.	Repair BMP and slopes as needed.
Treatment Control BMPs		
7. EcoStream Biofiltration Device	Inspect annually	See Appendix D
8. RTank Detention Vault	Inspect annually	See Appendix D
9. Trash Guard Plus	Inspect annually	See Appendix D
10. FocalPoint	Inspect annually	See Appendix D

For Training and Inspection Logs see Appendix A
For EcoStream biofiltration specific inspection and maintenance logs see Appendix D
For additional detail on source control BMP's see appendix C
For additional detail on treatment control BMP's see appendix D

Appendix A – Training, Inspection and Maintenance Logs

Trained Personnel Log

Name of Person Attending Training	Date of Training	Title of Training	Location of Training	Signature of Person Attending Training

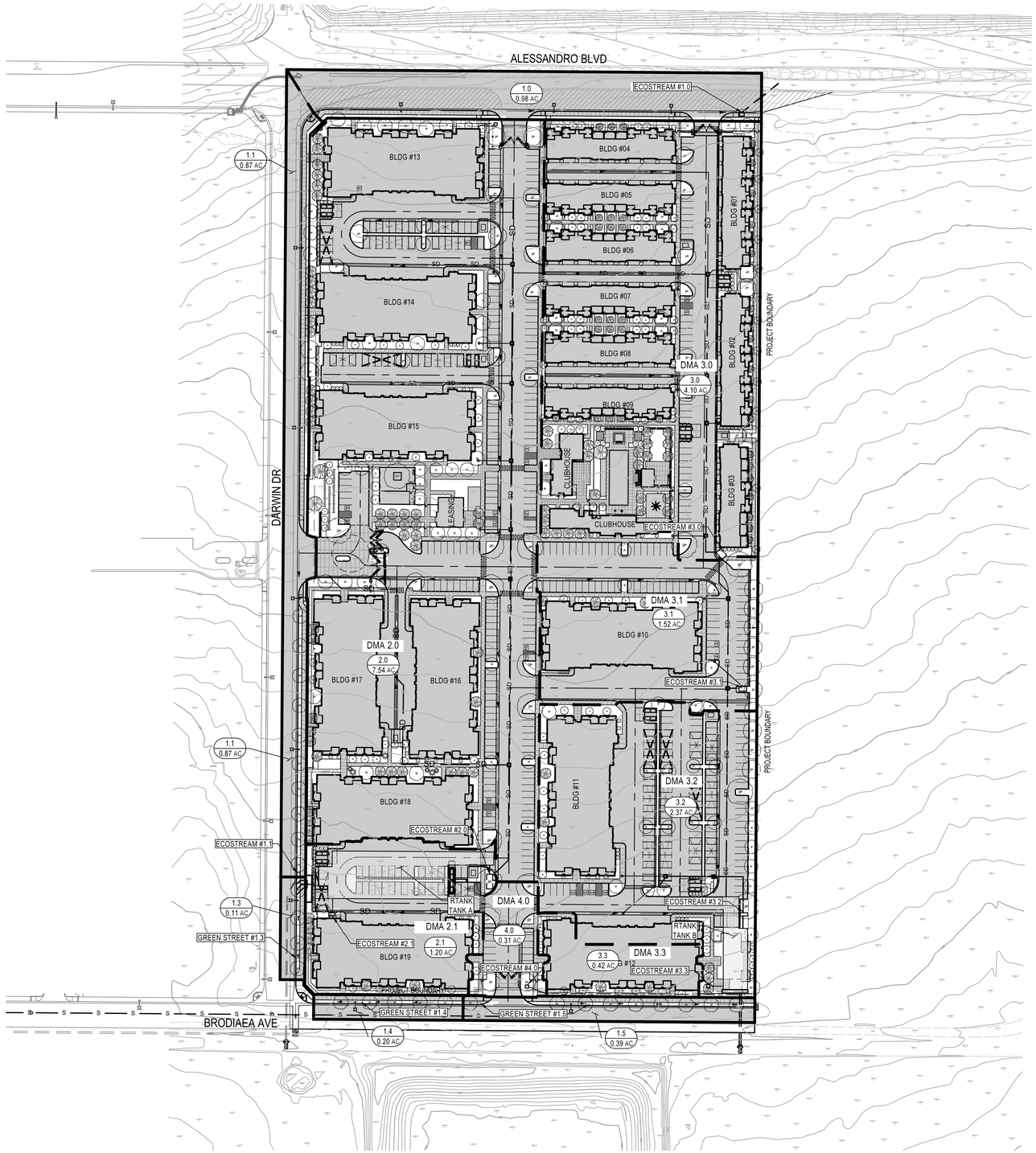
BMP Inspection Log

Name of Person Inspecting	Date of Inspection	BMP Inspected	Condition of BMP	Signature of Person Inspecting

BMP Inspection Log

Name of Person Doing Maintenance	Date of Maint.	BMP Maintained	Type of Maintenance Performed	Signature of Person Doing Maintenance

Appendix B – Storm Water Mitigation Site Plan



DMA TABLE

DMA #	IMPERVIOUS (SF) [ROOF/PAVING]	PERVIOUS (SF) [LANDSCAPING]	TOTAL AREA (SF)	(AC)
DMA 2.0	275,107	53,360	328,737	7.54
DMA 2.1	43,970	8,399	52,369	1.20
DMA 3.0	143,680	34,932	178,612	4.10
DMA 3.1	59,671	6,558	66,229	1.52
DMA 3.2	83,331	19,978	103,309	2.37
DMA 3.3	15,100	3,074	18,174	0.42
DMA 4.0	10,639	2,912	13,551	0.31
DMA 1.0	39,627	3,210	42,837	0.98
DMA 1.1	32,713	5,391	38,104	0.87
SELF-TREATING DMA 1.3	4,048	663	4,711	0.11
SELF-TREATING DMA 1.4	5,822	3,256	9,078	0.20
SELF-TREATING DMA 1.5	11,531	5,433	16,964	0.39

BMP TABLE

DMA #	BMP TYPE AREA (SF)	REQ. CFS	DESIGN CFS	DESIGN (FT)
DMA 2.0	ECOSTREAM	0.642	0.662	6x12
DMA 2.1	ECOSTREAM	1.185	1.20	8x20
DMA 3.0	ECOSTREAM	0.625	0.668	8x12
DMA 3.1	ECOSTREAM	0.251	0.251	6x6
DMA 3.2	ECOSTREAM	0.362	0.418	6x10
DMA 3.3	ECOSTREAM	0.065	0.111	4x4
DMA 4.0	ECOSTREAM	0.065	0.111	4x4
DMA 1.0	ECOSTREAM	0.166	0.167	4x6
DMA 1.1	ECOSTREAM	0.136	0.167	4x6
DMA 1.3	GREEN STREET			
DMA 1.4	GREEN STREET			
DMA 1.5	GREEN STREET			

