Appendix K Preliminary Water Quality Management Plan

Appendices

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PRELIMINARY WATER QUALITY MANAGEMENT PLAN

"NOHL RANCH CONDOMINIUMS"
VESTING TENTATIVE TRACT MAP NO. 18104
PERMIT NO. DEV2017-00039; OTH2017-00981

Project Address:
6509 Serrano Avenue
Anaheim, CA 92807

Prepared for:
6509 SERRANO L.P.
4040 MacArthur Boulevard, Suite 300
Newport Beach, CA 92660
(714) 658-6299

2nd Amendment
APPROVED
OCT 3 1 2018
PUBLIC WORKS DEPARTMENT
SUBDIVISION SERVICES SECTION
By: Keith Linker

Prepared by:
Hunsaker & Associates Irvine, Inc.
3 Hughes
Irvine, CA 92618
(949) 583-1010

WQMP Preparation Date:
October 1, 2018

W O. 4198-1

PRELIMINARY WATER QUALITY MANAGEMENT PLAN

"NOHL RANCH CONDOMINIUMS"

City of Anaheim, CA

Ted Frattone

From: Ed Mandich
Sent: Wednesday, October 31, 2018 4:52 PM
To: Ted Frattone; Robert Glessner; Dien Vu; Tommy Hsu; Martin Parker
Subject: FW: Conditional Approval of Second Amendment of Prelim WQMP for Nohl Ranch Condo, 6509 Serrano (OTH2017-00981)
Attachments: SKM_C65818103116230.pdf

fyi

From: Keith Linker [mailto:Klinker@anaheim.net]
Sent: Wednesday, October 31, 2018 4:50 PM
To: Ed Mandich <EMandich@hunsaker.com>
Cc: Edgar Garcia <EGarcia2@anaheim.net>
Subject: Conditional Approval of Second Amendment of Prelim WQMP for Nohl Ranch Condo, 6509 Serrano (OTH2017-00981)

Hi Ed,

Please consider this email your conditional approval of the recently submitted Revised Prelim WQMP. Attached is the approved cover sheet. Please ensure that the approved cover sheet is included in the document assuming it will become part of the EIR (an attachment or exhibit presumably).

Also, the condition below regarding determining feasibility of infiltration is no longer applicable since the supporting documentation is considered adequate for this purpose.

Thank you again for your efforts!
Keith Linker, PE, CPSWQ, QSD
Principal Civil Engineer
Public Works Department | Development Services
(714) 765-4141

From: Keith Linker
Sent: Friday, August 25, 2017 3:19 PM
To: Ed Mandich (emandich@hunsaker.com) <emandich@hunsaker.com>
Subject: Prelim WQMP for Nohl Ranch Condo, 6509 Serrano (OTH2017-00981

Hi Ed,

Thank you for your submittal of the Prelim WQMP. The Preliminary WQMP is conditionally approved as submitted with the following comments being applicable to the Final WQMP. Additionally, please be aware that the review of the Preliminary WQMP was focused on the Pretreatment and LID components. Therefore, additional comments should be anticipated at the Final WQMP both on these items (since sizing was not specifically reviewed in detail) and the rest of the document.

- This project has impacts to the Right of Way and results in some removed and replaced and added impervious surface. If this area is more significant than just the apron area in the right of way (which it appears to be in the exhibit) then a Right of Way BMP will be required to be installed in the Right of Way to treat the commensurate flow from the footprint not captured onsite.
- Please provide a letter from a Geotechnical Engineer that indicates that in their professional opinion, one of the open bullets below applies to this case.

- Would Infiltration BMPs **pose significant risk of increasing risk of geotechnical hazards that cannot be mitigated to an acceptable level**? (Yes if the answer to any of the following questions is yes, as established by a geotechnical expert):\
    - The BMP can only be located less than 50 feet away from slopes steeper than 15 percent
    - The BMP can only be located less than eight feet from building foundations or an alternative setback.
    - A study prepared by a geotechnical professional or an available watershed study substantiates that stormwater infiltration would potentially result in significantly increased risks of geotechnical hazards that cannot be mitigated to an acceptable level.

Thank you,

Keith Linker, PE, CPSWQ, QSD
Principal Civil Engineer
City of Anaheim
Public Works Department | Development Services
200 South Anaheim Boulevard | Suite 276
Anaheim, CA 92805
(714) 765-4141
klinker@anaheim.net

ANAHEIM
PUBLIC WORKS

PRELIMINARY
WATER QUALITY
MANAGEMENT PLAN
(WQMP)

"NOHL RANCH CONDOMINIUMS"
VESTING TENTATIVE TRACT MAP NO. 18104
PERMIT NO. DEV2017-00039; OTH2017-00981

6509 Serrano Avenue

City of Anaheim, CA

Prepared for:

6509 SERRANO L.P.

4040 MacArthur Boulevard, Suite 300

Newport Beach, CA 92660

(714) 658-6299

Prepared by:

Hunsaker & Associates, Irvine, Inc.

Engineer: Ed Mandich Registration No. _____

3 Hughes

Irvine, CA 92618

(949) 583-1010

Prepared: October 1, 2018

Project Owner's Certification			
Permit/Application No.	DEV2017-00039	Grading Permit No.	N/A
Tract/Parcel Map No.	TTM 18104	Building Permit No.	N/A
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract)			APN 365-062-09

This Preliminary Water Quality Management Plan (WQMP) has been prepared for 6509 Serrano LP by Hunsaker and Associates Irvine, Inc. The WQMP is intended to comply with the requirements of the local NPDES Stormwater Program requiring the preparation of the plan.

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

Owner: 6509 Serrano LP			
Name/Title	Robert Kim		
Company	6509 Serrano LP		
Address	4040 MacArthur Boulevard, Suite 300 Newport Beach, CA 92660		
Email	Bobkim727@gmail.com		
Telephone #	(714) 658-6299		
I understand my responsibility to implement the provisions of this WQMP including the ongoing operation and maintenance of the best management practices (BMPs) described herein.			
Signature		Date	

Preparer (Engineer): Ed Mandich			
Title	Project Engineer	PE Registration #	
Company	Hunsaker and Associates Irvine, Inc.		
Address	3 Hughes, Irvine, CA 92618		
Email	emandich@hunsaker.com		
Telephone #	(949) 583-1010		
I hereby certify that this Water Quality Management Plan is in compliance with, and meets the requirements set forth in, Order No. R8-2009-0030/NPDES No. CAS618030, of the Santa Ana Regional Water Quality Control Board.			
Preparer Signature		Date	
Place Stamp Here			

Contents Page No.

Section I Discretionary Permit(s) and Water Quality Conditions

The project's discretionary permit and water quality information are provided in the following:

Project Infomation			
Permit/Application No.	DEV2017-00039	Tract/Parcel Map No.	TTM 18104
Water Quality Conditions			
Water Quality Conditions (list verbatim)	The project is subject to the water quality conditions set forth per City of Anaheim, which requires all new development and significant redevelopment projects comply with the requirements of the County of Orange Drainage Area Management Plan (DAMP). Per City of Anaheim Municipal Code Title 10, Chapter 09, Section 030.010, project is subject to the requirements of New Development and Significant Redevelopment projects to control urban runoff in accordance with the County of Orange Drainage Area Management Plan. Site-specific water quality conditions of approval are currently not available as the project is in the Tentative Map approval process. Once available, the project's water quality conditions of approval will be listed verbatim in this section.		
Conceptual WQMP			
Was a Conceptual Water Quality Management Plan previously approved for this project?	Yes. The Conceptual (Preliminary) WQMP was previously approved by the City under OTH2017-00981. However the associated tentative tract map was not approved and has since undergone minor changes to the site plan. This WQMP has been prepared for consistency with the most current site plan.		
Watershed-Based Plan Conditions			
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	The project is located within the San Ana River Watershed and tributary to Santa Ana River Reaches 1 and 2; and Santiago Creek Channel Reach 1. Currently, there is no approved WIHMP for the watershed. Although Reach 1 of the Santa Ana River is considered impaired under Section 303(d) of the Clean Water Act (Pathogens), there is currently no TMDL's established for any of the project's receiving waters.		

Section II Project Description

II.1 Project Description

<table>
<tr><th colspan="5">Description of Proposed Project</th></tr>
<tr><td>Development Category (Verbatim from WQMP):</td><td colspan="4">Priority Project, Category 1 – New development projects that create 10,000 square feet or more of impervious surface. This category includes commercial, industrial, residential housing subdivisions, mixed-use, and public projects on private or public property that falls under the planning and building authority or the Permittees.</td></tr>
<tr><td>Project Area (ft^2):
Gross: 163,337 ft^2;
3.75 acres
Net: 132,443 ft^2;
3.04 acres</td><td colspan="2">Number of Dwelling Units: 58</td><td colspan="2">SIC Code: N/A. Project is a residential development.</td></tr>
<tr><td rowspan="2">Project Area[1]</td><td colspan="2">Pervious</td><td colspan="2">Impervious</td></tr>
<tr><td>Area (acres or sq ft)</td><td>Percentage</td><td>Area (acres or sq ft)</td><td>Percentage</td></tr>
<tr><td>Pre-Project Conditions</td><td>0.30 acres</td><td>8%</td><td>3.45 acres</td><td>92%</td></tr>
<tr><td>Post-Project Conditions</td><td>0.61 acres</td><td>16%</td><td>3.14 acres</td><td>84%</td></tr>
<tr><td>Narrative Project Description:</td><td colspan="4">Proposed Vesting Tentative Tract Map No. 18104, also known as "Nohl Ranch Condominiums" (The Project), consists of approximately 3.75 acres (gross) of land located in the southeastern portion of the City of Anaheim, just northeast of the intersection of Serrano Avenue and Nohl Ranch Road.

Specifically, the site is bound to the north and east by existing single-family residential use; to the south by Serrano Avenue and single family residential beyond; and to the west by Nohl Ranch Road and a vacant lot beyond. Two entrances to the site will be provided via Nohl Ranch Road to the west and Serrano Avenue to the south.

The project proposes fifty-eight (58) attached residential units and related improvements, including private drive aisles, parking areas, landscaping, walkways, curb, sidewalk, gutter and storm drain improvements, and wet and dry utilities. Site summary is as follows:

Table II.1-1 Land Use Summary Table
<table><tr><th>Lot</th><th>Description</th><th>Acreage</th></tr><tr><td>1</td><td>Condominium Use</td><td>3.03</td></tr><tr><td>--</td><td>Ultimate Right-of-Way
(Nohl Ranch Road & Serrano Avenue)</td><td>0.72</td></tr><tr><td>Total</td><td>--</td><td>3.75</td></tr></table>
The proposed residential units will consist of eight (8) building structures that accommodate 35 two-bedroom units and 23 three-bedroom units ranging from 1,171 ft^2 to 2,018 ft^2, with an average living area of 1,461 ft^2.</td></tr>
</table>

[1] *Area and percentage based on gross area, which includes 0.72 acres of public streets (impervious).*

Description of Proposed Project	
	Parking will consist of 116 residential garage spaces (2 per unit) and 30 designated on-street parking spaces (uncovered) located on the project's two drive aisle and 2 ADA spaces. Total parking spaces provided is 148 spaces. Project parking is consistent with City of Anaheim parking requirements. Proposed community amenities include an open space/common area located centrally within the project and two (2) trash enclosures. No other community facilities, such as vehicle wash areas, tot lots or recreation center, are proposed. The project does not include commercial or industrial elements, such as food service facilities, retail stores, delivery areas, loading docks or outdoor material storage areas. Project landscaping is anticipated within parkways and common areas and consist primarily of open space landscaping and planter areas. Total landscaping is anticipated to consist of approximately 20% of the project's onsite area (3.04 acres), or 0.61 acres. Paved and other impervious areas include project drive aisles, gutter, curb and sidewalk improvements, and the building footprint of each residential unit. Total impervious area is anticipated to consist of approximately 80% of the onsite area, or 2.43 acres. Activities typical of residential developments are anticipated for the project. These include day-to-day activities such as recreation, lounging, commuting, exercising and other residential related activities. Typical wastes from households are anticipated to be generated daily from the project. These include food wastes, paper products and recyclable materials. These materials shall be disposed to onsite trash enclosures and removed for disposal on a weekly basis by the local private waste management company. All improvements are shown in the WQMP Site Plan in Section VI of this WQMP.
Drainage Patterns/Connections	The pre-project site consists of a commercial development, with runoff divided into two drainages – a western drainage and an eastern drainage. The western drainage consists of the southwestern portion of the pre-project site, with runoff conveyed southerly as sheet flow to existing gutters, prior to discharging to Nohl Ranch Road. Runoff is then conveyed southerly as gutter flow to Serrano Avenue, and then westerly approximately 110' to an existing catch basin located just west of the intersection of Nohl Ranch Road and Serrano Avenue. Runoff is then conveyed approximately 1.4 miles westerly in the Serrano Avenue storm drain system prior to discharging Santiago Creek to the south, which is tributary to Reach 2 of the Santa Ana River. The eastern drainage consists of the northwestern and eastern portions of the pre-project site. Runoff is conveyed as sheet flow to project gutters that convey flows to the southeastern portion and discharged to Serrano

Description of Proposed Project	
	Avenue. Runoff is then conveyed as gutter flow easterly to South Calle Venado, and then northerly approximately 0.15 miles prior to discharging to an existing catch and then discharged northeasterly to Oak Canyon. Flows from Oak Canyon are conveyed north to Anaheim Hills Golf Course, and then westerly prior to discharging the existing storm drain system in Anaheim Hills Road (OCFCD Facility No. E01S09) and conveyed north to Reach 2 of the Santa Ana River. All flows are then conveyed southerly to Reach 1 of the Santa Ana River and ultimately, to the Pacific Ocean.

II.2 Potential Stormwater Pollutants

Table 2.1, Anticipated and Potential Pollutants Generated by Land Use Type from the Technical Guidance Document (December 2013) lists the following Pollutants of Concern (POC's) associated with the project:

Pollutants of Concern			
Pollutant	E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	E		Potential sources of sediment include existing landscaping areas and disturbed earth surfaces.
Nutrients	E		Potential sources of nutrients include fertilizers, sediment and trash/debris.
Heavy Metals	E		Potential sources include vehicles and automotive fluids.
Pathogens (Bacteria/Virus)	E		Potential sources of pathogens include landscaping areas and food wastes.
Pesticides	E		Potential sources of pesticides include landscaping areas.
Oil and Grease	E		Potential source includes automobiles.
Toxic Organic Compounds	E		Potential source includes automobiles.
Trash and Debris	E		Potential sources include common litter and trash from residents

II.3 Hydrologic Conditions of Concern

The purpose of this section is to identify any hydrologic conditions of concern (HCOC) with respect to downstream flooding, erosion potential of natural channels downstream, impacts of increased flows on natural habitat, etc. As specified in Section 2.3.3 of the 2013 Model WQMP, projects must identify and mitigate any HCOCs. A HCOC is a combination of upland hydrologic conditions and stream biological and physical conditions that presents a condition of concern for physical and/or biological degradation of streams.

In the North Orange County permit area, HCOCs are considered to exist if any streams located downstream from the project are determined to be potentially susceptible to hydromodification impacts and either of the following conditions exists:

- Post-development runoff volume for the 2-yr, 24-hr storm exceeds the pre-development runoff volume for the 2-yr, 24-hr storm by more than 5 percent.

or

- Time of concentration (Tc) of post-development runoff for the 2-yr, 24-hr storm event is less than the time of concentration of the pre-development condition for the 2-yr, 24-hr storm event by more than 5 percent.

If these conditions do not exist or streams are not potentially susceptible to hydromodification impacts, an HCOC does not exist and hydromodification does not need to be considered further. In the North Orange County permit area, downstream channels are considered not susceptible to hydromodification, and therefore do not have the potential for a HCOC, if all downstream conveyance channels that will receive runoff from the project are engineered, hardened, and regularly maintained to ensure design flow capacity, and no sensitive habitat areas will be affected.

Is the proposed project potentially susceptible to hydromodification impacts?

☒ Yes ☐ No

Based on County's current hydromodification susceptibility GIS data (provided on the following page), the project is subject to the specific 2-year criteria noted above. Runoff from the project site discharges to Oaks Canyon, Anaheim Hills Golf Course and Santiago Creek, which have natural or unimproved downstream drainage reaches that are susceptible to hydromodification impacts.

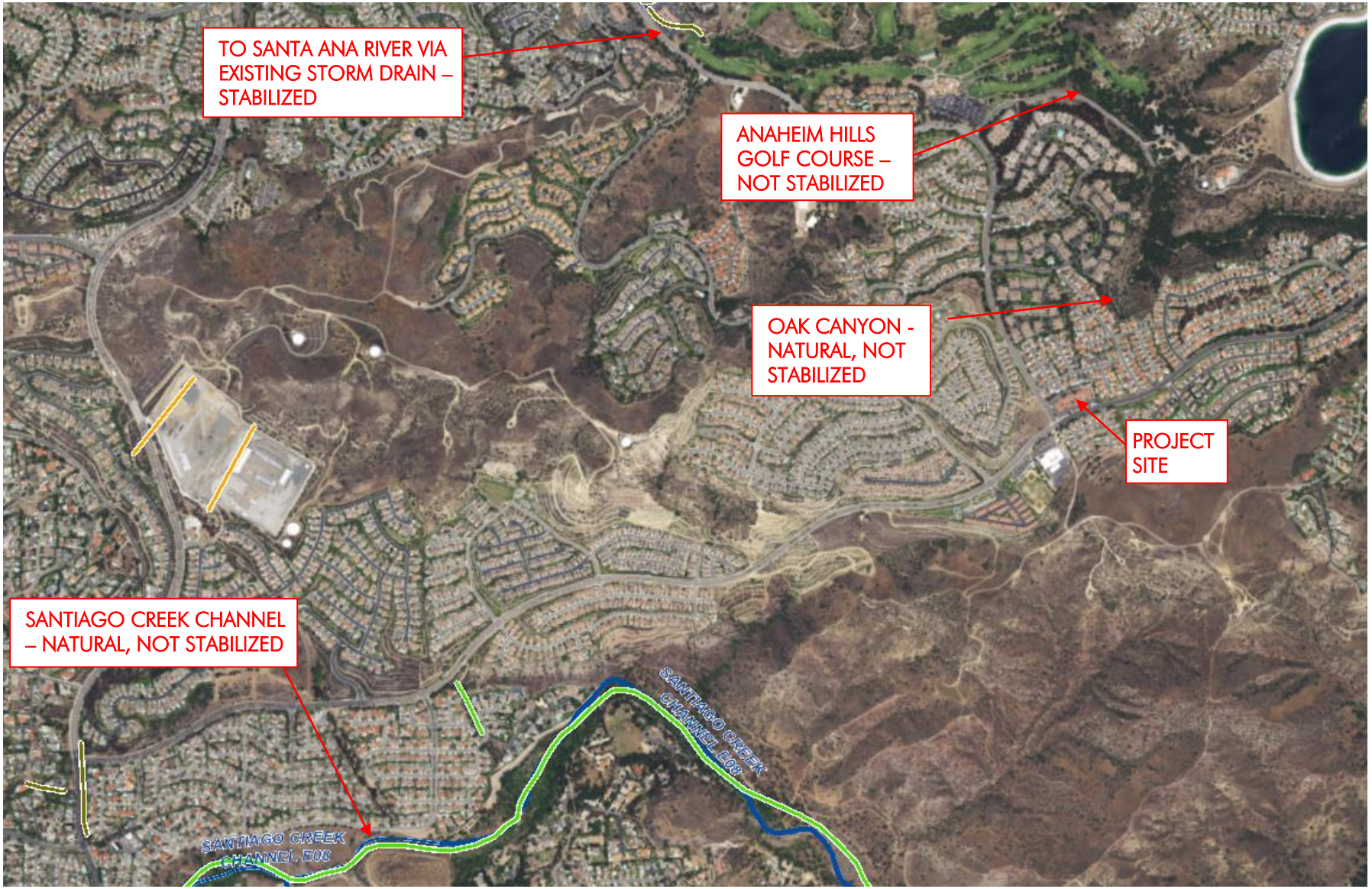
A hydromodification analysis was prepared as part of the project's hydrology study. Based on the results of the analysis, the project would not exceed the specific criteria for 2-year post-development runoff.

A summary is provided in the following table, with supporting documentation provided in Attachment D of this report.

Table II.3 – Hydromodification Analysis Summary

Drainage Area	Acres	Existing Q_2	Proposed Q_2	Existing Tc	Proposed Tc
A (southwestern site)	2.05	2.9 cfs	0.4 cfs	9.0 min	9.3 min
B (southwestern site)	0.88	1.68 cfs		5.5 min	

Note: in developed condition, Drainage A and B are combined to a single drainage.



Receiving Waters Map (Source: OC Land Records GIS)

II.4 Post Development Drainage Characteristics

In general, post-development drainage area and flow direction will be consistent with pre-project conditions. Runoff from the site is conveyed as surface flow to project gutters and discharged to a catch basin and the project's storm drain system. Runoff easterly and then southerly prior to discharging to the existing storm drain located southeast of the project site in Serrano Avenue.

All runoff is then conveyed to Reach 2 of the Santa Ana River, as in pre-project conditions.

Low Impact Development

To satisfy the project requirements for Low Impact Development (LID) and storm water treatment, water quality flows (non-storm water flows and the Design Capture Volume) from each of the project's Drainage Management Area (DMA) will be conveyed to a biotreatment BMP prior to discharging offsite. Summary of the DMAs is as follows:

DMA 1 (0.22 acres) – Consists of the northwestern portion of the project site. Runoff will be conveyed to a proprietary biofiltration BMP (Modular Wetland System or approved equivalent) located in the southeastern portion of the DMA, prior to discharging to the storm drain system.

DMA 2 (0.51 acres) – Consists of the southwestern and central western portions of the project site. Runoff will be conveyed to a proprietary biofiltration BMP (Modular Wetland System or approved equivalent) located in the central portion of the DMA, prior to discharging to the storm drain system.

DMA 3 (0.14 acres) – Consists of the central southwestern-central portion of the project site. Runoff will be conveyed to a bioretention with underdrains BMP located in the southeastern portion of this DMA, prior to discharging to proposed the storm drain system to the east.

DMA 4 (1.08 acres) – Consists of the central portion of the project site. Runoff will be conveyed to a bioretention with underdrains BMP (in series) located in the southern portion of this DMA, prior to discharging to proposed the storm drain system to the east.

DMA 5 (0.87 acres) – Consists of the central eastern and northeastern portions of the project site. Runoff will be conveyed to a proprietary biofiltration BMP (Modular Wetland System or approved equivalent) located in the northeastern portion of the DMA, prior to discharging to the storm drain system.

DMA 6 (0.14 acres) – Consists of the southeastern portion of the project site. Runoff will be conveyed to a bioretention with underdrains BMP located in the southeastern portion of this DMA, prior to discharging to proposed the storm drain system.

To meet the trash capture requirements of the Ocean Plan, full capture catch basin connector pipe screens will also be employed within each of the project's onsite catch basins.

The limits of the DMAs as well as the locations of the biofiltration units are provided in the WQMP Site Plan in Section VI.

II.5 Property Ownership/Management

The property owner, 6509 Serrano LP, shall assume all BMP maintenance and inspection responsibilities for the project site until all site responsibilities have been transferred to the HOA. Thereafter, the HOA shall assume all BMP maintenance and inspection responsibilities, including long-term funding for implementation of the project's BMP requirements.

Inspection and maintenance activities are provided in Section V of this WQMP.

Section III Site Description

III.1 Physical Setting

General descriptions of the project area are provided below:

Planning Area/ Community Name	The project is not located within a defined City of Anaheim planning area. Name of the existing commercial facility is "Serrano Center".
Location/Address	6509 Serrano Avenue, Anaheim, CA.
Project Area Description	The project site consists of an existing commercial shopping center. The site is bound to the north and east by existing single-family residential use; to the south by Serrano Avenue and single family residential beyond; and to the west by Nohl Ranch Road and a vacant lot beyond. Two entrances to the site will be provided via Nohl Ranch Road to the west and Serrano Avenue to the south.
Land Use	Existing: Commercial Proposed: Multiple-Family Residential (RM-4) and Mixed Use (MU)
Zoning	Existing: General Commercial (C-G) Proposed: Multiple-Family Residential (RM-4) and Mixed Use (MU)
Acreage	3.75 acres (gross); 3.04 acres (net)
Predominant Soil Type	Based on the County's most recent TGD GIS data, subsurface soils consist primary of HSG Type C and D Soils.

III.2 Site Characteristics

The following table summarizes general characteristics of the project site:

Precipitation Zone	0.85 in.
Topography	The pre-project site resides in a developed condition (shopping center), with the site generally sloping to the southwest and the southeast.
Drainage Patterns/Connections	The pre-project site is divided into two drainages – a western drainage and an eastern drainage. The western drainage consists of the southwestern portion of the pre-project site, with runoff conveyed southerly as sheet flow to existing gutters, prior to discharging to Nohl Ranch Road. Runoff is then conveyed southerly as gutter flow to Serrano Avenue, and then westerly approximately 110' to an existing catch basin located just west of the intersection of Nohl Ranch Road and Serrano Avenue. Runoff is then conveyed approximately 1.4 miles westerly in the Serrano Avenue storm drain system prior to discharging Santiago Creek to the south, which is tributary to Reach 2 of the Santa Ana River. The eastern drainage consists of the northwestern and eastern portions of the pre-project site. Runoff is conveyed as sheet flow to project gutters that convey flows to the southeastern portion and discharged to Serrano Avenue. Runoff is then conveyed as gutter flow easterly to South Calle Venado, and then northerly approximately 0.15 miles prior to discharging

	to an existing catch and then discharged northeasterly to Oak Canyon. Flows from Oak Canyon are conveyed north to Anaheim Hills Golf Course, and then westerly prior to discharging the existing storm drain system in Anaheim Hills Road (OCFCD Facility No. E01S09) and conveyed north to Reach 2 of the Santa Ana River. All flows are then conveyed southerly to Reach 1 of the Santa Ana River and ultimately the Pacific Ocean.
Soil Type, Geology, and Infiltration Properties	Based on the County's most recent TGD GIS data, subsurface soils consist primary of HSG Type C and D Soils. These soils consist primarily of clays and silts and are characterized as having high swell potential with low to very low rate of transmission when thoroughly wet.
Hydrogeologic (Groundwater) Conditions	Per the TGD, project area is not located within a shallow groundwater zone or plume protection zone.
Geotechnical Conditions (relevant to infiltration)	The site is located in very close proximity to the Geologic Hazard Abatement District Benefit Area, as part of the Santiago Landslide Area. Per preliminary correspondence with the geotechnical professional, infiltration should be avoided. See Attachment E.
Off-Site Drainage	The project will not receive run-on from any upstream areas. The project's storm drain system will connect to the existing storm drain system in Nohl Ranch Road to the west and the Serrano Avenue to the southeast.
Utility and Infrastructure Information	Wet and dry utilities are proposed for the project and will connect to existing connections in Nohl Ranch Road and Serrano Avenue.

III.3 Watershed Description

The following table includes descriptions of the project's receiving waters:

Receiving Waters	Santa Ana River Reach 2, Santiago Creek Channel Reach 1, Santa Ana River Reach 1
303(d) Listed Impairments	Santa Ana River Reach 2 - Pathogens
Applicable TMDLs	None
Pollutants of Concern for the Project	*Pollutants of Concern:* Suspended Solids/Sediment, Nutrients, Heavy Metals, Pathogens, Pesticides, Oil and Grease, Toxic Organic Compounds, Trash and Debris. *Primary Pollutants of Concern*: Pathogens
Environmentally Sensitive and Special Biological Significant Areas	The project site is not located within 200 feet of any Areas of Special Biological Significance (ASBS) or designated Environmentally Sensitive Areas (ESAs).

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

The project's applicable performance criteria are as follows:

Project Performance Criteria		
(NOC Permit Area only) Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?	YES ☐	NO ☒
If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.	A WIHMP has not been approved for the watershed.	
If HCOC exists, list applicable hydromodification control performance criteria	As discussed in Section II.3, there are no Hydrologic Conditions of Concern for this project.	
List applicable LID performance criteria	The applicable LID performance criteria are as follows (the project's selected LID performance criteria is provided in bold below): • Retain, onsite (infiltrate, harvest and use, or evapotranspire) stormwater runoff as feasible up to the Design Capture Volume, and • Recover (i.e.) drawdown the storage volume as soon as possible after a storm event, and, if necessary • **Biotreat, onsite, additional runoff, as feasible, up to 80 percent average annual capture efficiency, and, if necessary** • Retain or biotreat, in a regional facility, the remaining runoff up to 80 percent average annual capture efficiency, and, if necessary • Fulfill alternative compliance obligations for runoff volume not retained or biotreated up to 80 percent average annual capture efficiency using treatment controls or other alternative approaches.	
List applicable treatment control BMP performance criteria	N/A. Project proposes the use of LID BMPs to address the project's design capture volume.	
Calculate LID design storm capture volume for Project	Project's LID DCV has been determined using the following equation: DCV = C x D x A x 43560 sf/ac x 1ft/12in Where: DCV = design storm capture volume, cu-ft = 9,025 cu-ft C = runoff coefficient = (0.75 x imp + 0.15) = 0.78 Imp = impervious fraction of drainage area (ranges from 0 to 1) = 0.84 D = storm depth (inches) = 0.85" A = tributary area (acres) = 3.75 acres[1]	

[1] *Project gross area is 3.75 acres. See Section IV.2.2. for DCV based on Drainage Management Areas.*

IV.2 Site Design and Drainage Plan

The primary goal of site design principles and techniques is to reduce land development impacts on water quality and downstream hydrologic conditions. Benefits of site design include reductions in the size of downstream BMPs, conveyance systems, pollutant loading and hydromodification impacts.

IV.2.1 Site Design BMPs

The following section describes the site design BMPs that have been incorporated into this project.

Minimize Impervious Area

The project will minimize impervious area by incorporating the use of multi-level structures and providing landscaping in open space areas and common areas adjacent to walkways and residential units to minimize the project's impervious footprint, thereby reducing runoff generated during rain events.

Maximize Natural Infiltration Capacity

Due to the project's close proximity to the Geologic Hazard Abatement District Benefit Area, as part of the Santiago Landslide Area, infiltration is not recommended.

Preserve Existing Drainage Patterns and Time of Concentration

The proposed drainage pattern is consistent with existing drainage patterns, with drainage from the developed site conveyed southeasterly and southwesterly to the existing offsite drainage system.

Disconnect Impervious Areas

Landscaping will be provided adjacent to walkways and building units to break up the project's impervious areas.

Protect Existing Vegetation and Sensitive Areas, and Revegetate Disturbed Areas

The pre-project site consists of a commercial plaza, with limited landscaping areas. There are no natural areas or critical landscaping areas to preserve. All disturbed areas will either be paved or landscaped.

Xeriscape Landscaping

Native and/or tolerant landscaping will be incorporated into the site design, consistent with City guidelines.

IV.2.2 Drainage Management Areas

Per the TGD, the project site has been divided into Drainage Management Areas (DMAs) to be utilized for defining drainage areas tributary to the project's BMPs. DMA limits have been delineated based on the tributary drainage area for each BMP.

The design capture volume (DCV) and design flow rate utilizing the "Simple Method" and the "Capture Efficiency Method" described in the TGD Section III.3.1 and III.3.3 are provided below. Locations of DMAs and associated treatment BMPs are provided on the exhibits in Section VI. Additional calculations and TGD Worksheets are provided in Attachment C of this WQMP.

DMA	Tributary Drainage Area (Ac.)	Imp.	C-Value	D_{85} (in)	Simple Method DCV (ft^3)	Tc (min)	Design Intensity (in/hr)	Q_{BMP} (cfs)
1	0.22	0.8	0.75	0.85	509	5	0.26	0.043
2	0.51	0.8	0.75	0.85	1,180	7.3	0.24	0.092
3	0.14	0.8	0.75	0.85	324	5	0.26	0.027

DMA	Tributary Drainage Area (Ac.)	Imp.	C-Value	D_{85} (in)	Simple Method DCV (ft^3)	Tc (min)	Design Intensity (in/hr)	Q_{BMP} (cfs)
4	1.08	0.8	0.75	0.85	2,499	7.8	0.24	0.194
5	0.87	0.8	0.75	0.85	2,013	7.3	0.24	0.157
6	0.14	0.8	0.75	0.85	324	5	0.26	0.027

IV.3 LID BMP Selection and Project Conformance Analysis

Per the 4th Term MS4 Storm Water Permit (Order No. R8-2009-0030, as amended by Order No. R8-2010-0062), Low Impact Development (LID) BMPs must be incorporated into design features and source controls to reduce project related storm water pollutants. The incorporation of LID BMPs into project design requires evaluation of LID measures in the following BMP hierarchy: infiltration, evapotranspiration, harvest/reuse and biotreatment.

IV.3.1 Hydrologic Source Controls (HSCs)

Hydrologic source controls (HSCs) can be considered to be an integration of site design practices and LID BMPs. The goal of HSCs is to reduce runoff volume for a given drainage area without reducing the site's true impervious area.

Name	Included?
Localized on-lot infiltration	☐
Impervious area dispersion (e.g. roof top disconnection)	☐
Street trees (canopy interception)	☐
Residential rain barrels (not actively managed)	☐
Green roofs/Brown roofs	☐
Blue roofs	☐
Impervious area reduction (e.g. permeable pavers, site design)	☐

Although HSC design principles are anticipated to be implemented for the project, the volume reduction attributed to each HSC BMP has not been determined at this time, and the project's selected LID BMPs have been designed to address the full DCV for each DMA.

IV.3.2 Infiltration BMPs

Infiltration BMPs are LID BMPs that capture, store and infiltrate storm water runoff. These BMPs are engineered to store a specified volume of water and have no design surface discharge (underdrain or outlet structure) until this volume is exceeded. Examples of infiltration BMPs include infiltration trenches, bioretention without underdrains, infiltration wells, permeable pavement, and underground infiltration galleries.