SOURCE CONTROLS BMPS

1. STORM DRAIN STENCILING AND SIGNAGE
2. REDUCE PESTICIDE USE WITH NATIVE PLANTING
3. POOL TO BE PLUMBED TO THE SANITARY SEWER
4. COVERED TRASH ENCLOSURES
5. MISCELLANEOUS DRAIN OR WASH WATER WILL NOT INCREASE RUNOFF AND NOT DISCHARGE TO THE STORM DRAIN SYSTEM.
6. STREET AND SIDEWALK SWEEPING

LEGEND

MAJOR BASIN BOUNDARY	
MINOR BASIN BOUNDARY	
IMPERVIOUS AREA	14.54 AC (632,498 SF)
PERVIOUS AREA	2.97 AC (129,483 SF)
TOTAL AREA	17.49 AC (761,981 SF)

ROCAS GRANDES II WQMP EXHIBIT

PROJECT ADDRESS: APN 486-280-002 & -004
SCALE: 1" = 80'
DATE: 02-05-25
SHEET 1 OF 1

PLSA
PLSAENGINEERING.COM

SAVE DATE: ---- - PLOT DATE: 02/18/25 - FILE NAME: J:\ACTIVE JOBS\3816 ROCAS GRANDE II\CIVIL\REPORTS\WQMP\Appendix 01 Maps and Site Plans\3816_WQMP Exhibit.dwg

Appendix C – Source Control BMP's Information Sheets

Building & Grounds Maintenance SC-41

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

General Pollution Prevention Protocols

- ☐ Switch to non-toxic chemicals for maintenance to the maximum extent possible.
- ☐ Choose cleaning agents that can be recycled.
- ☐ Encourage proper lawn management and landscaping, including use of native vegetation.
- ☐ Encourage use of Integrated Pest Management techniques for pest control.
- ☐ Encourage proper onsite recycling of yard trimmings.
- ☐ Recycle residual paints, solvents, lumber, and other material as much as possible.

Objectives
■ *Cover*
■ *Contain*
■ *Educate*
■ *Reduce/Minimize*
■ *Product Substitution*

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

Minimum BMPs Covered	
Good Housekeeping	✓
Preventative Maintenance	
Spill and Leak Prevention and Response	✓
Material Handling & Waste Management	✓
Erosion and Sediment Controls	
Employee Training Program	✓
Quality Assurance Record Keeping	✓

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CALIFORNIA STORMWATER QUALITY ASSOCIATION®

- Clean work areas at the end of each work shift using dry cleaning methods such as sweeping and vacuuming.



Good Housekeeping

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.

- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.

- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

Landscaping Activities

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Use mulch or other erosion control measures on exposed soils. See also SC-40, Contaminated and Erodible Areas, for more information.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.

- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.

- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.

- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.

- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and

solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.
- Use hand weeding where practical.

Fertilizer and Pesticide Management

- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.
- Apply pesticides only when wind speeds are low.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.

Inspection

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

Building & Grounds Maintenance SC-41



Spill Response and Prevention Procedures

- ☐ Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- ☐ Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- ☐ Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- ☐ Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- ☐ Clean up spills immediately.



Material Handling and Waste Management

- ☐ Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- ☐ Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.
- ☐ Dispose of empty pesticide containers according to the instructions on the container label.
- ☐ Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- ☐ Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.



Employee Training Program

- ☐ Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- ☐ Train employees and contractors in proper techniques for spill containment and cleanup.
- ☐ Be sure the frequency of training takes into account the complexity of the operations and the needs of individual staff.



Quality Assurance and Record Keeping

- ☐ Keep accurate logs that document maintenance activities performed and minimum BMP measures implemented.
- ☐ Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and how the waste was disposed.
- ☐ Establish procedures to complete logs and file them in the central office.

Potential Capital Facility Costs and Operation & Maintenance Requirements

Facilities

- Additional capital costs are not anticipated for building and grounds maintenance. Implementation of the minimum BMPs described above should be conducted as part of regular site operations.

Maintenance

- Maintenance activities for the BMPs described above will be minimal, and no additional cost is anticipated.

Supplemental Information

Fire Sprinkler Line Flushing

Site fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

City of Seattle, Seattle Public Utilities Department of Planning and Development, 2009. *Stormwater Manual Vol. 1 Source Control Technical Requirements Manual*.

Kennedy/Jenks Consultants, 2007. *The Truckee Meadows Industrial and Commercial Storm Water Best Management Practices Handbook*. Available online at: http://www.cityofsparks.us/sites/default/files/assets/documents/env-control/construction/TM-I-C_BMP_Handbook_2-07-final.pdf.

Orange County Stormwater Program, Best Management Practices for Industrial/Commercial Business Activities. Available online at: http://ocwatersheds.com/documents/bmp/industrialcommercialbusinessesactivities.

Sacramento Stormwater Management Program. *Best Management Practices for Industrial Storm Water Pollution Control*. Available online at:

http://www.msa.saccounty.net/sactostormwater/documents/guides/industrial-BMP-manual.pdf.

US EPA, 1997. *Best Management Practices Handbook for Hazardous Waste Containers*. Available online at: http://www.epa.gov/region6/6en/h/handbk4.pdf.

Ventura Countywide Stormwater Management Program Clean Business Fact Sheets. Available online at: http://www.vcstormwater.org/documents/programs_business/building.pdf.

Drainage System Maintenance SC-44



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Description

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

Targeted Constituents

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

Approach

Pollution Prevention

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

Suggested Protocols

Catch Basins/Inlet Structures

- Staff should regularly inspect facilities to ensure compliance with the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

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- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

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

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

Illicit Connections and Discharges

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
  - Is there evidence of spills such as paints, discoloring, etc?

- Are there any odors associated with the drainage system?
- Record locations of apparent illegal discharges/illicit connections?
- Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
- Eliminate the discharge once the origin of flow is established.

- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Inspect and clean up hot spots and other storm drainage areas regularly where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Training

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

- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).

- Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Spill Response and Prevention

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

Other Considerations (Limitations and Regulations)

- Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and prohibition against disposal of flushed effluent to sanitary sewer in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.
- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:

  - Purchase and installation of signs.

  - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.

  - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.

  - Purchase of landfill space to dispose of illegally-dumped items and material.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Maintenance

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

Supplemental Information

Further Detail of the BMP

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to recollect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75% for organics and 55-65% for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm sewer flushing.

References and Resources

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

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

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

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

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

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

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

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line:
http://www.epa.gov/npdes/menuofbmps/poll_16.htm

Efficient Irrigation SD-12



Design Objectives

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

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

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- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

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

Storm Drain Signage SD-13



Design Objectives

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

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING

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– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

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

Trash Storage Areas SD-32

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Design Objectives

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

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

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- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

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

Appendix D – Treatment Control BMP Manual

EcoStream™ BioFilter

EcoStream BioFilter is designed to capture and retain a variety of pollutants including sediment, nutrients, heavy metals, and hydrocarbons while helping to meet green infrastructure objectives. This high flow, low impact system incorporates the processes of sedimentation, filtration, adsorption, and biological.