The project site resides in close proximity to the Geologic Hazard Abatement District Benefit Area, as part of the Santiago Landslide Area. Per preliminary correspondence with the geotechnical professional, infiltration should be avoided (See Attachment E).

INFILTRATION	
Name	Included?
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration basins	☐
Infiltration Wells	☐
Subsurface infiltration galleries	☐
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐
Other:	☐

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

EVAPOTRANSPIRATION	
Name	Included?
All HSCs; *See Section IV.3.1*	☐
Surface-based infiltration BMPs	☐
Biotreatment BMPs	☐
HARVEST & REUSE/ RAINWATER HARVESTING	
Name	Included?
Above-ground cisterns and basins	☐
Underground detention	☐
Other:	☐

Evapotranspiration

Evapotranspiration BMPs are a class of retention BMPs that discharges stored volume predominately to ET, through some infiltration may occur. ET includes both evaporation and transpiration, and ET BMPs may incorporate one or more of these processes. BMPs must be designed to achieve the maximum feasible ET, where required to demonstrate that the maximum amount of water has been retained on-site. Since ET is not the sole process in the proposed BMPs, specific design and sizing criteria have not been developed for ET-based BMPs.

Harvest and Reuse

Harvest and Reuse (aka. Rainwater Harvesting) BMPs are LID BMPs that capture and store storm water runoff for later use. These BMPs are engineered to store a specified volume of water and have no design surface discharge until this volume is exceeded. Harvest and use BMPs include both above-ground and

below-ground cisterns. Examples of uses for harvested water include irrigation, toilet and urinal flushing, vehicle washing, evaporative cooling, industrial processes and other non-potable uses.

The project does not propose the use of harvesting BMPs, as harvesting runoff exclusively for landscape irrigation was determined to be infeasible since the project's minimum irrigation area required for harvesting BMP would exceed the project's estimated use for irrigation (See Worksheet J in Attachment C).

IV.3.4 Biotreatment BMPs

Biotreatment BMPs are a class of structural LID BMPs that treat suspended solids and dissolved pollutants in storm water using mechanisms characteristic of biologically active systems. These BMPs are considered treat and release facilities and include treatment mechanisms that employ soil microbes and plants. Additional benefits of these BMPs may include aesthetic enjoyment, recreational use, wildlife habitat and reduction in storm water volume.

BIOTREATMENT		
ID	Name	Included?
BIO-1	Bioretention with underdrains	☒
	Stormwater planter boxes with underdrains	☐
	Rain gardens with underdrains	☐
BIO-5	Constructed wetlands	☐
BIO-2	Vegetated swales	☐
BIO-3	Vegetated filter strips	☐
BIO-7	Proprietary vegetated biotreatment systems	☒
BIO-4	Wet extended detention basin	☐
BIO-6	Dry extended detention basins	☐

To address the project's runoff pollutants of concern and meet the project's LID requirements, the project proposes the use of bioretention with underdrains and proprietary biotreatment (Modular Wetland Systems or approved equivalent). These units have been selected based on their proven pollutant removal efficiencies, as well as site constraints (~~shallow groundwater and~~ shallow storm drain system, utility crossings). The water quality design flow from each of the project's DMA will be conveyed to proposed biotreatment BMPs via diversion troughs located within each of the project's catch basins.

BMP Sizing

The design flow rate and proposed BMP units for each DMA are as follows:

Biotreatment BMP Summary								
DMA	Tributary Drainage Area (Ac.)	C-value	Tc (Min)	Design Intensity (in/hr)	Q_{DESIGN} (cfs)	$D_{FRACTION}$ (in)	V_{DESIGN} (cu-ft)	BMP Model/ Footprint
1	0.22	0.75	5	0.26	0.043	N/A	N/A	MWS-L-4-4
2	0.51	0.75	7.3	0.24	0.092	N/A	N/A	MWS-L-4-8

Biotreatment BMP Summary								
DMA	Tributary Drainage Area (Ac.)	C-value	Tc (Min)	Design Intensity (in/hr)	Q_{DESIGN} (cfs)	$D_{FRACTION}$ (in)	V_{DESIGN} (cu-ft)	BMP Model/ Footprint
3	0.14	0.75	N/A	N/A	N/A	0.22	84.2	191 sf bioretention provided (168.5 required)
4	1.08	0.75	N/A	N/A	N/A	0.22	649.8	1,491 sf bioretention provided (1,300 required)
5	0.87	0.75	7.3	0.24	0.157	N/A	N/A	MWS-L-4-15
6	0.14	0.75	N/A	N/A	N/A	0.22	84.2	349 sf bioretention provided (168.5 required)

IV.3.5 Hydromodification Control BMPs

Not applicable. Per discussion in Section II.3 of this WQMP, the project does not have hydrologic conditions of concern.

IV.3.6 Regional/Sub-Regional LID BMPs

Not applicable. The project is able to meet LID requirements onsite.

IV.3.7 Treatment Control BMPs

Not applicable. The project is able to meet LID requirements onsite. Please note that in addition to the project's proposed LID BMPs, the project is also subject to the current full trash capture requirements per the Ocean Plan. To address the requirement, the project proposes the use of Connector Pipe Screens (CPS) in all project catch basins.

IV.3.8 Non-structural Source Control BMPs

The Table below indicates all Non-Structural Source Control BMPs to be utilized in the project. Discussions of the selected BMPs are provided in the BMP Inspection and Maintenance Responsibility Matrix provided in Section V of this WQMP.

Non-Structural Source Control BMPs				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	

Non-Structural Source Control BMPs				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	Proposed facility is not subject Title 22 CCR.
N6	Local Industrial Permit Compliance	☐	☒	Not applicable to residential
N7	Spill Contingency Plan	☐	☒	Proposed facility will not generate waste or store materials subject to the requirements of Chapter 6.95 of the CA Health and Safety Code.
N8	Underground Storage Tank Compliance	☐	☒	None proposed.
N9	Hazardous Materials Disclosure Compliance	☐	☒	Proposed project will not store or generate hazardous materials subject to agency requirements.
N10	Uniform Fire Code Implementation	☐	☒	Proposed facility does not propose to store toxic or highly toxic compressed gases.
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☐	☒	None proposed.
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping	☒	☐	

A discussion of each selected Non-Structural Source Control BMP is provided in the following section. The implementation of each BMP is described in the Inspection and Maintenance Responsibility Matrix provided in Section V of this WQMP as well as the Operation and Maintenance Plan provided in Attachment B.

N1 Education for Property Owners, Tenants and Occupants – – Educational materials will be provided to homeowners at close of escrow by the owner and periodically thereafter by the HOA to inform them of their potential impacts to downstream water quality. Materials include those described in Section VII of this WQMP and provided in the Final WQMP.

N2 Activity Restrictions – Activity restrictions to minimize potential impacts to water quality and with the purpose of protecting water quality will be prescribed by the project's Covenant, Conditions and

Restrictions (CC&Rs), or other equally effective measure.

N3 Common Area Landscape Management – Maintenance activities for landscape areas shall be consistent with City, County and manufacturer guidelines for fertilizer and pesticide use (OC DAMP Section 5.5). Maintenance includes trimming, weeding and debris removal and vegetation planting and replacement. Stockpiled materials during maintenance activities shall be placed away from drain inlets and runoff conveyance devices. Wastes shall be properly disposed of or recycled.

N4 BMP Maintenance – Responsibility for implementation, inspection and maintenance of all BMPs (structural and non-structural) shall be consistent with the BMP Inspection and Maintenance Responsibilities Matrix provided in Section V of this WQMP, with documented records of inspections and maintenance activities completed.

N11 Common Area Litter Control – Litter control onsite will include the use of HOA litter patrols, violation reporting and clean up during landscaping maintenance activities and as needed to ensure good housekeeping of the project's common areas.

N12 Employee Training – All employees, contractors and subcontractors of the HOA shall be trained on the proper use and staging of landscaping and other materials with the potential to impact runoff and proper clean-up of spills and materials.

N14 Common Area Catch Basin – As required by the TGD, at least 80% of the project's drainage facilities shall be inspected, cleaned/maintained annually, with 100% of facilities inspected and maintained within a two-year period. Cleaning should take place in the late summer/early fall, prior to the start of the wet season. Records shall be kept to document annual compliance.

N15 Street Sweeping Private Streets and Parking Lots – The project's private streets shall be swept, at minimum, on a weekly basis.

IV.3.9 Structural Source Control BMPs

The table below indicates all Structural Source Control BMPs to be utilized in the project. Discussions of the selected BMPs are provided in the BMP Inspection and Maintenance Responsibility Matrix provided in Section V of this WQMP.

Structural Source Control BMPs				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	No outdoor material storage areas proposed for project use.
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☒	☐	

Structural Source Control BMPs				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☐	☒	No large slopes onsite.
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☐	☒	Not applicable. Project resides in SARWQCB.
S6	Dock areas	☐	☒	None proposed.
S7	Maintenance bays	☐	☒	None proposed.
S8	Vehicle wash areas	☐	☒	None proposed.
S9	Outdoor processing areas	☐	☒	None proposed.
S10	Equipment wash areas	☐	☒	None proposed.
S11	Fueling areas	☐	☒	None proposed.
S12	Hillside landscaping	☐	☒	None proposed.

A discussion of each selected Structural Source Control BMP is provided in the following section. The implementation of each BMP and the responsible party are described in the Inspection and Maintenance Responsibility Matrix provided in Section V of this WQMP as well as the Operation and Maintenance Plan provided in Attachment A.

S1 Storm Drain Stenciling – Storm drain stencils or signage prohibiting dumping and discharge of materials ("No Dumping – Drains to Ocean") shall be provided adjacent to each of the project's proposed inlets. The stencils shall be inspected and restenciled as needed to maintain legibility.

S3 Designated Trash Enclosure – Designated trash enclosure areas shall be covered and designed to preclude trash and pad area from run-on, run-off and wind. Any drains within area shall be connected to the sanitary sewer system, with proper approval from the sewer company. Site shall be inspected with use to ensure all materials are disposed of properly.

S4 (SD-10, SD-12) Use Efficient Irrigation Systems and Landscape Design – In conjunction with routine landscaping maintenance activities, inspect irrigation for signs of leaks, overspray and repair or adjust accordingly. Adjust system cycle to accommodate seasonal fluctuations in water demand and temperatures. Ensure use of native or drought tolerant/non-invasive plant species to minimize water consumption.

IV.4 Alternative Compliance Plan (If Applicable)

IV.4.1 Water Quality Credits

The project does not propose the use of water quality credits as it is able to meet LID requirements onsite.

<table>
<tr><th colspan="5">Description of Proposed Project</th></tr>
<tr><td colspan="5">Project Types that Qualify for Water Quality Credits (Select all that apply):</td></tr>
<tr><td colspan="2">☐ Redevelopment projects that reduce the overall impervious footprint of the project site.</td><td colspan="2">☐ Brownfield redevelopment, meaning redevelopment, expansion, or reuse of real property which may be complicated by the presence or potential presence of hazardous substances, pollutants or contaminants, and which have the potential to contribute to adverse ground or surface WQ if not redeveloped.</td><td>☐ Higher density development projects which include two distinct categories (credits can only be taken for one category): those with more than seven units per acre of development (lower credit allowance); vertical density developments, for example, those with a Floor to Area Ratio (FAR) of 2 or those having more than 18 units per acre (greater credit allowance).</td></tr>
<tr><td colspan="2">☐ Mixed use development, such as a combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that can demonstrate environmental benefits that would not be realized through single use projects (e.g. reduced vehicle trip traffic with the potential to reduce sources of water or air pollution).</td><td colspan="2">☐ Transit-oriented developments, such as a mixed use residential or commercial area designed to maximize access to public transportation; similar to above criterion, but where the development center is within one half mile of a mass transit center (e.g. bus, rail, light rail or commuter train station). Such projects would not be able to take credit for both categories, but may have greater credit assigned</td><td>☐ Redevelopment projects in an established historic district, historic preservation area, or similar significant city area including core City Center areas (to be defined through mapping).</td></tr>
<tr><td>☐ Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.</td><td>☐ Developments in a city center area.</td><td>☐ Developments in historic districts or historic preservation areas.</td><td>☐ Live-work developments, a variety of developments designed to support residential and vocational needs together – similar to criteria to mixed use development; would not be able to take credit for both categories.</td><td>☐ In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.</td></tr>
<tr><td>Calculation of Water Quality Credits
(if applicable)</td><td colspan="4">Not applicable to project.</td></tr>
</table>

IV.4.2 Alternative Compliance Plan Information

Not applicable. The project is able to meet LID BMP requirements onsite to address pollutants in project related storm water runoff.

Section V Inspection/Maintenance Responsibility for BMPs

Refer to the BMP inspection and maintenance responsibility matrix below. Inspection and maintenance records must be kept for a minimum of five years for inspection by regulatory agencies.

The HOA shall be responsible the long-term funding, inspection and maintenance of all BMPs prescribed in this WQMP. Until transfer of ownership and site responsibilities to the HOA, all responsibilities pertaining to this WQMP shall be that of the project owner/developer, 6509 Serrano LP.

Contact for the interim responsible party is as follows:

Responsible Party: 6509 Serrano LP
Contact Name: Bob Kim
Address: 4040 MacArthur Boulevard, Suite 300 Newport Beach, CA 92660
Phone: (714) 658-6299
Email: Bobkim727@gmail.com

Inspection and maintenance activities, frequencies and responsibilities for the project's selected BMPs are provided in the following BMP matrix. Inspection and maintenance records must be kept for a minimum of five years for inspection by the regulatory agencies.

BMP INSPECTION & MAINTENANCE RESPONSIBILITIES MATRIX				
BMP		Inspection/ Maintenance Activities Required	Minimum Frequency	Reponsible Party(s)
HYDROLOGIC SOURCE CONTROL BMPs				
HSC-2	Impervious Area Dispersion	Inspect for standing water and that water is absorbed by landscaping/soil or evaporates completely. Inspect vegetation for overall health with N3 and S4. Remove accumulated sediment or repair eroded areas as needed.	After significant storm events and monthly with landscaping maintenance	Owner/HOA
HSC-3	Street Trees	Inspect for standing water and that water is absorbed by landscaping/soil. Inspect vegetation for overall health with N3 and S4.	After significant storm events and monthly with landscaping maintenance	Owner/HOA

BMP INSPECTION & MAINTENANCE RESPONSIBILITIES MATRIX				
BMP		Inspection/ Maintenance Activities Required	Minimum Frequency	Reponsible Party(s)
BIOTREATMENT BMPs				
BIO-1	Bioretention with Underdrains	Conduct general inspection and maintenance per routine landscaping maintenance activities. Inspect surface area for debris, trash and vegetation accumulation. Inspect for general plant health. Inspect for sediment, build up on planting surface and in area drain inlet. Inspect for sediment or debris clogging inlet. Clean/repair items as necessary. Inspect for ponding water lasting more than 48 hours after a rain event. Unclog sub-drain pipe and/or aeration of soil as necessary. Remove vegetation, permeable soil and drain rock. Replace in kind. Check sub-drain pipe and inlet. Repair if necessary.	Weekly Monthly (Rainy Season) Every 5 to 7 years	Owner/HOA
BIO-7	Proprietary Biofiltration (Modular Wetland System)	Inspect unit for accumulated debris and sediment and plant health; remove trash from screening device and separation chamber; trim vegetation. Remove sediment from pre-chamber, replace pre-filter cartridge media and drain down filter media. Replace wetland media.	Annually 20 years	Owner/HOA
GROSS SOLIDS REMOVAL BMPs				
PRE-1	Catch Basin Connector Pipe Screen	Inspect catch basin for debris accumulation. Clean out catch basin when debris accumulation exceeds 40% of height of connector pipe screen to prevent potential flooding and/or debris overflow into the connecting storm drain system.	Quarterly	Owner/HOA
NON-STRUCTURAL SOURCE CONTROL BMPs				
N1	Education for Property Owners, Tenants and Occupants	Educational materials will be provided to the owner and thereafter on an annual basis. Materials shall include those provided in Attachment A of this WQMP and any updated materials.	Annually	Owner/HOA

BMP INSPECTION & MAINTENANCE RESPONSIBILITIES MATRIX				
BMP		Inspection/ Maintenance Activities Required	Minimum Frequency	Reponsible Party(s)
N2	Activity Restrictions	The Owner will prescribe activity restrictions to protect surface water quality, through a Covenant, Conditions and Restrictions (CC&Rs) agreement, or other equally effective measure, for the property. Upon takeover of site responsibilities by the Homeowners Association (HOA), the HOA shall be responsible for ensuring residents compliance.	Ongoing	Owner/HOA
N3	Common Area Landscape Management	Maintenance shall be consistent with City requirements, plus fertilizer and/or pesticide usages shall be consistent with County guidelines for use of fertilizers and pesticides (OC DAMP Section 5.5). Maintenance includes mowing, weeding, and debris removal. Trimming, replanting and replacement of mulch shall be performed on an as-needed basis. Trimmings, clippings, and other waste shall be properly disposed of off-site in accordance with local regulations. Materials temporarily stockpiled during maintenance activities shall be placed away from water courses and drain inlets.	Monthly	Owner/HOA
N4	BMP Maintenance	Maintenance of BMPs implemented at the project site shall be performed at the frequency prescribed in this WQMP. Records of inspections and BMP maintenance shall be maintained by the City and documented with the WQMP, and shall be available for review upon request.	Ongoing	Owner/HOA
N11	Common Area Litter control	Litter patrol, violations investigation, reporting and other litter control activities shall be performed by the HOA in conjunction with routine patrols and with landscaping maintenance activities. Litter collection and removal shall be performed as needed and monthly with landscaping maintenance.	Ongoing patrols and as needed	Owner/HOA

BMP INSPECTION & MAINTENANCE RESPONSIBILITIES MATRIX				
BMP		Inspection/ Maintenance Activities Required	Minimum Frequency	Reponsible Party(s)
N12	Employee Training	All staff and employees of the HOA shall receive initial training upon hire and annually thereafter on the importance of their actions on storm water quality. Training shall include educational materials provided by the County as well as other permitting agencies.	Upon hire and annually	Owner/HOA
N14	Common Area Catch Basin Inspection	Catch basin inlets, area drains, swales, curb-and-gutter systems and other drainage systems shall be inspected prior to October 1st of each year and after large storm events. If necessary, drains shall be cleaned prior to any succeeding rain events. 80% of facilities shall be inspected and cleaned annually, with 100% of facilities inspected and maintained	Annually	Owner/HOA
N15	Street Sweeping Private Streets and Parking Lots	Streets must be swept at minimum, prior to the start of the rainy season (October 1st). Streets shall also be swept as needed.	Annually and as needed	Owner/HOA
STRUCTURAL SOURCE CONTROL BMPs				
S1 SD-13	Provide storm drain system stencilling and signage	Storm drain stencils shall be inspected for legibility, at minimum, once prior to the storm season, no later than October 1st each year. Those determined to be illegible will be re-stenciled as soon as possible.	Annually	Owner/HOA
S3 SD-32	Designated Trash Enclosure	Designated trash enclosure areas shall be covered and designed to preclude trash and pad area from run-on, run-off and wind. Any drains within area shall be connected to the sanitary sewer system, with proper approval from the sewer company. Site shall be inspected with use to ensure all materials are disposed of properly.	Daily with Use	Owner/POA

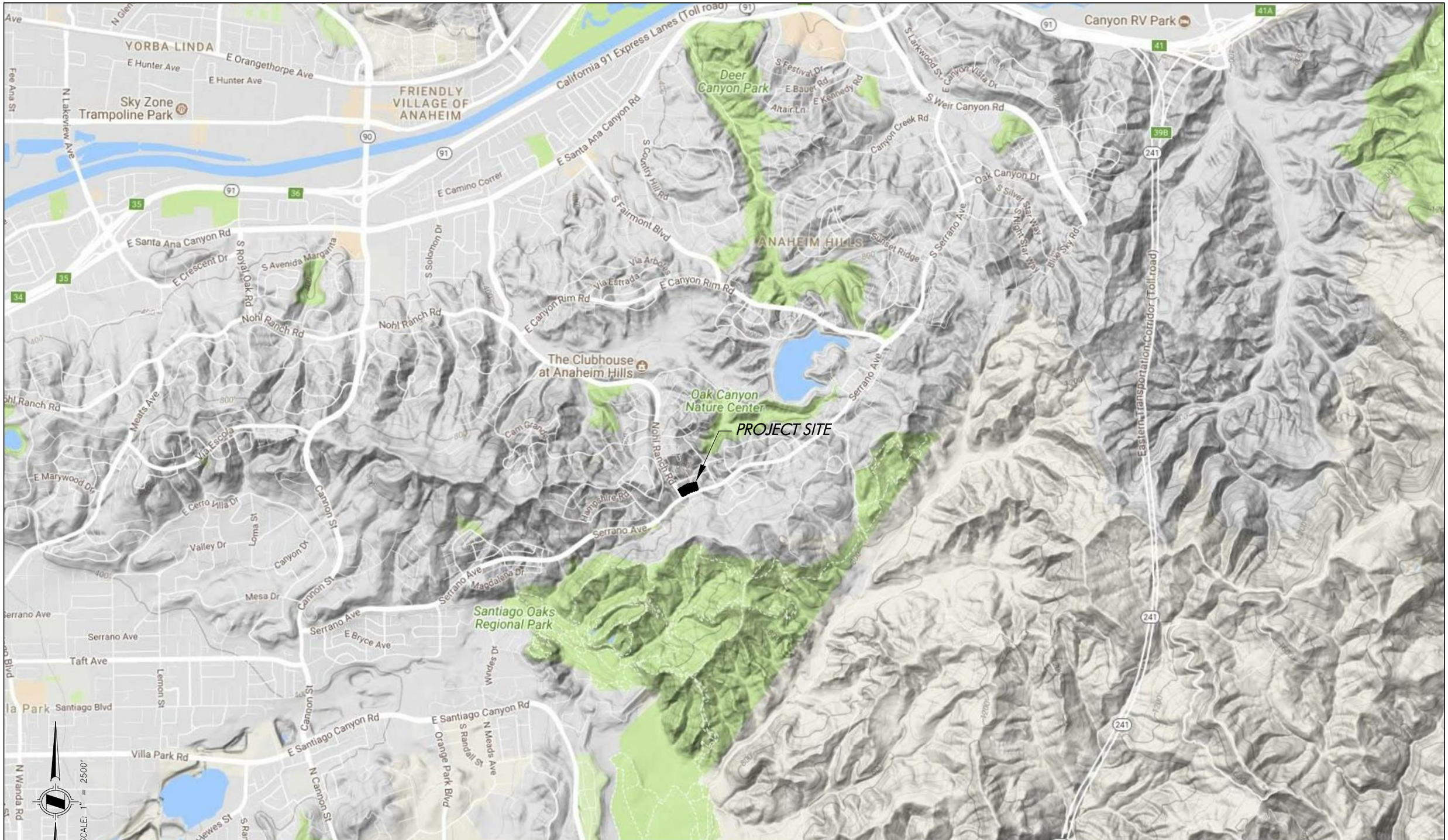
BMP INSPECTION & MAINTENANCE RESPONSIBILITIES MATRIX				
BMP		Inspection/ Maintenance Activities Required	Minimum Frequency	Reponsible Party(s)
S4 SD-10 SD-12	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	In conjunction with routine maintenance activities, verify that landscape design continues to function properly by adjusting properly to eliminate overspray to hardscape areas, and to verify that irrigation timing and cycle lengths are adjusted in accordance with water demands, given time of year, weather, day or night time temperatures based on system specifications and local climate patterns.	Monthly	Owner/HOA

Section VI Site Plan and Drainage Plan

The exhibits provided in this section are to illustrate the post construction BMPs prescribed within this WQMP. Drainage flow information of the proposed project, such as general surface flow lines, concrete or other surface drainage conveyances, and storm drain facilities are also depicted. All structural source control and treatment control BMPs are shown as well.

Exhibits

- Vicinity Map
- WQMP Site Plan

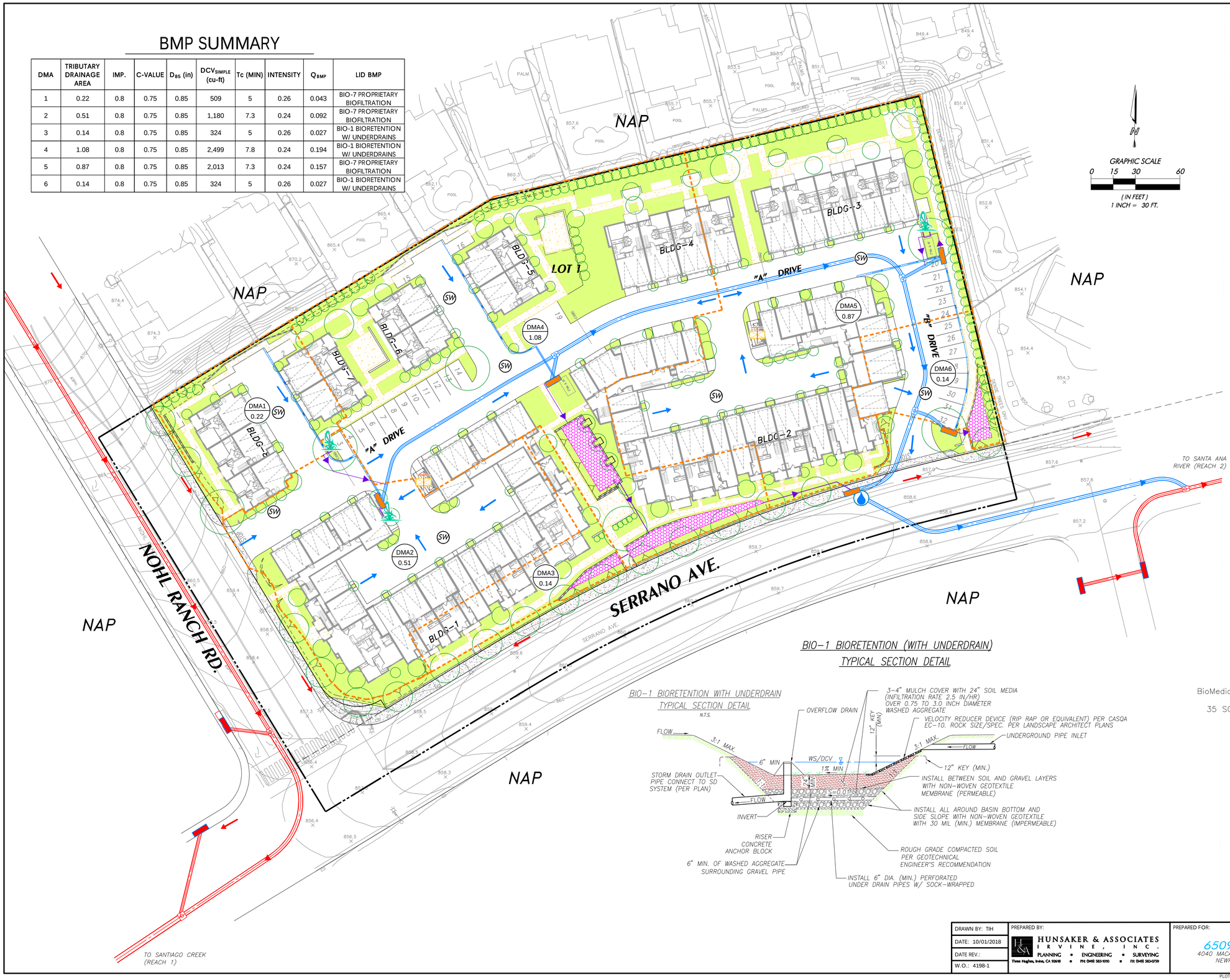


DRAWN BY: TIH	PREPARED BY: HUNSAKER & ASSOCIATES IRVINE, INC. PLANNING ▪ ENGINEERING ▪ SURVEYING Three Hughes, Irvine, CA 92618 ▪ PH: (949) 583-1010 ▪ FX: (949) 583-0759	PREPARED FOR: 6509 SERRANO L.P. 4040 MACARTHUR BOULEVARD, STE 300 NEWPORT BEACH, CA 92660 (714) 658-6299	"NOHL RANCH CONDOMINIUMS" VESTING TENTATIVE TRACT MAP NO. 18104 6509 SERRANO AVENUE CITY OF ANAHEIM, CA	PRELIMINARY WQMP VICINITY MAP
DATE: 04/16/2018				
W.O.: 4198-1				

DATE: Apr. 17, 2018 09:14:31 AM FILE: F:\0985\Planning\SY_WQ\WQMP\Exhibits\PWQMP_VIC TTM18104.dwg

BMP SUMMARY

DMA	TRIBUTARY DRAINAGE AREA	IMP.	C-VALUE	D_{85} (in)	DCV_{SIMPLE} (cu-ft)	Tc (MIN)	INTENSITY	Q_{BMP}	LID BMP
1	0.22	0.8	0.75	0.85	509	5	0.26	0.043	BIO-7 PROPRIETARY BIOFILTRATION
2	0.51	0.8	0.75	0.85	1,180	7.3	0.24	0.092	BIO-7 PROPRIETARY BIOFILTRATION
3	0.14	0.8	0.75	0.85	324	5	0.26	0.027	BIO-1 BIORETENTION W/ UNDERDRAINS
4	1.08	0.8	0.75	0.85	2,499	7.8	0.24	0.194	BIO-1 BIORETENTION W/ UNDERDRAINS
5	0.87	0.8	0.75	0.85	2,013	7.3	0.24	0.157	BIO-7 PROPRIETARY BIOFILTRATION
6	0.14	0.8	0.75	0.85	324	5	0.26	0.027	BIO-1 BIORETENTION W/ UNDERDRAINS



LEGEND

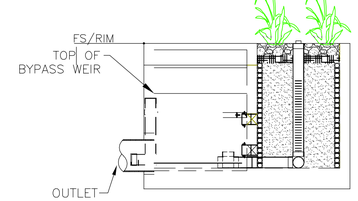
- TRACT BOUNDARY
- NAP — NOT A PART
- DRAINAGE MANAGEMENT AREA (DMA) LIMITS
- DMA / ACRE — DMA DESIGNATION AND ACREAGE
- SURFACE FLOW (ONSITE)
- SURFACE FLOW (OFFSITE)
- PROPOSED STORM DRAIN SYSTEM (PRIVATE)
- PROPOSED BIORETENTION DRAINAGE SYSTEM (PRIVATE)
- EXISTING STORM DRAIN SYSTEM (PUBLIC)
- PROPOSED CATCH BASIN/INLET (PRIVATE) WITH BMP
  PRE-1 CONNECTOR PIPE SCREEN
  S1 STORM DRAIN SYSTEM STENCILING/SIGNAGE
  N14 COMMON AREA CATCH BASIN INSPECTION
- EXISTING CATCH BASIN (PUBLIC)
- PROPOSED LANDSCAPING AREA WITH BMPS
  N3 COMMON AREA LANDSCAPE MANAGEMENT
  S4 EFFICIENT IRRIGATION SYSTEM AND LANDSCAPING DESIGN
  HSC-2 IMPERVIOUS AREA DISPERSION
  HSC-3 STREET TREES
- S3 DESIGNATED TRASH ENCLOSURE
- BIO-1 BIORETENTION WITH UNDERDRAIN
- PAVEMENT/ WALKWAY
- BIO-7 PROPRIETARY BIOTREATMENT
  MODULAR WETLAND SYSTEM (OR APPROVED EQUIVALENT)
- DISCHARGE POINT/ POINT OF COMPLIANCE
- SW — N15 STREET SWEEPING

N

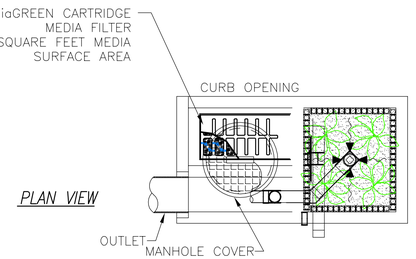
GRAPHIC SCALE
0 15 30 60
(IN FEET)
1 INCH = 30 FT.

BIO-7 PROPRIETARY BIOTREATMENT (MWS) TYPICAL SECTION DETAIL

N.T.S.



ELEVATION VIEW



PLAN VIEW

BIO-1 BIORETENTION (WITH UNDERDRAIN) TYPICAL SECTION DETAIL

BIO-1 BIORETENTION WITH UNDERDRAIN
TYPICAL SECTION DETAIL
N.T.S.