Features

- High filter media area and flow rate
- Low elevation change between inlet and outlet
- Superior pollutant removal rates
- Living plant component on the surface of the unit (optional)
- Internal bypass
- Optional external high flow bypass available in most configurations
- Multiple configurations to meet specific requirements
- Scalable systems allow for treatment rates starting at 66 GPM (NJDEP) and 50 GPM (WSDOE) within a single structure
- Curb inlet or piped inlet options
- Easy and cost effective to maintain

Benefits

- Compact footprint without sacrificing treatment capacity
- Can utilize regional plant life in the plant growth section
- Simple, efficient, cost-effective design
- No confined space entry required for inspection or maintenance
- Supports designs both with and without a plant growth section providing greater design flexibility for the engineer

State of Washington TAPE GULD Basic Enhanced/Metals Phosphorus

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NJCAT Corporation for Advanced Technology





ADS

EcoStream BioFilter Specification

Materials and Design

- Concrete Structures: Designed for H-20 traffic loading and applicable soil loads or as otherwise determined by a Licensed Professional Engineer. The materials and structural design of the devices conform to ASTM C857 and ASTM C858.
- Internal components include a proprietary media blend, recycled polyethlyene underdrain piping, crushed rock, and mulch.

Performance

- The EcoStream BioFilter can be designed as an online unit capable of treating the design storm event and can internally bypass peak storm events.
- NJDEP certified. EcoStream Biofilter can remove greater than 85% of TSS and 84% of Phosphorus.
- WSDOE GULD approved for basic, metals, and phosphorus treatment. EcoStream Biofilter can effectively remove 85% of TSS, 70% of TP, 39% of copper and 65% of zinc.

		NJCAT/NJDEP		WSDOE GULD
EcoStream Model	Media Bay Size (ft x ft)	Treatment Rate cfs (L/s)	Mass Capture Capacity lb (kg)	Treatment Rate cfs (L/s)
ES16	4 x 4	0.147 (4.2)	271 (123)	0.111 (3.1)
ES24	4 x 6	0.221 (6.3)	407 (185)	0.167 (4.7)
ES32	4 x 8	0.294 (8.3)	542 (246)	0.223 (6.3)
ES36	6 x 6	0.331 (9.4)	610 (277)	0.251 (7.1)
ES40	4 x 10	0.368 (10.4)	678 (308)	0.279 (7.9)
ES48	4 x 12 or 6 x 8	0.441 (12.5)	813 (369)	0.334 (9.4)
ES60	6 x 10	0.551 (15.6)	1016 (461)	0.418 (11.8)
ES72	6 x 12	0.662 (18.7)	1220 (553)	0.501 (14.1)
ES80	8 x 10	0.735 (20.8)	1355 (615)	0.557 (15.7)
ES96	8 x 12	0.882 (25.0)	1626 (738)	0.668 (18.9)
ES112	8 x 14	1.029 (29.1)	1897 (860)	0.780 (22.0)
ES128	8 x 16	1.176 (33.3)	2168 (983)	0.891 (25.2)

Installation

EcoStream should be activated after a site is stabilized to prevent uncontrolled stormwater runoff from the construction site from entering the system. Installation of the EcoStream BioFilter unit(s) shall be performed per manufacturer's installation instructions. Such instructions can be obtained by calling Advanced Drainage Systems at (800) 821-6710 or by logging on to www.adspipe.com.

adspipe.com
800-821-6710

ADS "Terms and Conditions of Sale" are available on the ADS website, www.ads-pipe.com
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EcoStream™ Biofiltration System Operation & Maintenance Guidance

Description

The EcoStream Biofiltration System (EcoStream) is an engineered stormwater biofiltration treatment system designed to capture and retain a variety of pollutants including sediments, phosphorus, heavy metals, and hydrocarbons from stormwater runoff. EcoStream incorporates the processes of sedimentation, filtration, infiltration, adsorption, and biological uptake to provide both water quality and quantity benefits in a small footprint. EcoStream should be activated after a site is stabilized to prevent uncontrolled stormwater runoff from the construction site from entering the system.

Configuration

The EcoStream system comes in many standard sizes and is available in several different deployment configurations. Excess flow spills over an overflow pipe and is directly discharged along with treated flow. The EcoStream system can be configured as a planter box filter with an open top that is suitable for shrubs and grasses, or as an underground filter with a subsurface inlet pipe. The optional external high flow bypass may be incorporated with any of these configurations.

Operations

Stormwater runoff enters the EcoStream via a pipe inlet or curb inlet and flows downward under gravity flow through mulch/media/gravel layers. The top layer provides pretreatment by retaining the coarse sediments, trash, and debris. The fine sediments and dissolved pollutants are further treated through the media bed in depth. Treated water enters an underdrain pipe or infiltrates into the ground (installations with open bottoms). A flow control orifice is placed downstream of the underdrain to ensure the distribution of flow in the media bed.

Inspections and Maintenance Overview

The EcoStream system requires periodic inspection and maintenance for it to operate at the design efficiency. The inspection process helps in deciding when and what level of maintenance will be needed to bring the unit up to or near peak efficiency. As with ADS' other water quality products, the maintenance cycle of the EcoStream system will be driven mostly by the actual solids and trash/debris load brought into the system.

The frequency of maintenance depends on the site-specific pollutant loading conditions. ADS recommends a visual inspection of the system quarterly for the first year of service, and after every high intensity and high-volume storm event occurring (1 in/hr and greater than 3 inches rainfall within 24 hours) during the first six months. After the first year, systems should be inspected at least bi-annually and ideally before the spring or rainy season and after the summer season, or prior to fall or winter seasons. The inspections should look for signs of but not limited to erosion, displacement, sediment, and trash accumulations in the upper portion of media bed or planting area. It is recommended that some general "good housekeeping" maintenance be performed at the beginning of the rainy or spring season every year. Depending on the site conditions, full system maintenance including removal of all media and plant life may be necessary if ponding water remains on top of media bed for 24 hours after any storm event.

For most maintenance needs, the EcoStream planting component follows the practices used for handling standard bioretention systems (i.e., general landscaping, cover management, and replacement planting of surface plants).

It may be advisable to “water” or irrigate the EcoStream plant area in geographical regions experiencing droughts or prolong periods without rainfall during the first year of service. Watering the plant life will help to ensure the plants can take hold and be established for future growth and treatment capabilities.

Inspection and General Maintenance Equipment

The following is a list of equipment recommended for inspection and general maintenance.