DRAWN BY: TIH DATE: 10/01/2018 DATE REV.: W.O.: 4198-1	PREPARED BY: HUNSAKER & ASSOCIATES IRVINE, INC. PLANNING ■ ENGINEERING ■ SURVEYING Three Hughes, Irvine, CA 92618 ■ PH: (949) 583-1010 ■ FX: (949) 583-0759	PREPARED FOR: 6509 SERRANO L.P. 4040 MACARTHUR BOULEVARD, STE 300 NEWPORT BEACH, CA 92660 (714) 658-6299	"NOHL RANCH CONDOMINIUMS" VTTM NO. 18104 6509 SERRANO AVENUE CITY OF ANAHEIM, CA	PRELIMINARY WQMP SITE PLAN

PLOTTED BY: Tommy Hsu DATE: Oct. 01, 2018 01:52:02 PM FILE: F:\0985\Planning\SY_WQ\WQMP\Exhibits\PWQMP_SP Nohl Ranch.dwg

Vicinity Map, WQMP Site Plan

Section VII Educational Materials

Education Materials			
Residential Material (http://www.ocwatersheds.com)	Check If Applicable	Business Material (http://www.ocwatersheds.com)	Check If Applicable
The Ocean Begins at Your Front Door	☒	Tips for the Automotive Industry	☐
Tips for Car Wash Fund-raisers	☐	Tips for Using Concrete and Mortar	☐
Tips for the Home Mechanic	☒	Tips for the Food Service Industry	☐
Homeowners Guide for Sustainable Water Use	☒	Proper Maintenance Practices for Your Business	☐
Household Tips	☒	Other Material	Check If Attached
Proper Disposal of Household Hazardous Waste	☒		
Recycle at Your Local Used Oil Collection Center (North County)	☐		☐
Recycle at Your Local Used Oil Collection Center (Central County)	☒		☐
Recycle at Your Local Used Oil Collection Center (South County)	☐		☐
Tips for Maintaining a Septic Tank System	☐		☐
Responsible Pest Control	☒		☐
Sewer Spill	☒		☐
Tips for the Home Improvement Projects	☒		☐
Tips for Horse Care	☐		☐
Tips for Landscaping and Gardening	☒		☐
Tips for Pet Care	☒		☐
Tips for Pool Maintenance	☐		☐
Tips for Residential Pool, Landscape and Hardscape Drains	☐		☐
Tips for Projects Using Paint	☒		☐

Attachment A

Educational Materials

(Materials to be provided in Final WQMP)

Attachment B

O & M Plan

OPERATIONS AND MAINTENANCE (O&M) PLAN

WATER QUALITY MANAGEMENT PLAN

FOR

"NOHL RANCH CONDOMINIUMS" – TENTATIVE TRACT MAP NO. 18104

CITY OF ANAHEIM

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Non-Structural Source Control BMPs			
Yes	**N1. Education for Property Owners, Tenants and Occupants** Educational materials will be provided to the owner an annual basis. Materials shall include those provided in Attachment A of this WQMP and any updated materials.	At close of escrow and annually	Owner/HOA
Yes	**N2. Activity Restrictions** The Owner will prescribe activity restrictions to protect surface water quality. Restrictions will include prohibiting vehicle washing onsite, standard operating procedures for proper waste and material storage and handling, maintenance activities and water conservation.	Ongoing	Owner/HOA
Yes	**N3. Common Area Landscape Management** Maintenance shall be consistent with City requirements, plus fertilizer and/or pesticide usages shall be consistent with County guidelines for use of fertilizers and pesticides (OC DAMP Section 5.5). Maintenance includes mowing, weeding, and debris removal on a weekly basis. Trimming, replanting and replacement of mulch shall be performed on an as-needed basis. Trimmings, clippings, and other waste shall be properly disposed of off-site in accordance with local regulations. Materials temporarily stockpiled during maintenance activities shall be placed away from water courses and drain inlets.	Monthly	Owner/HOA

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**N4. BMP Maintenance** Maintenance of BMPs implemented at the project site shall be performed at the frequency prescribed in this WQMP. Records of inspections and BMP maintenance shall be maintained by the responsible party and documented with the WQMP, and shall be available for review upon request.	Ongoing, as prescribed per WQMP	Owner/HOA
No	**N5. Title 22 CCR Compliance** Not applicable to residential projects.		
No	**N6. Local Water Quality Permit Compliance** Not applicable. No local water quality permits are required for the operation of the project.		
No	**N7. Spill Contingency Plan** Not applicable to residential projects.		
No	**N8. Underground Storage Tank Compliance** Not applicable. None onsite.		
No	**N9. Hazardous Materials Disclosure Compliance** Not applicable to residential projects.		
No	**N10. Uniform Fire Code Implementation** Not applicable to residential projects.		
Yes	**N11. Common Area Litter Control** Owner/HOA shall implement litter control procedures to minimize the potential for runoff pollution. City shall also designate staff or contractor to patrol the site on a regular basis, ensuring all litter is properly disposed and illegal dumping/disposal is reported and investigated.	Ongoing patrols. Weekly (minimum) pick up and removal. Monthly inspections with landscaping maintenance	Owner/HOA

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**N12. Employee Training** All staff and employees of the HOA shall receive initial training upon hire and annually thereafter on the importance of their actions on storm water quality. Training shall include educational materials provided by the County as well as other permitting agencies.	Upon hire and annually	Owner/HOA
No	**N13. Housekeeping of Loading Docks** Not applicable. None proposed.		
Yes	**N14. Common Area Catch Basin Inspection** Catch basin inlets, area drains, bioretention areas, curb-and-gutter systems and other drainage systems shall be inspected prior to October 1st of each year and after large storm events. If necessary, drains shall be cleaned prior to any succeeding rain events. 80% of facilities shall be inspected and cleaned annually, with 100% of facilities inspected and maintained	Annually	Owner/HOA
Yes	**N15. Street Sweeping** Streets must be swept at minimum, prior to the onset of the traditional rainy season, in late summer or early fall (October 1).	Annually and as needed	Owner/HOA
	Structural Source Control BMPs		
Yes	**S1. Provide Storm Drain System Stenciling and Signage** Storm drain stencils shall be inspected for legibility, at minimum, once prior to the storm season, no later than October 1st each year. Those determined to be illegible will be re-stenciled as soon as possible.	Annually	Owner/HOA

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
No	**S2. Design Outdoor Hazardous Material Storage Areas to Reduce Pollutant Introduction** Not applicable. No outdoor storage of hazardous materials onsite.		
Yes	**S3. Design Trash Enclosures to Reduce Pollutant Introduction** Designated trash enclosure areas shall be covered and designed to preclude trash and pad area from run-on, run-off and wind. Any drains within area shall be connected to the sanitary sewer system, with proper approval from the sewer company. Site shall be inspected with use to ensure all materials are disposed of properly.	Daily with use	Owner/ HOA
Yes	**S4. Use Efficient Irrigation Systems and Landscape Design** In conjunction with routine maintenance activities, verify that landscape design continues to function properly by adjusting properly to eliminate overspray to hardscape areas, and to verify that irrigation timing and cycle lengths are adjusted in accordance with water demands, given time of year, weather, day or night time temperatures based on system specifications and local climate patterns.	Monthly	Owner/HOA
No	**S5. Protect Slopes and Channels** Not applicable. Site is flat.		
No	**S6. Loading Dock Areas** Not applicable. None proposed.		
No	**S7. Maintenance Bays and Docks** Not applicable. None proposed.		

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
No	**S8. Vehicle Wash Areas** Not applicable. None proposed.		
No	**S9. Outdoor Processing Areas** Not applicable. No outdoor processing onsite.		
No	**S10. Equipment Wash Areas** Not applicable. No wash areas onsite.		
No	**S11. Fueling Areas** Not applicable. No fueling areas onsite.		
No	**S12. Site Design and Landscape Planning (Hillside Landscaping)** Not applicable. Project is not hillside development.		
No	**S13. Wash Water Controls for Food Preparation Areas** Not applicable. None proposed.		
No	**S14. Community Car Wash Racks** Not applicable. None proposed.		
Project BMPs			
Hydrologic Source Control #1 **HSC-2 Impervious Area Dispersion** – Inspect dispersion area for signs of scouring, standing water, saturated conditions and dead/dying vegetation. Inspection vegetation for overall health with N3 and S4. Repair and replace as necessary. Mow/trim dispersion area as needed.		After significant storm events and monthly with landscaping maintenance	Owner/HOA
Hydrologic Source Control #1 **HSC-3 Street Trees** – Inspect for standing water and that water is absorbed by landscaping/soil. Inspect vegetation for overall health with N3 and S4.		After significant storm events and monthly with landscaping maintenance	Owner/HOA

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
	Biotreatment BMP #1 **BIO-1 Bioretention with Underdrains** Conduct general inspection and maintenance per routine landscaping maintenance activities. Inspect surface area for debris, trash and vegetation accumulation. Inspect for general plant health. Inspect for sediment, build up on planting surface and in area drain inlet. Inspect for sediment or debris clogging inlet. Clean/repair items as necessary. Inspect for ponding water lasting more than 48 hours after a rain event. Unclog sub-drain pipe and/or aeration of soil as necessary. Remove vegetation, permeable soil and drain rock. Replace in kind. Check sub-drain pipe and inlet. Repair if necessary.	Weekly Monthly (Rainy Season) Every 5 to 7 years	Owner/HOA
	Biotreatment BMP #2 **BIO-7 Proprietary Biotreatment** Inspect unit for accumulated debris and sediment and plant health; remove trash from screening device and separation chamber; trim vegetation. Remove sediment from pre-chamber, replace pre-filter cartridge media and drain down filter media. Replace wetland media.	Annually 20 years	Owner/HOA
	Gross Solids Removal BMP – Catch Basin Connector Pipe Screen Inspect catch basin for debris accumulation. Clean out catch basin when debris accumulation exceeds 40% of height of connector pipe screen to prevent potential flooding and/or debris overflow into the connecting storm drain system.	Quarterly	Owner/HOA

Required Permits

No additional permits are necessary for the operation and maintenane of the proposed BMPs.

Forms to Record BMP Implementation, Maintenance, and Inspection

The form that will be used to record implementation, maintenance, and inspection of BMPs is attached.

Recordkeeping

All records must be maintained for at least five (5) years and must be made available for review upon request.

Today's Date: _____

Name of Person Performing Activity (Printed): _____

Signature: _____

BMP Name (As Shown in O&M Plan)	Brief Description of Implementation, Maintenance, and Inspection Activity Performed

Attachment C

BMP Feasibility Worksheets, Calculations and Details

BMP Feasibility Worksheet

Table 2.7: Infiltration BMP Feasibility Worksheet

	Infeasibility Criteria	*Yes*	*No*
1	Would Infiltration BMPs pose significant risk for groundwater related concerns? Refer to Appendix VII (Worksheet I) for guidance on groundwater-related infiltration feasibility criteria.		X
Provide basis: Based on TGD and Count of Orange GIS data, there are no restrictions for infiltration.			
2	Would Infiltration BMPs pose significant risk of increasing risk of geotechnical hazards that cannot be mitigated to an acceptable level? (Yes if the answer to any of the following questions is yes, as established by a geotechnical expert): The BMP can only be located less than 50 feet away from slopes steeper than 15 percent. The BMP can only be located less than eight feet from building foundations or an alternative setback. A study prepared by a geotechnical professional or an available watershed study substantiates that stormwater infiltration would potentially result in significantly increased risks of geotechnical hazards that cannot be mitigated to an acceptable level.	X	
Provide basis: The project site resides in close proximity to the Geologic Hazard Abatement District Benefit Area, as part of the Santiago Landslide Area. Per preliminary correspondence with the geotechnical professional, infiltration should be avoided (See Attachment E).			
3	Would infiltration of the DCV from drainage area violate downstream water rights?		X
Provide basis: No restrictions on water rights for project site.			
	Partial Infeasibility Criteria	*Yes*	*No*
4	Is proposed infiltration facility located on HSG D soils or the site geotechnical investigation identifies presence of soil characteristics which support categorization as D soils?	X	
Provide basis: Per TGD, site consists primarily of HSG D soils. Soils report is currently under preparation.			
5	Is measured infiltration rate below proposed facility less than 0.3 inches per hour? This calculation shall be based on the methods described in Appendix VII.		X
Provide basis: No information currently available as the project's geotechnical investigation is currently under preparation.			

Table 2.7: Infiltration BMP Feasibility Worksheet

	Infeasibility Criteria	*Yes*	*No*
6	Would reduction of over pre-developed conditions cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?		X
Provide citation to applicable study and summarize findings relative to the amount of infiltration that is permissible: Project discharges to storm drains and channels that are not ephemeral.			
7	Would an increase in infiltration over pre-developed conditions cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?		X
Provide citation to applicable study and summarize findings relative to the amount of infiltration that is permissible: Based on TGD and county GIS records, no restrictions on infiltration due to groundwater concerns.			
Infiltration Screening Results (check box corresponding to result):			
8	Is there substantial evidence that infiltration from the project would result in a significant increase in I&I to the sanitary sewer that cannot be sufficiently mitigated? (See Appendix XVII) Provide narrative discussion and supporting evidence: Per TGD and County of Orange GIS data, project is not located in an area where increase in I&I to the sanitary sewer is of concern.		X
9	If any answer from row 1-3 is yes: infiltration of any volume is not feasible within the DMA or equivalent. Provide basis: Answer to 2 is no. Awaiting geotechnical report completion.	Infiltration is not feasible. Awaiting geotechnical report for confirmation.	
10	If any answer from row 4-7 is yes, infiltration is permissible but is not presumed to be feasible for the entire DCV. Criteria for designing biotreatment BMPs to achieve the maximum feasible infiltration and ET shall apply. Provide basis:		
11	If all answers to rows 1 through 11 are no, infiltration of the full DCV is potentially feasible, BMPs must be designed to infiltrate the full DCV to the maximum extent practicable. Provide basis:		

Worksheet J: Summary of Harvested Water Demand and Feasibility

1	What demands for harvested water exist in the tributary area (check all that apply):			
2	Toilet and urinal flushing		☐	
3	Landscape irrigation		☒	
4	Other:		☐	
5	What is the design capture storm depth? (Figure III.1)	d	0.85	inches
6	What is the project size?	A	3.04	ac
7	What is the acreage of impervious area?	IA	3.14	ac
	For projects with multiple types of demand (toilet flushing, irrigation demand, and/or other demand)			
8	What is the minimum use required for partial capture? (Table X.6)			gpd
9	What is the project estimated wet season total daily use (Section X.2)?			gpd
10	Is partial capture potentially feasible? (Line 9 > Line 8?)			
	For projects with only toilet flushing demand			
11	What is the minimum TUTIA for partial capture? (Table X.7)			users
12	What is the project estimated TUTIA?			users
13	Is partial capture potentially feasible? (Line 12 > Line 11?)			
	For projects with only irrigation demand			
14	What is the minimum irrigation area required based on conservation landscape design? (Table X.8)	2.98		ac
15	What is the proposed project irrigated area? (multiply conservation landscaping by 1; multiply active turf by 2)	0.61		ac
16	Is partial capture potentially feasible? (Line 15 > Line 14?)	No		

Provide supporting assumptions and citations for controlling demand calculation:
Item 14 – Min. irrigation area for conservation landscape (K_L= 0.35) = 0.95 x 3.14 ac = **2.98 ac**
Item 15 – Proposed irrigated area = 0.61 ac x 1 = **0.61 ac**

BMP Calculations

Worksheet B: Simple Design Capture Volume Sizing Method

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.85	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.85	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	See table	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=		
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=		
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=		cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=	N/A	In/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=		
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=		In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	N/A	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=		feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=		sq-ft
Calculations:				

DMA	Tributary Drainage Area (Ac.)	Imp.	C-value	Design Storm Depth (in.)	Simple Method DCV (cu-ft)
1	0.88	0.80	0.75	0.85	2,036
2	1.08	0.80	0.75	0.85	2,499
3	0.87	0.80	0.75	0.85	2,013
4	0.14	0.80	0.75	0.85	324

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	See Table Below	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	See Table Below	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP $I_{design} = I_1 - I_2$	I_{design}=	See Table Below	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	See Table Below	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=		
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=		
4	Calculate design flow rate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=		cfs

Supporting Calculations

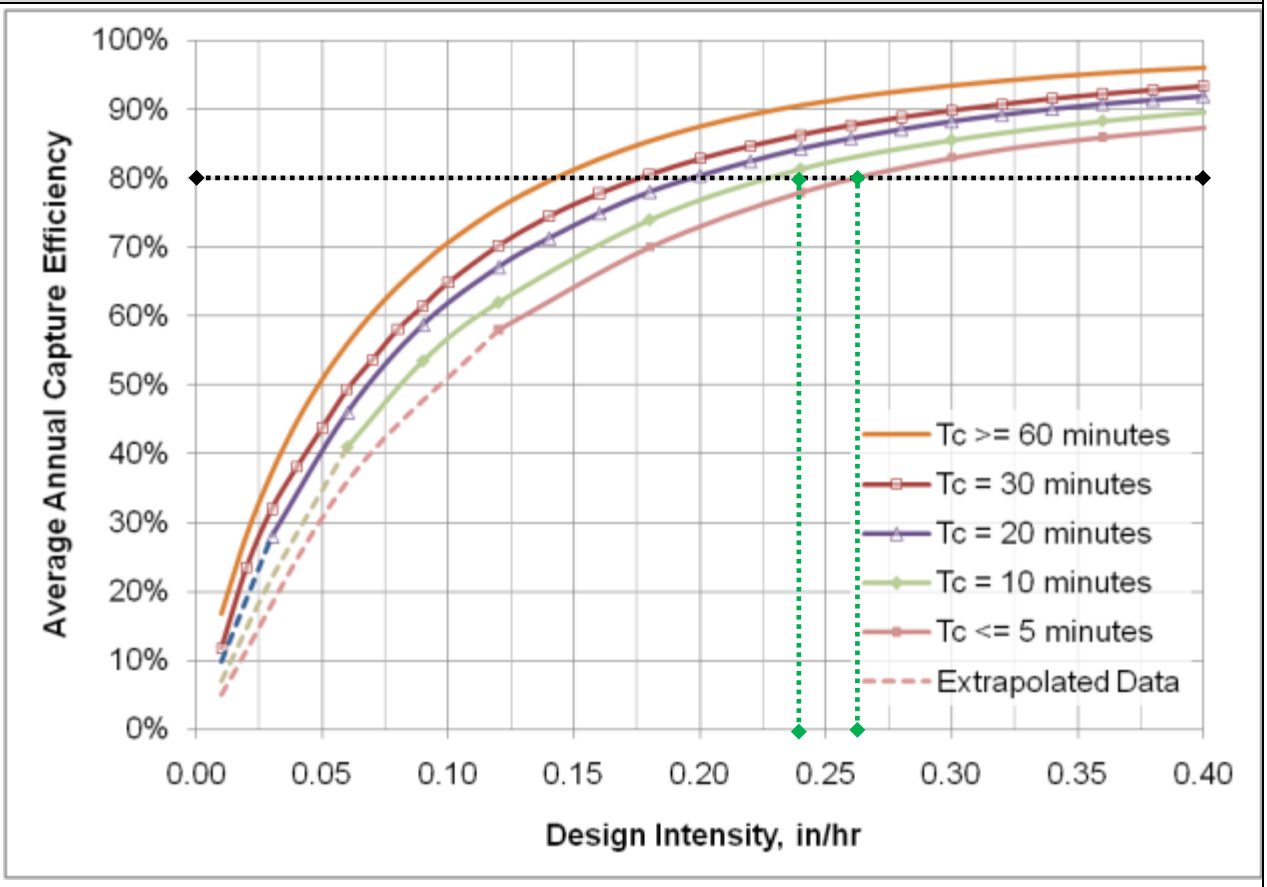
Describe system: DMA 1 and 3 runoff conveyed to proprietary biofiltration BMPs. DMA 2 and 4 conveyed to bioretention with underdrain BMP.

DMA	Tributary Drainage Area (Ac.)	% Imp.	C-value	Tc (Min)	Design Intensity (in/hr)	Design Flowrate (cfs)	BMP Model (Capacity cfs)
1	0.22	80	0.75	5	0.26	0.043	MWS-L-4-4 (0.052)
2	0.51	80	0.75	7.3	0.24	0.092	MWS-L-4-8 (0.115)
5	0.87	80	0.75	7.3	0.24	0.157	MWS-L-4-15 (0.175)

Provide time of concentration assumptions: T_c determined based on the 2-year event for each DMA. See Attachment D.

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Graphical Operations



Worksheet C: Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, d (inches)	d=	0.85	inches
2	Enter calculated drawdown time of the proposed BMP based on equation provided in applicable BMP Fact Sheet, T (hours)	T=	3	hours
3	Using Figure III.2, determine the "fraction of design capture storm depth" at which the BMP drawdown time (T) line achieves 80% capture efficiency, X_1	X_1=	0.26	
4	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
5	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	0	%
6	Using Figure III.2, determine the fraction of "design capture storm depth" at which the drawdown time (T) achieves the equivalent of the upstream capture efficiency(Y_2), X_2	X_2=	0	
7	Calculate the fraction of design volume that must be provided by BMP, fraction = X_1 - X_2	fraction=	0.26	
8	Calculate the resultant design capture storm depth (inches), $d_{fraction}$= fraction × d	$d_{fraction}$=	0.22	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), A (acres)	A=	See table below	acres
2	Enter Project Imperviousness, imp (unitless)	imp=		
3	Calculate runoff coefficient, C= (0.75 x imp) + 0.15	C=		
4	Calculate runoff volume, V_{design}= (C x $d_{rfraction}$ x A x 43560 x (1/12))	V_{design}=		cu-ft

Supporting Calculations

Describe system: Runoff from DMAs 3, 4 and conveyed to bioretention BMPs at the southern portions of the site. Facilities have 0.5' ponding depth, 2' of engineered soil media over 1' of rock.

DMA	Tributary Drainage Area (Ac.)	Imp.	C-value	$D_{fraction}$	V_{design} (cu-ft)	A_{min} (sf)	A_{design} (sf)
3	0.14	0.80	0.75	0.22	84.2	168.5	191
4	0.87	0.80	0.75	0.22	649.8	1,300	1,491
6	0.14	0.80	0.75	0.22	84.2	168.5	349

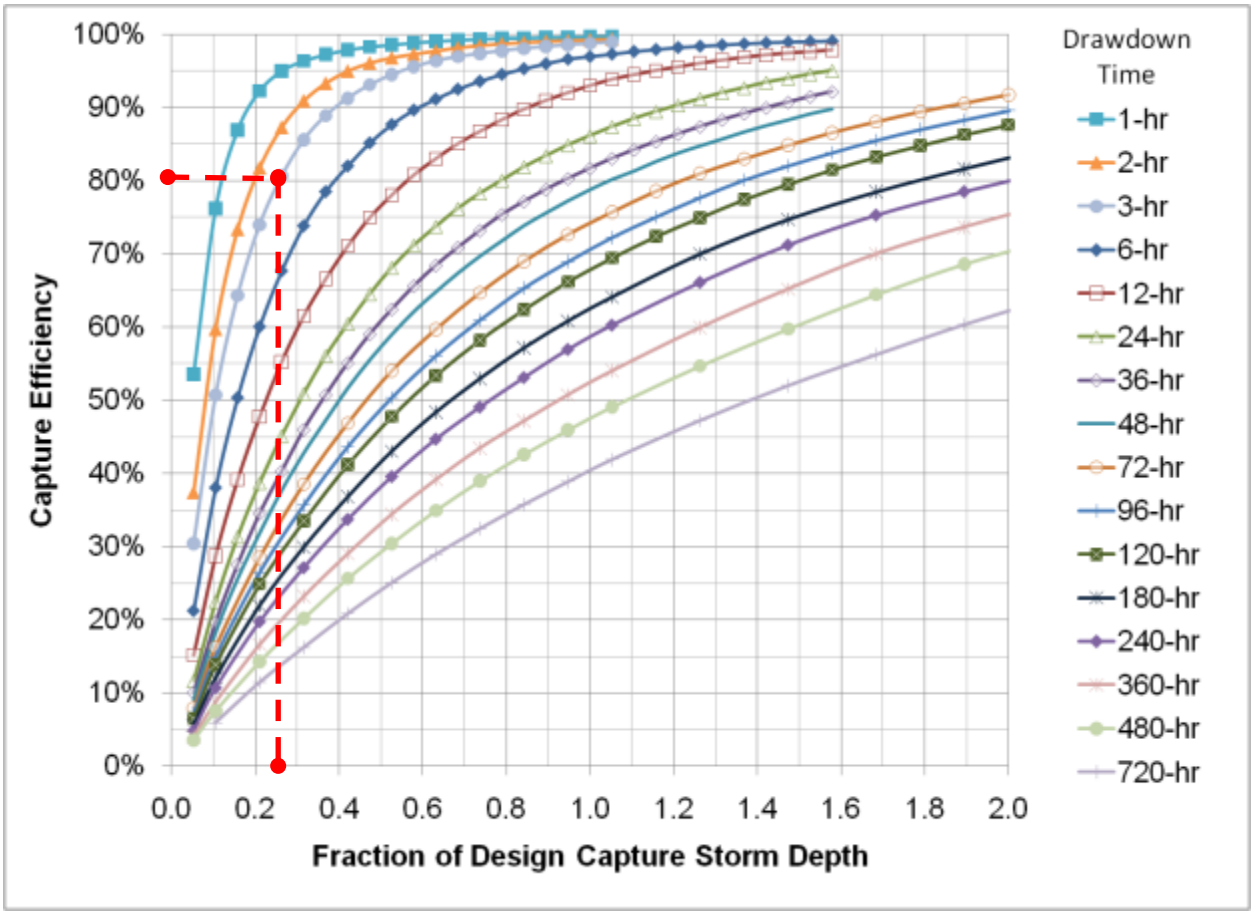
Provide drawdown time calculations per applicable BMP Fact Sheet:

DD_P= (d_P/K_{MEDIA}) x 12 in/hr = (0.5 ft/2.5 in/hr) x 12 in/ft = 2.4 hrs. Use 3 hours.

Footprint required (A) = V_{DESIGN}/ d_P

Worksheet C: Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs

Graphical Operations



BMP Details

Biotreatment

BIO-1 Bioretention with Underdrains
BIO-7 Proprietary Biotreatment

XIV.5. Biotreatment BMP Fact Sheets (BIO)

Conceptual criteria for biotreatment BMP selection, design, and maintenance are contained in **Appendix XII**. These criteria are generally applicable to the design of biotreatment BMPs in Orange County and BMP-specific guidance is provided in the following fact sheets.

Note: Biotreatment BMPs shall be designed to provide the maximum feasible infiltration and ET based on criteria contained in ***Appendix*** **XI.2**.

BIO-1: Bioretention with Underdrains

Bioretention stormwater treatment facilities are landscaped shallow depressions that capture and filter stormwater runoff. These facilities function as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. The facilities normally consist of a ponding area, mulch layer, planting soils, and plants. As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded, and sequestered by the soil and plants. Bioretention with an underdrain are utilized for areas with low permeability native soils or steep slopes where the underdrain system that routes the treated runoff to the storm drain system rather than depending entirely on infiltration. **Bioretention must be designed without an underdrain** in areas of high soil permeability.

Also known as:

- *Rain gardens with underdrains*
- *Vegetated media filter*
- *Downspout planter boxes*

Bioretention
Source: Geosyntec Consultants

Feasibility Screening Considerations

- If there are no hazards associated with infiltration (such as groundwater concerns, contaminant plumes or geotechnical concerns), **bioinfiltration facilities**, which achieve partial infiltration, should be used to maximize infiltration.
- Bioretention with underdrain facilities should be lined if contaminant plumes or geotechnical concerns exist. If high groundwater is the reason for infiltration infeasibility, bioretention facilities with underdrains do not need to be lined.

Opportunity Criteria

- Land use may include commercial, residential, mixed use, institutional, and subdivisions. Bioretention may also be applied in parking lot islands, cul-de-sacs, traffic circles, road shoulders, road medians, and next to buildings in planter boxes.
- Drainage area is ≤ 5 acres.
- Area is available for infiltration.

- Site must have adequate relief between land surface and the stormwater conveyance system to permit vertical percolation through the soil media and collection and conveyance in underdrain to stormwater conveyance system.

OC-Specific Design Criteria and Considerations

- ☐ Ponding depth should not exceed 18 inches; fencing may be required if ponding depth is greater than 6 inches to mitigate drowning.
- ☐ The minimum soil depth is 2 feet (3 feet is preferred).
- ☐ The maximum drawdown time of the bioretention ponding area is 48 hours. The maximum drawdown time of the planting media and gravel drainage layer is 96 hours, if applicable.
- ☐ Infiltration pathways may need to be restricted due to the close proximity of roads, foundations, or other infrastructure. A geomembrane liner, or other equivalent water proofing, may be placed along the vertical walls to reduce lateral flows. This liner should have a minimum thickness of 30 mils.
- ☐ If infiltration in bioretention location is hazardous due to groundwater or geotechnical concerns, a geomembrane liner must be installed at the base of the bioretention facility. This liner should have a minimum thickness of 30 mils.
- ☐ The planting media placed in the cell shall be designed per the recommendations contained in MISC-1: Planting/Storage Media
- ☐ Plant materials should be tolerant of summer drought, ponding fluctuations, and saturated soil conditions for 48 hours; native place species and/or hardy cultivars that are not invasive and do not require chemical inputs should be used to the maximum extent feasible
- ☐ The bioretention area should be covered with 2-4 inches (average 3 inches) or mulch at the start and an additional placement of 1-2 inches of mulch should be added annually.
- ☐ Underdrain should be sized with a 6 inch minimum diameter and have a 0.5% minimum slope. Underdrain should be slotted polyvinyl chloride (PVC) pipe; underdrain pipe should be more than 5 feet from tree locations (if space allows).
- ☐ A gravel blanket or bedding is required for the underdrain pipe(s). At least 0.5 feet of washed aggregate must be placed below, to the top, and to the sides of the underdrain pipe(s).
- ☐ An overflow device is required at the top of the bioretention area ponding depth.
- ☐ Dispersed flow or energy dissipation (i.e. splash rocks) for piped inlets should be provided at basin inlet to prevent erosion.
- ☐ Ponding area side slopes shall be no steeper than 3:1 (H:V) unless designed as a planter box BMP with appropriate consideration for trip and fall hazards.

Simple Sizing Method for Bioretention with Underdrain

If the Simple Design Capture Volume Sizing Method described in **Appendix III.3.1** is used to size a bioretention with underdrain facility, the user selects the basin depth and then determines the appropriate surface area to capture the DCV. The sizing steps are as follows:

Step 1: Determine DCV

Calculate the DCV using the Simple Design Capture Volume Sizing Method described in **Appendix III.3.1**.

Step 2: Verify that the Ponding Depth will Draw Down within 48 Hours

The ponding area drawdown time can be calculated using the following equation:

$DD_P = (d_P / K_{MEDIA}) \times 12$ in/ft

Where:

DD_P = time to drain ponded water, hours

d_P = depth of ponding above bioretention area, ft (not to exceed 1.5 ft)

K_{MEDIA} = media design infiltration rate, in/hr (equivalent to the media hydraulic conductivity with a factor of safety of 2; K_{MEDIA} of 2.5 in/hr should be used unless other information is available)

If the drawdown time exceeds 48 hours, adjust ponding depth and/or media infiltration rate until 48 hour drawdown time is achieved.

Step 3: Determine the Depth of Water Filtered During Design Capture Storm

The depth of water filtered during the design capture storm can be estimated as the amount routed through the media during the storm, or the ponding depth, whichever is smaller.

$d_{FILTERED}$ = Minimum [$((K_{MEDIA} \times T_{ROUTING})/12)$, d_P]

Where:

$d_{FILTERED}$ = depth of water that may be considered to be filtered during the design storm event, ft

K_{MEDIA} = media design infiltration rate, in/hr (equivalent to the media hydraulic conductivity with a factor of safety of 2; K_{MEDIA} of 2.5 in/hr should be used unless other information is available)

$T_{ROUTING}$ = storm duration that may be assumed for routing calculations; this should be assumed to be no greater than 3 hours. If the designer desires to account for further routing effects, the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (See **Appendix III.3.2**) should be used.

d_P = depth of ponding above bioretention area, ft (not to exceed 1.5 ft)

Step 4: Determine the Facility Surface Area

$A = DCV / (d_P + d_{FILTERED})$

Where:

A = required area of bioretention facility, sq-ft

DCV = design capture volume, cu-ft

$d_{FILTERED}$ = depth of water that may be considered to be filtered during the design storm event, ft

d_P = depth of ponding above bioretention area, ft (not to exceed 1.5 ft)

Capture Efficiency Method for Bioretention with Underdrains

If the bioretention geometry has already been defined and the user wishes to account more explicitly for routing, the user can determine the required footprint area using the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (See **Appendix III.3.2**) to determine the fraction of the DCV that must be provided to manage 80 percent of average annual runoff volume. This method accounts for drawdown time different than 48 hours.

Step 1: Determine the drawdown time associated with the selected basin geometry

$DD = (d_p / K_{DESIGN}) \times 12$ in/ft

Where:

DD = time to completely drain infiltration basin ponding depth, hours

d_P = bioretention ponding depth, ft (should be less than or equal to 1.5 ft)

K_{DESIGN} = design media infiltration rate, in/hr (assume 2.5 inches per hour unless otherwise proposed)

If drawdown is less than 3 hours, the drawdown time should be rounded to 3 hours or the Capture Efficiency Method for Flow-based BMPs (See **Appendix III.3.3**) shall be used.

Step 2: Determine the Required Adjusted DCV for this Drawdown Time

Use the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (See **Appendix III.3.2**) to calculate the fraction of the DCV the basin must hold to achieve 80 percent capture of average annual stormwater runoff volume based on the basin drawdown time calculated above.

Step 3: Determine the Basin Infiltrating Area Needed

The required infiltrating area (i.e. the surface area of the top of the media layer) can be calculated using the following equation:

A = Design Volume / d_p

Where:

A = required infiltrating area, sq-ft (measured at the media surface)

Design Volume = fraction of DCV, adjusted for drawdown, cu-ft (see Step 2)

d_p = ponding depth of water stored in bioretention area, ft (from Step 1)

This does not include the side slopes, access roads, etc. which would increase bioretention footprint. If the area required is greater than the selected basin area, adjust surface area or adjust ponding depth and recalculate required area until the required area is achieved.

Configuration for Use in a Treatment Train

- Bioretention areas may be preceeded in a treatment train by HSCs in the drainage area, which would reduce the required design volume of the bioretention cell. For example, bioretention could be used to manage overflow from a cistern.
- Bioretention areas can be used to provide pretreatment for underground infiltration systems.

Additional References for Design Guidance

- CASQA BMP Handbook for New and Redevelopment: **http://www.cabmphandbooks.com/Documents/Development/TC-32.pdf**
- SMC LID Manual (pp 68): **http://www.lowimpactdevelopment.org/guest75/pub/All_Projects/SoCal_LID_Manual/SoCalLID_Manual_FINAL_040910.pdf**
- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 5: **http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf**
- San Diego County LID Handbook Appendix 4 (Factsheet 7): **http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf**

  Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4: **http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850**
- County of Los Angeles Low Impact Development Standards Manual, Chapter 5: **http://dpw.lacounty.gov/wmd/LA_County_LID_Manual.pdf**

BIO-7: Proprietary Biotreatment

Proprietary biotreatment devices are devices that are manufactured to mimic natural systems such as bioretention areas by incorporating plants, soil, and microbes engineered to provide treatment at higher flow rates or volumes and with smaller footprints than their natural counterparts. Incoming flows are typically filtered through a planting media (mulch, compost, soil, plants, microbes, etc.) and either infiltrated or collected by an underdrain and delivered to the storm water conveyance system. Tree box filters are an increasingly common type of proprietary biotreatment device that are installed at curb level and filled with a bioretention type soil. For low to moderate flows they operate similarly to bioretention systems and are bypassed during high flows. Tree box filters are highly adaptable solutions that can be used in all types of development and in all types of soils but are especially applicable to dense urban parking lots, street, and roadways.