- Personal Protection Equipment (pants, steel-toed shoes, safety glasses, gloves, safety vest, hard hat, etc.)
- Manhole Hook or Crowbar
- Traffic Cones and Signage
- Stadia Rod and Tape Measure
- Inspection Operation and Maintenance (O&M) Log or other recording method (included at end of guide)
- Flashlight, Trash removal “Net” device, shovel, rake, broom and trash receptacle
- Vac Truck (if more extensive maintenance is required)
- Light Duty Construction Equipment (if bioretention media replacement is required

General Inspection and Maintenance Procedures

Routine inspection will ensure that the system is performing at optimal conditions and that the risk of public flooding is low. EcoStream inspection involves a visual inspection of the plant surface area, structure inlet, and the media bed. This can all be done at the surface and requires no confined space entry into the EcoStream unit. An Inspection O&M log should be used, dates and weather conditions should be noted.

If the EcoStream is located in a traffic area (i.e. roadway or automobile travel way), and inspection is not possible without entering the vehicular area, safety measures should be employed --safety cones setup, etc. --prior to performing the inspection and maintenance.

For inspection of the treatment chamber of the EcoStream system, the manhole cover should be safely removed (i.e., using a manhole hook). A visual inspection of any inlet grates should be noted. If grates are missing or inlets are damaged, contact ADS for recommendation of repair. A visual inspection of the general appearance of the EcoStream should be performed, and notes should be taken detailing the condition of the surface plant life, invasive species intrusion, vandalism, erosion in the planting area and any signs of standing water or disturbed or “shifted” surface soil bed area. This general system condition should be noted in the inspection/maintenance log.

If the plant life and surface media show signs of distress, general landscaping O&M should be performed, i.e., raking, weeding (removal of invasive plants), and general planting replacement to maximize the cover area in the planting bed/media treatment chamber. If ponding of water is present in the media treatment cell and the last rain event was greater than 24 hours prior, further inspection should be performed to ensure the effluent pipe is not blocked.

A visual inspection (with a flashlight if needed) will inspect the appearance of the inlet (pipe or curb) and media bed. Remove all trash and debris from the inlet and the top of the media bed manually or by vacuum truck as required. If there is a visible sediment load or the media bed appears to have been greatly disturbed during preceding storm events, redistribute or replace the top mulch layer as needed. If sediment load is heavy, remove the mulch layer and inspect the biofiltration media and replace the top two-inch media if it appears clogged. Additionally, a further inspection should be undertaken within 24 hours after a major storm event to see if there is standing water in the system. Water stagnation in the treatment chamber indicates that media bed replacement may be recommended. ADS Field Engineering can assist with this analysis.

ADS should be contacted for material specifications and replacement parts. Media chamber replacement will involve utilizing small construction excavation equipment.

Disposal of material from the treatment chamber should be in accordance with the local municipality’s requirements. Typically, traditional municipal landfills can be used for disposal of solids and trash obtained from servicing the EcoStream. Call ADS at 800-821-6710 for further information.

Records of Operation and Maintenance

The owner shall maintain annual records of the operation and maintenance of the EcoStream unit to document the effective maintenance of this important component of a site’s stormwater management program. The attached Inspection & Maintenance Log is suggested and should be retained for a minimum period of two years.

EcoStream BioFilter Inspection and O&M Log Sheet

Project Name: _____

Location: _____

Date	Inspection or O&M	Observation/Actions	Operator comments and general description	Inspector

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adspipe.com
800-821-6710

TRASH GUARD"PLUS" SPECIFICATION

INLET PROTECTION

Trash Guard "Plus"® Specification

1.0 This work shall consist of furnishing, installing, and maintaining the Trash Guard "Plus"® inlet filter.

2.0 Trash Guard "Plus"® is manufactured using 100% recycled HDPE material by Trash Guard" Plus"® Incorporated. Trash Guard Inc.P.O. Box 10 Roseboro, NC. 28382 .

3.0 Trash Guard "Plus"® is distributed exclusively by ACF Environmental, 2831 Cardwell Road, Richmond, VA. 23234. 800-448-3636.

4.0 Materials

Trash Guard "Plus"® is a catch basin filter device manufactured from 100% recycled HDPE.

5.0 Installation

Trash Guard shall be installed over the outlet pipe within the catch basin according the various installation applications provided in the Trash Guard "Plus"® Installation Guide.

Trash Guard "Plus"® shall be installed in such a manner that that the unit is securely fastened to the sidewall of the catch basin and completely covers the outlet pipe.

Trash Guard "Plus"® comes in 3 Standard Sizes:

23" unit for pipe diameters ≤ 15" (TGRD-23x24)

28" unit for pipe diameters ≤ 18" (TGRD 28x30)

34" unit for pipe diameters ≤ 24" (TGRD-34x36)

6.0 Maintenance

Trash Guard "Plus"® shall be inspected on a on a quarterly basis to determine when maintenance is necessary. If sediment and debris build up is covering over half of the unit, removal of debris is recommended. Some installations may require more inspections and maintenance according to loads.

R-TANK® OPERATION, INSPECTION AND MAINTENANCE

Operation

Your R-Tank System has been designed to function in conjunction with the engineered drainage system on your site, the existing municipal infrastructure, and/or the existing soils and geography of the receiving watershed. Unless your site included certain unique and rare features, the operation of your R-Tank System will be driven by naturally occurring systems and will function autonomously. However, upholding a proper schedule of Inspection & Maintenance is critical to ensuring continued functionality and optimum performance of the system.

Inspection

Both the R-Tank and all stormwater pre-treatment features incorporated into your site must be inspected regularly. Inspections should be done every six months for the first year of operation, and at least yearly thereafter. Inspections may be required more frequently for pre-treatment systems. You should refer to the manufacturer requirements for the proper inspection schedule.

With the right equipment most inspections and measurements can be accomplished from the surface without physically entering any confined spaces. If your inspection does require confined space entry, you must follow all local, regional, and OSHA requirements.

All maintenance features of your system can be accessed through a covering at the surface. With the lid removed, you can visually inspect each component to identify sediment, trash, and other contaminants within the structure. Check you construction plans to identify the maintenance features engineered into your R-Tank system, which may include:

Upstream Pipes, Inlets, and Manholes

- Working from the structures adjacent the R-Tank toward those farther away, check for debris and sediment in both the structures and the pipes. Be sure to Include all structures that contain pre- treatment systems. Some structures may include a sump.

Maintenance Ports

- Located near the inlet and outlet connections and throughout the system, check sediment depth at each port.

Inspection Ports

- Less common, inspection ports are primarily located within the Treatment Row of an R-Tank System. These should be used to check for sediment deposits but are typically too small to access for backflushing.

Treatment Row

- On installations in 2018 or later, inlet pipes may connect to a row of modules with 12” diameter access holes running horizontally through the module that can be jet vacuumed. Check these rows for accumulation of sediment and debris.

All observations and measurements should be recorded on an Inspection Log kept on file. We’ve included a form you can use at the end of this guide.

Maintenance

For modules taller than 40” the R-Tank System should be back-flushed once sediment accumulation has reached 6”. For modules less than 40” tall, perform maintenance when sediment depths are greater than 15% of the total system height.

If your system includes a Treatment Row with linear access through the modules from the inlet pipe, backflush this area when sediment depths reach 6”.

BEFORE ANY MAINTENANCE IS PERFORMED ON YOUR SYSTEM -
PLUG THE OUTLET PIPE TO PREVENT CONTAMINATION OF THE DOWNSTREAM SYSTEMS.

Begin by cleaning all upstream structures, pipes, and pre-treatment systems containing sediment and/or debris. If your system includes a Treatment Row, this portion of the system should be cleaned with traditional jet-vac equipment. Add a centralizer to the jet for easiest access through the modules.

To back-flush the R-Tank, water is pumped into the system through the Maintenance Ports as rapidly as possible. The turbulent action of the water moving through the R-Tank will suspend sediments which may then be pumped out. If your system includes an Outlet Structure, this will be the ideal location to pump contaminated water out of the system. However, removal of back-flush water may be accomplished through the Maintenance Ports, as well.

For systems with large footprints that would require extensive volumes of water to properly flush the system, you should consider performing your maintenance within 24 hours of a rain event. Stormwater entering the system will aid in the suspension of sediments and reduce the volume of water required to properly flush the system.

STEP BY STEP INSTRUCTIONS FOR INSPECTION AND MAINTENANCE CAN BE FOUND ON THE NEXT PAGE, WITH A MAINTENANCE LOG ON THE LAST PAGE.

INSPECTION

1. Upstream Structures
    a. Remove cover
    b. Use flashlight to detect sediment deposits If present, measure sediment depth
    c. Inspect pipes connecting to R-Tank
        i. If inlet pipes connect to Treatment Row, check sediment depth within these modules
        ii. If access for measurement inside the Treatment Row is difficult, sediment depth can be estimated based on the coverage of the round, 12” opening of the module
    d. Inspect pre-treatment systems (if present)
    e. Record results on Maintenance Log
    f. Replace cover
    g. Repeat for ALL Manholes upstream of R-Tank until no sedimentation is observed and all pre- treatment systems have been checked
2. Maintenance Ports
    a. Remove cap
    b. Use flashlight to detect sediment deposits
    c. If present, measure sediment depth with stadia rod
    d. Record results on maintenance log
    e. Replace cap
    f. Repeat for ALL Maintenance Ports
3. Inspection Port
    a. Remove cap
    b. Use flashlight to detect sediment deposits
    c. If present, measure sediment depth with stadia rod
    d. Record results on Maintenance Log
    e. Replace cap

MAINTENANCE

1. Plug system outlet to prevent discharge of back-flush water
2. Vacuum all upstream structures, inlet pipes, and stormwater pre-treatment systems
3. If a Treatment Row is present, vacuum this row of modules
4. Determine best location to pump out back-flush water. Typically, the outlet structure will work best, but sometimes the Maintenance Ports must be used.
5. Remove cap from Maintenance Port and pump water as rapidly as possible into system through port to suspend sediments, pumping dirty water out of the system from the outlet or nearby Maintenance Port
6. Repeat at all Maintenance Ports until sediment levels are reduced to a satisfactory level
7. Sediment-laden water shall be disposed of per local regulations
8. Replace any remaining caps or covers and remove outlet plug
9. Record the back-flushing event in your Maintenance Log with any relevant specifics

R-Tank® Maintenance Log

Site Name:		Company:	
Location:		Contact:	
City and State:		Phone:	
System Owner:		Email:	

Date	Location	Sediment Depth	Observations / Notes	Initials

FERGUSON
WATERWORKS

R-TANK® STORMWATER STORAGE SYSTEM





STORMWATER MANAGEMENT

IS YOUR STORMWATER SYSTEM TAKING UP TOO MUCH SPACE?

R-Tank can reduce your underground stormwater storage system footprint, avoiding nearby utility conflicts, freeing up space for future expansion and overcoming construction phase challenges.

DOES YOUR PROJECT REQUIRE A UNIQUE SOLUTION DUE TO DEPTH OR TRAFFIC LOADS?

R-Tank provides system height options from 2 inches to over 7 feet tall. It also accommodates HS-20 and HS-25 loading with cover depths as little as 6" and as deep as 16'.

R-Tank solves tough stormwater problems by adapting to the needs of your site–whether you are designing a project with shallow ground water or deep cover conditions.

R-TANK

BENEFITS

HIGH CAPACITY
- 95% void internal area (LD, HD, SD, UD)
- 90% void internal area (XD)

STRENGTH
- Supports traffic loading
- Module options for HS-20 and HS-25 rating with cover depths from 6" to 16'

DESIGN AND CONSTRUCTION VERSATILITY
- Modules can be combined into various shapes to use space efficiently and effectively
- Module heights vary from 2" to 7'

INCREASED INFILTRATION AND EXFILTRATION
- 90% open area on face of modules
- Increases groundwater recharge, reducing post-construction discharge volumes

EASY TO TRANSPORT
- Can be supplied preassembled or unassembled to reduce delivery costs

LIGHTWEIGHT AND QUICK TO INSTALL
- Installed by hand; no cranes required
- Reduces site access delays

RECYCLED CONTENT
- Manufactured with post industrial grade recycled polypropylene



PRODUCTS

R-TANK LD
- Light-duty module (30 psi)
- Ideal for applications in green space
- Not rated for vehicular traffic
- 12" minimum cover
- 36" maximum cover
- Four internal plates

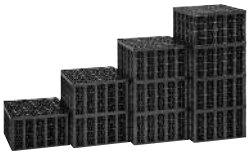
R-TANK HD
- Heavy-duty module (33.4 psi)
- 20" minimum cover
- 84" maximum cover
- Five internal plates
- Standard module for traffic applications



R-TANK SD
- Super-duty module (42.9 psi)
- Higher safety factors for shallow traffic applications and deeper cover
- 18" minimum cover
- 120" maximum cover



R-TANK UD
- Ultra-duty module (134.2 psi)
- Traffic loads with 12" of cover
- Available from 14" to 66" tall
- Ideal for high water table sites



R-TANK XD
- Extreme-duty module (320 psi)
- Traffic loads with 6" cover
- 16.5' maximum cover
- Available from 2" to 10' tall



DESIGN CONSIDERATIONS

Many factors will influence the design of the R-Tank system. While this list is not intended to be all-inclusive, the following design considerations are worth highlighting:

1. PRE-TREATMENT

Removing pollutants from runoff before they enter an underground detention system is the smart way to design and build a system. Trash Guard Plus® is a great tool for this. Be sure the system you select will remove heavy sediments, gross pollutants (trash) and biodegradable debris.