Also known as:

- *Catch basin planter box*
- *Bioretention vault*
- *Tree box filter*

Proprietary biotreatment
Source:
http://www.americastusa.com
/index.php/filterra/

Feasibility Screening Considerations

- Proprietary biotreatment devices that are unlined may cause incidental infiltration. Therefore, an evaluation of site conditions should be conducted to evaluate whether the BMP should include an impermeable liner to avoid infiltration into the subsurface.

Opportunity Criteria

- Drainage areas of 0.25 to 1.0 acres.
- Land use may include commercial, residential, mixed use, institutional, and subdivisions. Proprietary biotreatment facilities may also be applied in parking lot islands, traffic circles, road shoulders, and road medians.
- Must not adversely affect the level of flood protection provided by the drainage system.

OC-Specific Design Criteria and Considerations

☐ Frequent maintenance and the use of screens and grates to keep trash out may decrease the likelihood of clogging and prevent obstruction and bypass of incoming flows.

☐ Consult proprietors for specific criteria concerning the design and performance.

☐ Proprietary biotreatment may include specific media to address pollutants of concern. However, for proprietary device to be considered a biotreatment device the media must be capable of supporting rigorous growth of vegetation.

☐ Proprietary systems must be acceptable to the reviewing agency. Reviewing agencies shall have the discretion to request performance information. Reviewing agencies shall have the discretion to deny the use of a proprietary BMP on the grounds of performance, maintenance considerations, or other relevant factors.

☐ In right of way areas, plant selection should not impair traffic lines of site. Local jurisdictions may also limit plant selection in keeping with landscaping themes.

Computing Sizing Criteria for Proprietary Biotreatment Device

- Proprietary biotreatment devices can be volume based or flow-based BMPs.
- Volume-based proprietary devices should be sized using the Simple Design Capture Volume Sizing Method described in **Appendix III.3.1** or the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs described in **Appendix III.3.2**.
- The required design flowrate for flow-based proprietary devices should be computed using the Capture Efficiency Method for Flow-based BMPs described in **Appendix III.3.3)**.

Additional References for Design Guidance

- Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4: **http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850**
- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 9: **http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf**
- Santa Barbara BMP Guidance Manual, Chapter 6: **http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf**

MWS-LINEAR 2.0 STORMWATER FILTRATION SYSTEM

NATURE AND TECHNOLOGY WORKING TOGETHER IN PERFECT HARMONY.

The need for a new stormwater treatment system is evident. Federal and state requirements on cities and industry to reduce stormwater runoff increase every year as our population explodes. The EPA is now reporting that stormwater runoff represents the nation's number one water quality problem, and is the reason why nearly half of our rivers and lakes are not even clean enough to support fishing or swimming. ***Nearly half.***

MODULAR WETLANDS

To combat this catastrophe, we turned to the expert in this field: **Nature.** By developing technology that imitates the processes found in nature, we've created the most advanced stormwater filtration system available. Years ahead of current EPA requirements, our clients understand that when they invest in our new technology, they are investing in the future. For all of us.

GRATE TYPE

CURB TYPE

MWS-LINEAR TESTED REMOVAL EFFICIENCIES

TSS	Nitrate	Copper	Zinc	Oils & Grease	Bacteria	Turbidity
82% - 98%	74%	>53% - 93%	79% - 81%	84% - 99%	60% - 89%	>90%

Washington State DOE Approved

SIZING

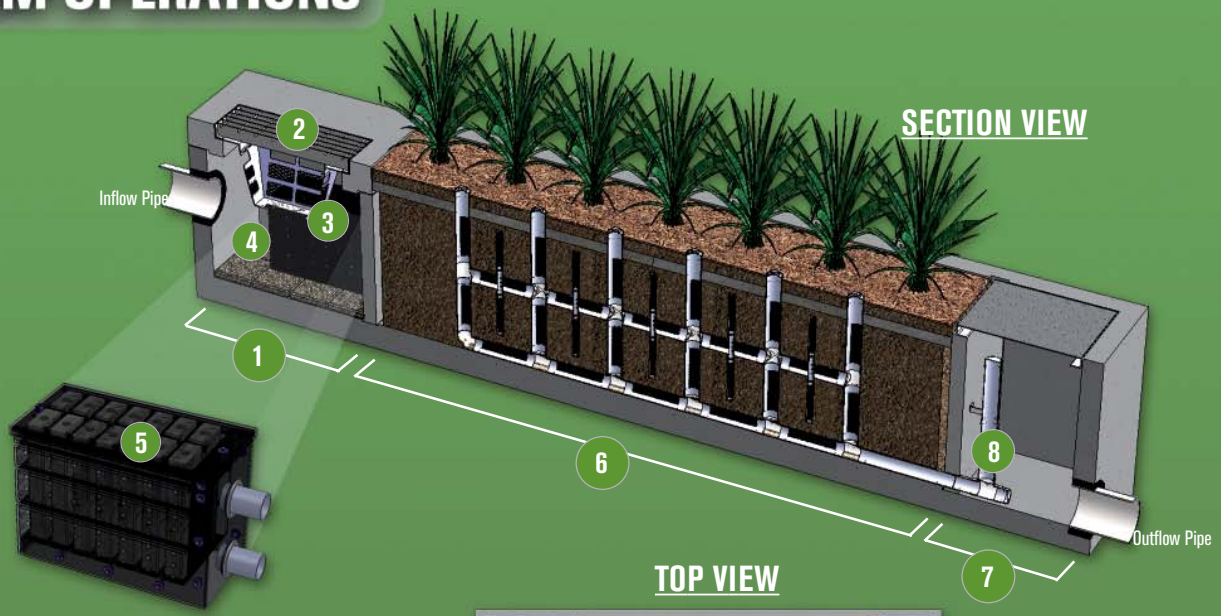
Model #	Dimensions (ft)	WetlandMedia Surface Area (sq ft)	Treatment Flow Rate (cfs)
MWS-L-3-6	3 x 6	34	0.076
MWS-L-4-8	4 x 8	50	0.116
MWS-L-4-13	4 x 13	63	0.144
MWS-L-4-15	4 x 15	76	0.175
MWS-L-4-17	4 x 17	90	0.206
MWS-L-4-19	4 x 19	103	0.236
MWS-L-4-21	4 x 21	117	0.267

VOLUME SIZING

The Modular Wetland System is the only biofilter that can be installed downstream of detention systems.

T 760.433.7640 E info@modularwetlands.com www.modularwetlands.com

SYSTEM OPERATIONS

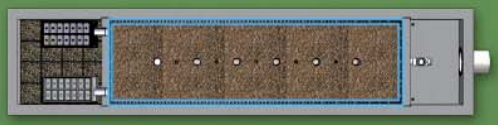


Pre-Filter Cartridge

35 sq ft surface area per cartridge ensures higher effectiveness and lower maintenance requirements.

This pre-filter eliminates maintenance in the Wetland Chamber.

TOP VIEW



Perimeter Wetland Chamber

Pre-filtered runoff entering the wetland chamber flows into a peripheral void area, maximizing the media surface area.

Over 2x to 3x more surface area than traditional downward flow bioretention systems.

INTERNAL HIGH FLOW BYPASS CONFIGURATION AVAILABLE

FEATURES

1. **PRE-TREATMENT CHAMBER**
   Captures incoming runoff and contains the first three stages of treatment.
2. **GRATE TYPE CATCH BASIN INLET**
   A standard 41" x 24" grate type traffic rated catch basin opening directs stormwater into the system.
3. **CATCH BASIN INSERT FILTER**
   Provides the first stage of treatment by capturing trash & litter, gross solids, and sediment.
4. **SETTLING CHAMBER**
   Provides the second stage of treatment by separating out larger suspended solids.
5. **PRE-FILTER CARTRIDGE**
   Provides the third stage of treatment by physically and chemically capturing fine TSS, metals, nutrients, and bacteria.
6. **WETLAND CHAMBER**
   Provides the final stage of treatment through a combination of physical, chemical and biological processes.
7. **DISCHARGE CHAMBER**
   Contains flow control, high flow bypass and optional drain down filter.
8. **MULTI-LEVEL FLOW CONTROL**
   Orifice plates and/or valves are used to control the flow through the treatment stages.