2. BACKFILL MATERIALS

Backfill materials should be angular stone (<1.5" in diameter) or soil (GW, GP SW or SP per the Unified Soil Classification System). Material must be free from lumps, debris and sharp objects that could cut the geotextile. See the R-Tank narrative specification for additional information.

3. RUNOFF REDUCTION

Most designs incorporate an outlet to drain the system at a controlled rate and/or an overflow to prevent flooding in extreme events. Any infiltration that can be achieved on the site should also be taken advantage of. Consider raising the invert of your outlet or creating a sump to capture and infiltrate the water quality volume whenever possible.

4. WATER TABLE

While installing R-Tank below the water table is manageable, a stable base must be created to support the system. Ground water can be allowed to enter and drain from the system, or a liner can be used to prevent ground water from entering the system if measures are taken to prevent the system from floating.

5. CONSTRUCTION LOADS

Construction loads are often the heaviest loads the system will experience. Care must be taken during backfilling and compaction, and post-installation construction traffic should be routed around the system.

6. LATERAL LOADS

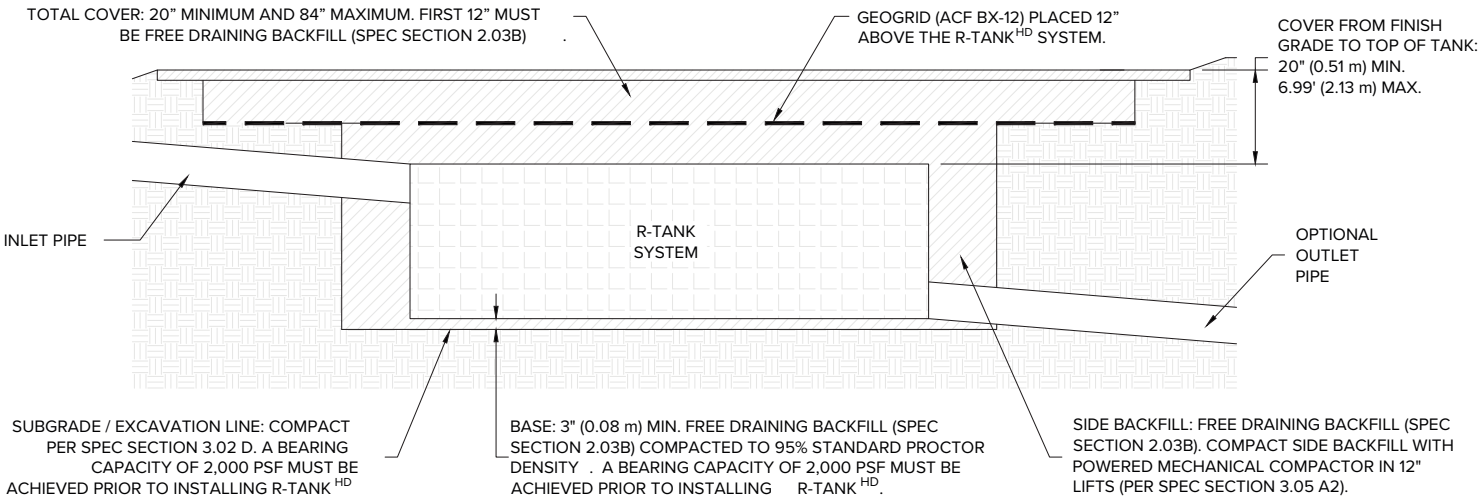
As systems get deeper, the loads acting on the sides of the tank increase. While vertical loads often control the design, lateral loads should also be considered.

7. R-TANK MODULES

Selecting the right module for your application is critical. See page 3 and the specs on the back of this brochure for details. Our team is also here to help!

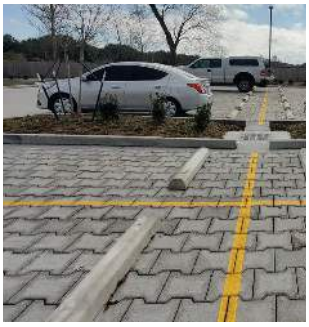
8. LOAD MODELING

A safety factor of >1.75 is required when designing an R-Tank System using the AASHTO LRFD Bridge Design Specifications. It is also necessary to run your own loading model with site specific requirements.



CREATIVE GREEN STORMWATER INFRASTRUCTURE APPLICATIONS





R-TANK UNDER PERMEABLE AND POROUS SURFACES

For projects with shallow depth restrictions and high ground water table elevations, R-Tank can be strategically deployed beneath permeable and porous surfaces. The high void space of the modules allows designers to maximize the volume stored at shallow depths and converts the permeable/porous surface into an “inlet” to the storage below. Ferguson offers a selection of “alternative surfaces” that can be paired with the R-Tank.





R-TANK IN LINEAR GREEN STREETSCAPES

Based on its space efficiency and modular versatility, the R-Tank is a popular option for storage of stormwater in urban linear street applications. Beyond the void efficiency, the system layout can be easily adjusted to work around unexpected utility conflicts and other site features. Green Infrastructure programs in Philadelphia, Pittsburgh, New York City, and Salt Lake City are just a few examples of where R-Tank has been adopted in this application.





UNDER BIORETENTION FOR ENHANCED STORAGE

In many green stormwater practices, R-Tank can offer an “enhanced” storage zone providing 95% void space vs. the typical 40% void space of stone. Throughout the country, engineers have utilized this approach to maximize capacity and reduce the depth of excavation of the storage layer in rain gardens, bioretention and curbline vegetated stormwater practices.





COMBINED WITH INNOVATIVE MEDIA

Ferguson offers a series of innovative stormwater filtration media to provide water quality treatment. The R-Tank can be used in these systems as a space-efficient high-performance underdrain with the option to expand over larger footprints for infiltration or detention. R-Tank can also be used to house media in certain applications and systems.



INNOVATIVE APPLICATIONS (FLOOD MITIGATION, RE-USE, ETC.)

The R-Tank is a popular choice under playgrounds and sports fields. The high void space and the ability to work around light pole bases, equipment footings and foundations allows municipalities to maximize storage when developing or redeveloping these community gems. The system can also be lined and combined with pump equipment for irrigation and other re-use applications.

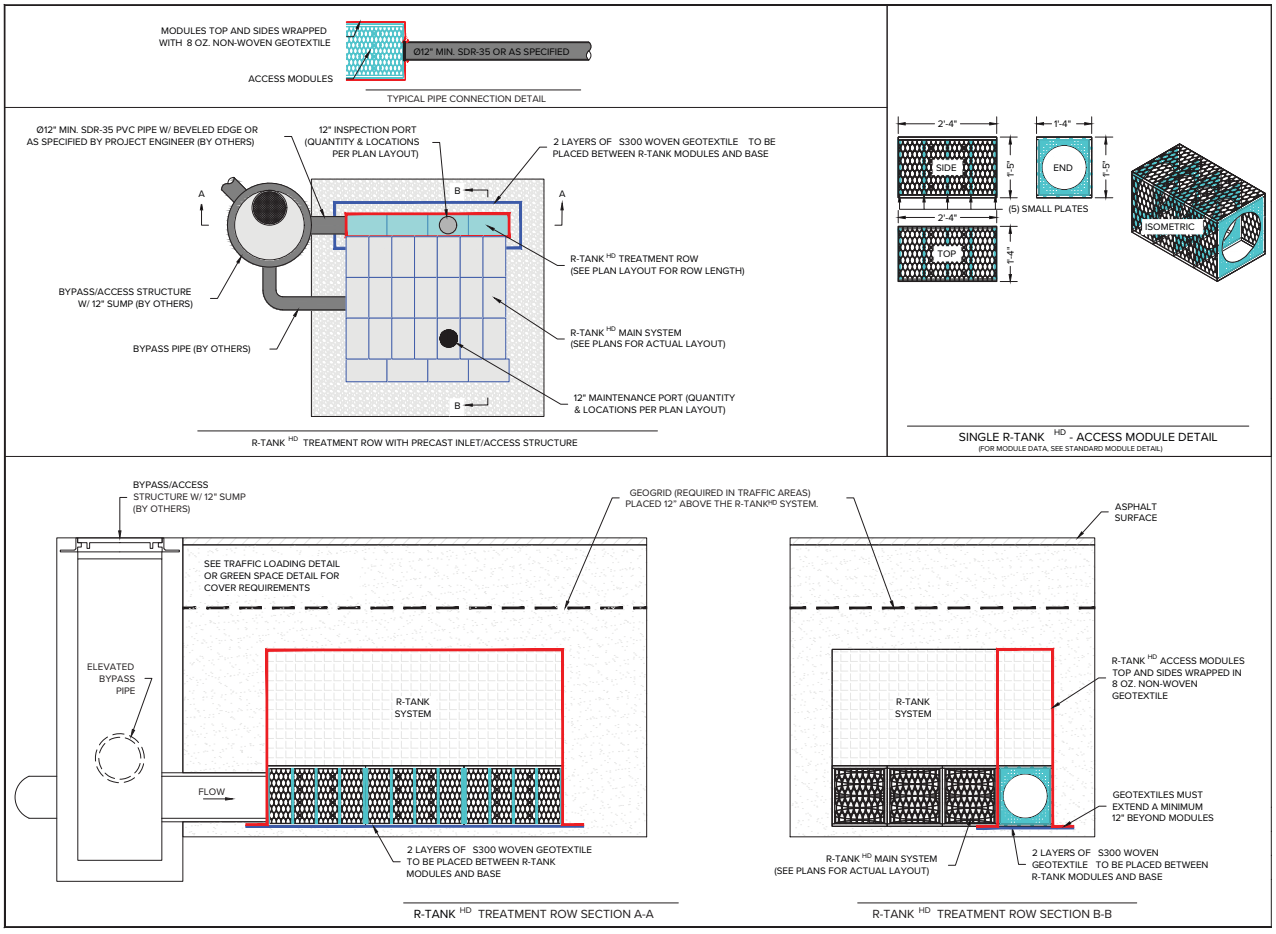
MAINTENANCE

DESIGNING AN R-TANK SYSTEM WITH LONGEVITY & MAINTENANCE IN MIND IS A THREE-STEP PROCESS:

1. PRE-TREAT
Keep debris out of the system using decentralized filters and screens. Ferguson offers a complete range of options from perforated screen devices to high flow geotextile bag and cartridge based filter drain inserts.

2. ISOLATE
Trap solid pollutants inside the treatment row (see treatment row drawing below) where they can be easily removed using the acess modules (available in LD, HD, and UD only). These modules are wrapped in geotextile to retain solids and are fully accessible by conventional jet-vac systems to remove captured pollutants.

3. PROTECT
Ensure a long system life by including maintenance ports to remove any pollutants that evade the pre-treatment system and treatment row. Maintenance ports should be specified within 10' of inlet and outlet connections, and roughly 50' on center.



PRE-TREATMENT DEVICES

From simple trash and debris screens to filters for targeted pollutants, Ferguson offers a complete selection of decentralized pre-treatment devices.


TRASHGUARD PLUS


FABCO STORMBASIN

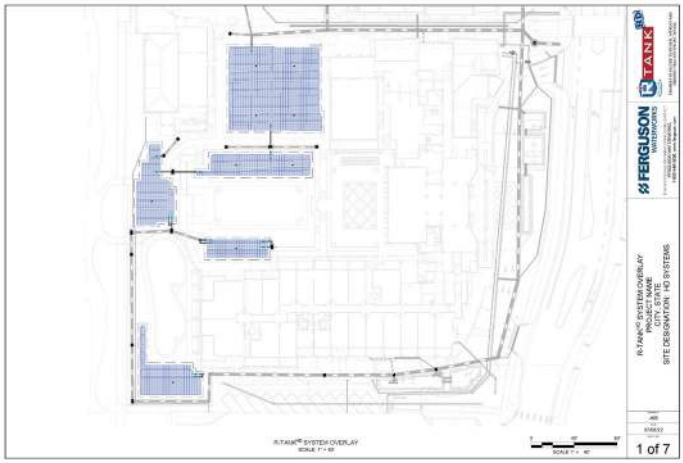

FABCO STORMRING


FABCO STORMSACK

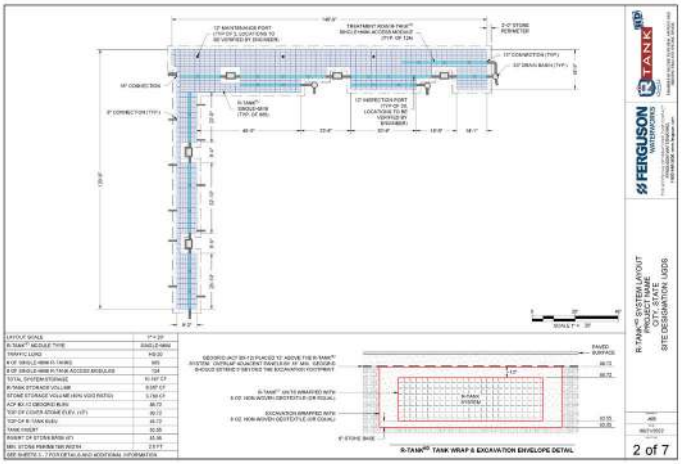


SUPPORT SERVICES AND TANK SELECTION

Our regional engineers and designers are well versed in local regulations, innovative urban green street applications and can help develop site-specific solutions using one or a combination of our products. Our team produces high-quality custom layouts and details to support your permitting and construction efforts. From AutoCAD to HydroCAD, we have a variety of design tools to help you move through the permitting process efficiently.



SAMPLE R-TANK SYSTEM OVERLAY



SAMPLE R-TANK SYSTEM LAYOUT



R-TANK SD INSTALLATION



R-TANK WITHIN BUILDING FOOTPRINT

SELECTING THE RIGHT R-Tank MODULE

Cover Depth (inches)*	LD	HD	SD	UD	XD
Min. 6"	Green Space - No Traffic	Green Space - No Traffic	Green Space - No Traffic	Green Space - No Traffic	HS-20
12"	Green Space - No Traffic	Green Space - No Traffic	Green Space - No Traffic	HS-20**	HS-20
14"	Green Space - No Traffic	Green Space - No Traffic	Green Space - No Traffic	HS-20	HS-20
18"	Green Space - No Traffic	Green Space - No Traffic	HS-20	HS-20	HS-20
20"	Green Space - No Traffic	HS-20	HS-20	HS-20	HS-20
24"	Green Space - No Traffic	HS-20	HS-20	HS-20	HS-20
36"	Green Space - No Traffic	HS-20	HS-20	HS-20	HS-20
48"		HS-20	HS-20	HS-20	HS-20
60"		HS-20	HS-20	HS-20	HS-20
72"		HS-20	HS-20		HS-20
84"			HS-20		HS-20
120"			HS-20		HS-20
160"					HS-20
Max. 200"					HS-20

HS-20 designation based on AASHTO LRFD Bridge Design Specification for single lane traffic.
*Cover depth is measured from top of module to finished grade or top of pavement.
**The UD module requires STONE backfill (not soil) on sides at this depth.

R-TANK SPECIFICATIONS

DIMENSIONS & CAPACITY

Module (Segments)	Width (in)	Length (in)	Height (in/ft)	Volume (cf)	Capacity (cf)	Weight* (lbs)
Mini	15.75	28.15	9.45"/0.79'	2.42	2.30	10.1/10.9
Single (1)	15.75	28.15	17.32"/1.44'	4.44	4.22	15.7/17.3
Single + Mini (1.5)	15.75	28.15	25.98"/2.17'	6.67	6.33	23.6/25.9
Double (2)	15.75	28.15	33.86"/2.82'	8.69	8.25	29.1/32.3
Double + Mini (2.5)	15.75	28.15	42.52"/3.54'	10.91	10.36	37.0/41.0
Triple (3)	15.75	28.15	50.39"/4.20'	12.93	12.28	42.5/47.4
Triple + Mini (3.5)	15.75	28.15	59.06"/4.92'	15.15	14.39	50.4/56.0
Quad (4)	15.75	28.15	66.93"/5.58'	17.17	16.31	55.9/62.4
Quad + Mini (4.5)	15.75	28.15	75.59"/6.30'	19.39	18.42	63.8/71.0
Pent (5)	15.75	28.15	83.46"/6.96'	21.41	20.34	69.3/77.4

*Weights shown are for LD/HD modules.

DIMENSIONS & CAPACITY

Module (Segments)	Width (in)	Length (in)	Height (in/ft)	Volume (cf)	Capacity (cf)	Weight (lbs)
Single (1)	15.75	28.15	9.45"/0.79'	2.42	2.30	10.95
Double (2)	15.75	28.15	18.12"/1.51'	4.64	4.41	19.58
Triple (3)	15.75	28.15	26.79"/2.23'	6.86	6.52	28.21
Quad (4)	15.75	28.15	35.46"/2.96'	9.08	8.63	36.84
Pent (5)	15.75	28.15	44.13"/3.68'	11.30	10.74	45.47
Hex (6)	15.75	28.15	52.80"/4.40'	13.52	12.84	54.10
Septa (7)	15.75	28.15	61.47"/5.12'	15.74	14.95	62.73
Octo (8)	15.75	28.15	70.14"/5.85'	17.96	17.06	71.36
Nono (9)	15.75	28.15	78.81"/6.57'	20.18	19.17	79.99
Decka (10)	15.75	28.15	87.48"/7.29'	22.40	21.28	88.62

DIMENSIONS & CAPACITY

Module (Segments)	Width (in)	Length (in)	Height (in/ft)	Volume (cf)	Capacity (cf)	Weight (lbs)
Single (1)	23.62	23.62	14.17"/1.18'	4.57	4.35	21.2
Double (2)	23.62	23.62	27.17"/2.26'	8.77	8.33	39.0
Triple (3)	23.62	23.62	40.16"/3.35'	12.97	12.32	56.8
Quad (4)	23.62	23.62	53.15"/4.43'	17.16	16.30	74.6
Pent (5)	23.62	23.62	66.14"/5.5'	21.35	20.29	92.4

DIMENSIONS & CAPACITY

Module (Segments)	Width (in)	Length (in)	Height (in)	Volume (cf)	Capacity (cf)	Weight (lbs)
Single (1)	19.68	23.62	1.97	0.53	0.48	4
Double (2)	19.68	23.62	3.94	1.06	0.95	8
Triple (3)	19.68	23.62	5.91	1.59	1.43	12
Quad (4)	19.68	23.62	7.87	2.12	1.91	16
Pent (5)	19.68	23.62	9.84	2.65	2.38	20

Note: XD modules may be stacked up to 10' tall (60 layers).

SPECIFICATIONS

Item	Description	LD	HD	SD	UD	XD
		Value	**Value**	**Value**	**Value**	**Value**
Void Area	Volume available for water storage	95%	95%	95%	95%	90%
Surface Area Void	% of exterior available for infiltration	90%	90%	90%	90%	90%
Compressive Strength	ASTM D 2412/ASTM F 2318	30.0 psi	33.4 psi	42.9 psi	134.2 psi	320 psi
Unit Weight	Weight of plastic per cubic foot of tank	3.29 lbs/cf	3.62 lbs/cf	3.96 lbs/cf	4.33 lbs/cf	7.55 lbs/cf
Rib Thickness	Thickness of load-bearing members	0.18"	0.18"	0.18"	-	-
Service Temperature	Safe temperature range for use	-14–167° F	-14–167° F	-14–167° F	-14–167° F	-14–167° F
Recycled Content	Use of recycled polypropylene	100%	100%	100%	100%	100%
Minimum Cover	Cover required for HS-20 loading	Not traffic rated	20"	18"	12"–14"	6"
	Cover required for HS-25 loading	Not traffic rated	24"	18"	15"–17"	6"
Maximum Cover	Maximum allowable cover depth	36"	6.99'	9.99'	5.0'	16.7'

Contact your local sales associate:

Call **866-684-9177** or visit **FERGUSONGSS.COM** to get started.

FERGUSON WATERWORKS

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Appendix 10: Educational Materials

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

See Appendix 9 for Educational Materials