MODULAR WETLANDS

RAINFOREST ALLIANCE CERTIFIED

T 760.433.7640 E info@modularwetlands.com www.modularwetlands.com

Attachment D
Hydromodification Analysis

```
**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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            Ver. 23.0  Release Date: 07/01/2016  License ID 1239

                        Analysis prepared by:

                        HUNSAKER & ASSOCIATES
                              Irvine,Inc
                    Planning * Engineering * Surveying
           Three Hughes * Irvine, California 92618 * (949)583-1010

 ************************* DESCRIPTION OF STUDY *************************
* W.O. 4198-1, NOHL CONDOS                                              *
* 2-YR STUDY                                                            *
* EXISTING CONDITION                                                    *
 **************************************************************************

  FILE NAME: NOHL-E.DAT
  TIME/DATE OF STUDY: 09:21 08/02/2017
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE       1.00 TO NODE       2.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   231.00
  ELEVATION DATA: UPSTREAM(FEET) =    866.00  DOWNSTREAM(FEET) =    860.00
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.564
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.129
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                  D        0.40      0.20      0.100    57    5.56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.76
  TOTAL AREA(ACRES) =      0.40   PEAK FLOW RATE(CFS) =      0.76

**************************************************************************
  FLOW PROCESS FROM NODE       2.00 TO NODE       3.00 IS CODE =  51
--------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    860.00  DOWNSTREAM(FEET) =    858.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   557.00   CHANNEL SLOPE =  0.0036
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.565
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  D        1.65      0.20      0.100    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      1.92
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.35
  AVERAGE FLOW DEPTH(FEET) =   0.52   TRAVEL TIME(MIN.) =   3.95
  Tc(MIN.) =    9.52
  SUBAREA AREA(ACRES) =     1.65      SUBAREA RUNOFF(CFS) =     2.29
  EFFECTIVE AREA(ACRES) =     2.05    AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =      2.0        PEAK FLOW RATE(CFS) =      2.85

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.61   FLOW VELOCITY(FEET/SEC.) =   2.59
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     788.00 FEET.

**************************************************************************
  FLOW PROCESS FROM NODE       3.00 TO NODE       4.00 IS CODE =  61
--------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STANDARD CURB SECTION USED)<<<<<
==========================================================================
  UPSTREAM ELEVATION(FEET) =  858.00  DOWNSTREAM ELEVATION(FEET) =  857.00
  STREET LENGTH(FEET) =    58.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 31.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  26.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020
```

```
 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.07
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.34
   HALFSTREET FLOOD WIDTH(FEET) =    9.24
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.95
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.01
 STREET FLOW TRAVEL TIME(MIN.) =   0.33   Tc(MIN.) =    9.84
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.535
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        0.33      0.20      0.100    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.33      SUBAREA RUNOFF(CFS) =    0.45
 EFFECTIVE AREA(ACRES) =      2.38    AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =        2.4        PEAK FLOW RATE(CFS) =       3.24

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.35   HALFSTREET FLOOD WIDTH(FEET) =   9.44
 FLOW VELOCITY(FEET/SEC.) =  3.00   DEPTH*VELOCITY(FT*FT/SEC.) =   1.04
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      4.00 =     846.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     11.00 TO NODE     12.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   262.00
 ELEVATION DATA: UPSTREAM(FEET) =    866.00  DOWNSTREAM(FEET) =    857.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.534
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.136
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                  D        0.44      0.20      0.100    57    5.53
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      0.84
 TOTAL AREA(ACRES) =      0.44   PEAK FLOW RATE(CFS) =      0.84

****************************************************************************
 FLOW PROCESS FROM NODE     12.00 TO NODE     12.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    5.53
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.136
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        0.88      0.20      0.100    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.88      SUBAREA RUNOFF(CFS) =    1.68
 EFFECTIVE AREA(ACRES) =      1.32   AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =        1.3        PEAK FLOW RATE(CFS) =       2.51
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =        1.3  TC(MIN.) =      5.53
 EFFECTIVE AREA(ACRES) =      1.32  AREA-AVERAGED Fm(INCH/HR)=  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.100
 PEAK FLOW RATE(CFS)    =       2.51
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
           RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                        Analysis prepared by:

                        HUNSAKER & ASSOCIATES
                              Irvine,Inc
                    Planning * Engineering * Surveying
             Three Hughes * Irvine, California 92618 * (949)583-1010

 ************************* DESCRIPTION OF STUDY *************************
* W.O. 4198-1, NOHL CONDOS                                              *
* 2-YR STUDY                                                            *
* PROPOSED CONDITION                                                    *
 ************************************************************************

  FILE NAME: NOHL-P.DAT
  TIME/DATE OF STUDY: 16:08 09/20/2018
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   140.00
  ELEVATION DATA: UPSTREAM(FEET) =    861.00  DOWNSTREAM(FEET) =    860.20
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.301
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.822
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  CONDOMINIUMS                D        0.87      0.20      0.350    57    7.30
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      1.37
  TOTAL AREA(ACRES) =      0.87   PEAK FLOW RATE(CFS) =      1.37

**************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE =  31
--------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   860.20  DOWNSTREAM(FEET) =   859.50
  FLOW LENGTH(FEET) =   160.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   5.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.94
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.37
  PIPE TRAVEL TIME(MIN.) =   0.91    Tc(MIN.) =    8.21
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     300.00 FEET.

**************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =  81
--------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==========================================================================
  MAINLINE Tc(MIN.) =    8.21
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.703
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS                D        1.08      0.20      0.350    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    1.08      SUBAREA RUNOFF(CFS) =    1.59
  EFFECTIVE AREA(ACRES) =      1.95   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        2.0       PEAK FLOW RATE(CFS) =       2.87

**************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  31
--------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   859.50  DOWNSTREAM(FEET) =   858.20
  FLOW LENGTH(FEET) =   255.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
```
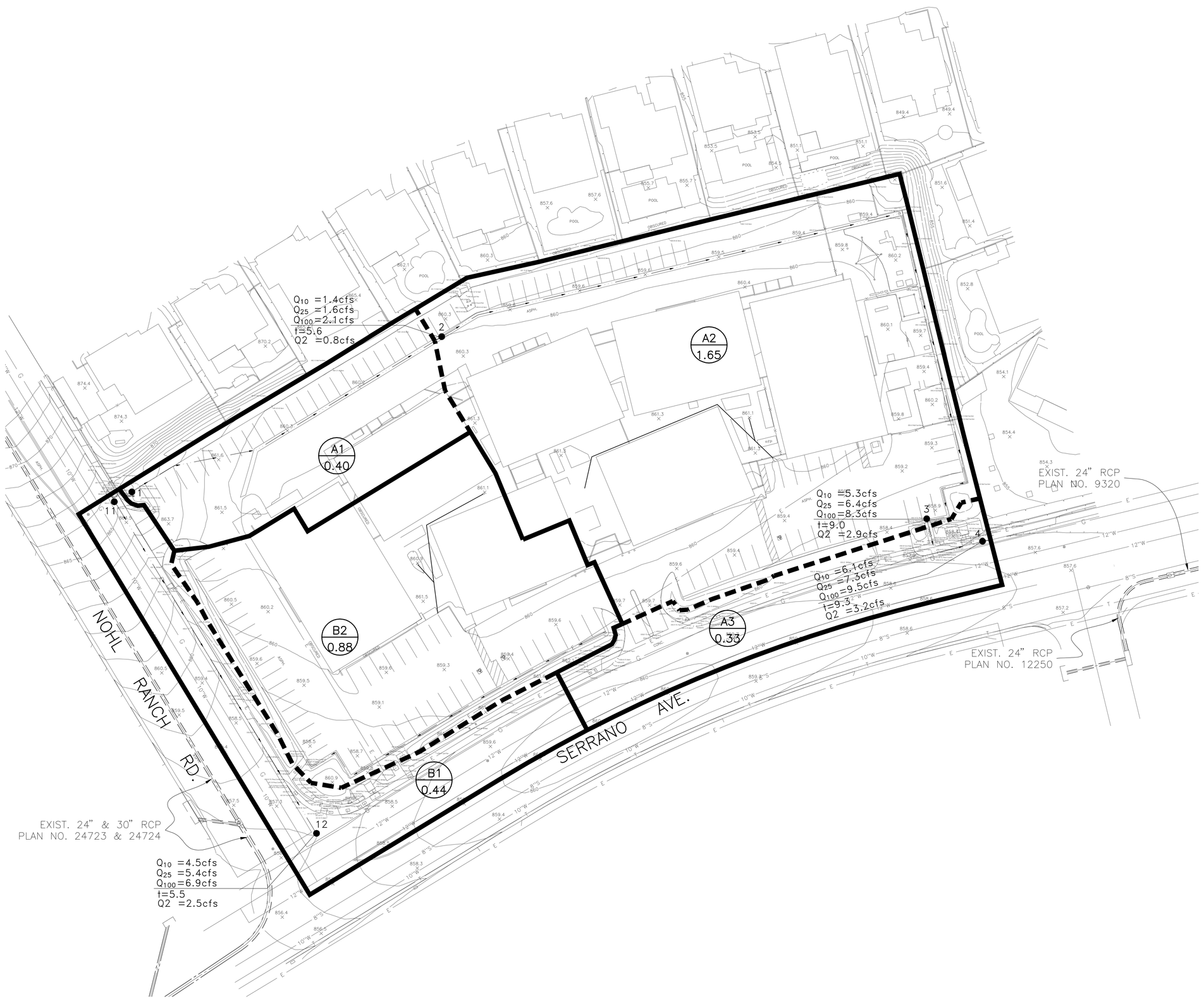
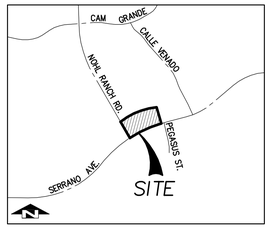

```
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   8.0 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   3.81
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       2.87
 PIPE TRAVEL TIME(MIN.) =   1.12    Tc(MIN.) =    9.32
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      4.00 =     555.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      4.00 TO NODE      4.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    9.32
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.583
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 CONDOMINIUMS               D        0.89      0.20      0.350    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
 SUBAREA AREA(ACRES) =    0.89      SUBAREA RUNOFF(CFS) =    1.21
 EFFECTIVE AREA(ACRES) =      2.84   AREA-AVERAGED Fm(INCH/HR) =  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.35
 TOTAL AREA(ACRES) =        2.8       PEAK FLOW RATE(CFS) =       3.87

****************************************************************************
 FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   858.20  DOWNSTREAM(FEET) =   857.80
 FLOW LENGTH(FEET) =    90.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   9.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   3.90
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       3.87
 PIPE TRAVEL TIME(MIN.) =   0.38    Tc(MIN.) =    9.71
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      5.00 =     645.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      5.00 TO NODE      5.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    9.71
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.547
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 D        0.14      0.20      0.100    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.14      SUBAREA RUNOFF(CFS) =    0.19
 EFFECTIVE AREA(ACRES) =      2.98   AREA-AVERAGED Fm(INCH/HR) =  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.34
 TOTAL AREA(ACRES) =        3.0       PEAK FLOW RATE(CFS) =       3.97

****************************************************************************
 FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   857.80  DOWNSTREAM(FEET) =   857.30
 FLOW LENGTH(FEET) =    70.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   8.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.69
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       3.97
 PIPE TRAVEL TIME(MIN.) =   0.25    Tc(MIN.) =    9.96
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      6.00 =     715.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    9.96
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.524
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 D        0.31      0.20      0.100    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.31      SUBAREA RUNOFF(CFS) =    0.42
 EFFECTIVE AREA(ACRES) =      3.29   AREA-AVERAGED Fm(INCH/HR) =  0.06
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.32
 TOTAL AREA(ACRES) =        3.3       PEAK FLOW RATE(CFS) =       4.33
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =        3.3  TC(MIN.) =      9.96
 EFFECTIVE AREA(ACRES) =      3.29  AREA-AVERAGED Fm(INCH/HR)=  0.06
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.316
 PEAK FLOW RATE(CFS)    =       4.33
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```





VICINITY MAP

LEGEND

- MAJOR DRAINAGE BOUNDARY
- MINOR DRAINAGE BOUNDARY
- 1 — NODE NUMBER
- A / 1.0 — AREA DESIGNATION / AREA ACREAGE (IN ACRES)
- Q10 =6.0cfs, Q100=8.0cfs, t=15.0, C.B. #1 — PEAK FLOW RATE / TIME OF CONCENTRATION
- D — SOIL GROUP

SCALE: 1" = 30'

30 15 0 30 90

GRAPHIC SCALE 1"=30'

PREPARED FOR:

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Mr. John Saunders
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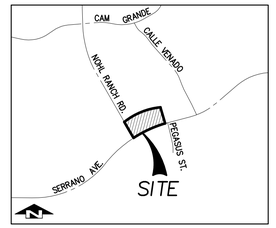
PLANNING ▪ ENGINEERING ▪ SURVEYING
Three Hughes ▪ Irvine, CA 92618 ▪ PH: (949) 583-1010 ▪ FX: (949) 583-0759

HYDROLOGY MAP
NOHL CONDOS
TTM NO. 18104
EXISTING CONDITION

W.O. #4198-1

PLOTTED BY: Tu Trinh DATE: Aug. 03, 2017 03:33:57 PM FILE: F:\0985\Engineering\SY_Hydrology\Serrano-Existing.dwg



VICINITY MAP

LEGEND

- MAJOR DRAINAGE BOUNDARY
- MINOR DRAINAGE BOUNDARY
- 1 — NODE NUMBER
- A / 1.0 — AREA DESIGNATION / AREA ACREAGE (IN ACRES)
- Qa =6.0cfs, Qa=8.0cfs, Tc=15.0, C.B. #1 — PEAK FLOW RATE / TIME OF CONCENTRATION
- D — SOIL GROUP

SINGLE-FAMILY EXISTING RESIDENTIAL TRACT NO. 8375 M.M. 345/34,39 ZONE: RS-2

MAP

SINGLE-FAMILY EXISTING RESIDENTIAL TRACT NO. 8375 M.M. 345/34,39 ZONE: RS-2

MAP

LOT 1

A2 / 1.08

"A" DRIVE

A3 / 0.89

A4 / 0.14

A1 / 0.87

A5 / 0.31

NOHL RANCH RD.

SERRANO AVE.

"A" DRIVE

"A" DRIVE

BIO-FILTRATION AREA

EXIST. 24" RCP PLAN NO. 9320

EXIST. 24" RCP PLAN NO. 12250

EXIST. 24" & 30" RCP PLAN NO. 24723 & 24724

MAP

UNDEVELOPED PROPERTY IN T TRANSITIONAL ZONE

SINGLE-FAMILY EXISTING RESIDENTIAL TRACT NO. 9313 M.M. 399-32,33 ZONE: RS-3

MAP

ANAHEIM HILLS ELEMENTARY SCHOOL ZONE: T TRANSITIONAL ZONE

Node	Flow
1	ΣQ_{10} =5.3cfs ΣQ_{25} =6.3cfs ΣQ_{100} =8.2cfs t=8.0 $\Sigma Q2$ =2.9cfs
2	Q_{10} =2.5cfs Q_{25} =3.0cfs Q_{100} =3.9cfs t=7.3 Q2 =1.4cfs
3	Q_{10} =2.9cfs Q_{25} =3.5cfs Q_{100} =4.5cfs t=7.8 Q2 =1.6cfs
4	ΣQ_{10} =7.2cfs ΣQ_{25} =8.7cfs ΣQ_{100} =11.2cfs t=8.8 $\Sigma Q2$ =3.9cfs
5	ΣQ_{10} =7.4cfs ΣQ_{25} =8.9cfs ΣQ_{100} =11.6cfs t=9.1 $\Sigma Q2$ =4.0cfs
6	Q_{10} =0.8cfs Q_{25} =0.9cfs Q_{100} =1.2cfs t=9.3 Q2 =0.4cfs
7	Q_{10} =2.3cfs Q_{25} =2.7cfs Q_{100} =3.5cfs t=8.8 Q2 =1.2cfs
8	ΣQ_{10} =8.1cfs ΣQ_{25} =9.7cfs ΣQ_{100} =12.6cfs t=9.3 $\Sigma Q2$ =4.3cfs
9	Q_{10} =0.3cfs Q_{25} =0.4cfs Q_{100} =0.6cfs t=9.1 Q2 =0.2cfs

NOTES:

THE PROPOSED PUBLIC CATCH BASIN AT NODE 6 WILL HAVE CONNECTOR PIPE SCREENS THAT MEET THE FULL CAPTURE REQUIREMENTS OF THE STATE TRASH PROVISIONS

SCALE: 1" = 30'

30 15 0 30 90

GRAPHIC SCALE 1"=30'

PREPARED FOR:

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HYDROLOGY MAP
NOHL CONDOS
TTM NO. 18104
PROPOSED CONDITION

W.O. #4198-1

PLOTTED BY: Tu Trinh DATE: Sep. 21, 2018 10:49:06 AM FILE: F:\0985\Engineering\SY_Hydrology\Serrano-Proposed-R3.dwg

Attachment E

Geotechnical Report

(Provided when available)

GEOTECHNICAL EXPLORATION REPORT
PROPOSED RESIDENTIAL DEVELOPMENT
6501-6513 EAST SERRANO AVENUE
ANAHEIM, CALIFORNIA

Leighton and Associates, Inc.

A LEIGHTON GROUP COMPANY

Leighton and Associates, Inc.
A LEIGHTON GROUP COMPANY

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Site Location Map

City of Anaheim Base Map 286

[illegible]

1.2 [illegible]

[illegible]

[illegible]

- *Background Review* [illegible]

- *Pre-Field Exploration Activities* [illegible]

- *Field Exploration* [illegible] *Boring Location Map.*

  [illegible]

[illegible] *Field Exploration Logs*.

- ***Laboratory Tests*** [illegible]

  - [illegible]
  - [illegible]
  - [illegible]
  - [illegible]
  - [illegible]
  - [illegible]
  - [illegible]
  - [illegible]
  - [illegible]

[illegible] *Laboratory Test Results*.

- *Percolation Testing* □ □□r□□□ □□r □□□d □□□□□r□□□□□ □□r□r□ □d □□ □□□□□□□ □□□□ 2□□□□ □□ □ □dd□□□□□□□ □□□□□□□ d□□□ □□□r □□□□□□ □□□□□□ □□□r □□□□□ □□□□□ □□d □□ 2□□□□□□□□d □□ □□□ □□□□□□□r□ □□r□□□□ □□□□□ □□□□ □□ □□□ □□□□□□□□ □□□□□ □r□□□□□d □□□r□ □ □□□r □□□□□r□□□□ □r□□□ □□r□ □□□□ dr□□□d □□ □□ □□□r□□□□ □□□ d□□□□ □□□ □□□□ □□□ □□d □□□□□r□□d □□ □ □□□ □□r□r□ □□r□□□□□□□□ □□□□ □ □□□□r □□r□□□□□□□□□ □□r□□□□□□ □□□□□□□□ □ □□□r □□ □□□ d□□□□□□□□□ □□ □□□□□r□□□ r□□□ □r□□□□□□d □□ □□□□□□ 2□□ □□d □□□ □□□d □□r□□□□□□□ □□□□ d□□□ □r□□d□d □□ □□□□□d□□ □□ *Percolation Test Results*□

- *Engineering Analysis* □ □□□ d□□□ □□□□□□d r□□ □□r □□□□r□□d r□□□□ □□□d □□□□r□□□□□d □□□r□□□r□ □□□□□□ □r□□r□□ □□r□ □□□□□□□□d □□d □□□□□□d □□ d□□□□□ □□□□□□□□□□□□r□□□ □ □□d□□□□□ □r □□□ □r□□□□□□□ □□rr□□□□ □□□□□□d□

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2.1 [illegible]

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[illegible] *Regional Geology Map*.

2.2 [illegible]

[illegible]

Artificial Fill

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[illegible]

Puente Formation Bedrock

[illegible]

[illegible]

2 [illegible]

[illegible]

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2 [illegible]

[illegible] *Technical Guidance Document (TGD) for the Preparation of Conceptual/Preliminary and/or Project Water Quality Management Programs (WQMPs)* [illegible]

[illegible] *Exploration Location Map* [illegible]

[illegible] *Percolation Test Results* [illegible]

[illegible] 1 [illegible]

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[illegible] *Seismicity Data* [illegible] *Historic Seismicity Map* [illegible]

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[illegible] *Seismic Hazard Map* [illegible]

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[illegible] *Seismic Hazard Map* [illegible]

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[illegible] *Dam Inundation Map* [illegible]

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Shrinkage and Subsidence

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[illegible] *Standard Specifications for Public Works Construction,* [illegible]

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Conventional Shallow Foundations

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Slab-on-Grade

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Retaining Wall Backfill and Subdrain Detail

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Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

SITE LOCATION MAP

LEGEND

LB-6
T.D.76.5'
Af 0-76.5'
No G.W.

APPROXIMATE LOCATION OF HOLLOW-STEM AUGER BORING
SHOWING TOTAL DEPTH (T.D.) AND DEPTH OF GEOLOGIC UNITS IN FEET BELOW GROUND SUFACE

LP-2
T.D.9'
Af 0-9'
No G.W.
Perc Test
@4-9'

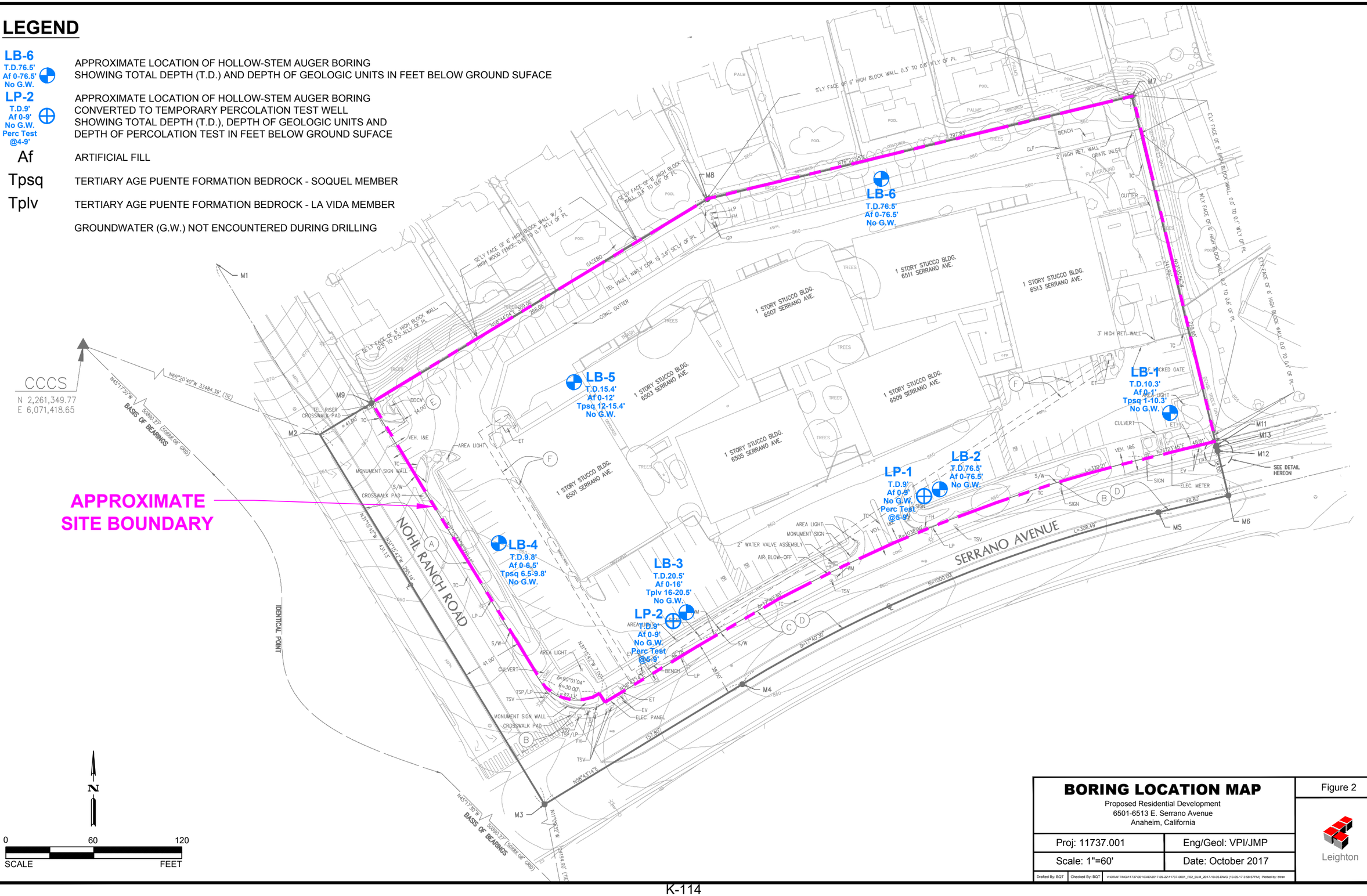
APPROXIMATE LOCATION OF HOLLOW-STEM AUGER BORING
CONVERTED TO TEMPORARY PERCOLATION TEST WELL
SHOWING TOTAL DEPTH (T.D.), DEPTH OF GEOLOGIC UNITS AND
DEPTH OF PERCOLATION TEST IN FEET BELOW GROUND SUFACE

Af — ARTIFICIAL FILL

Tpsq — TERTIARY AGE PUENTE FORMATION BEDROCK - SOQUEL MEMBER

Tplv — TERTIARY AGE PUENTE FORMATION BEDROCK - LA VIDA MEMBER

GROUNDWATER (G.W.) NOT ENCOUNTERED DURING DRILLING



BORING LOCATION MAP

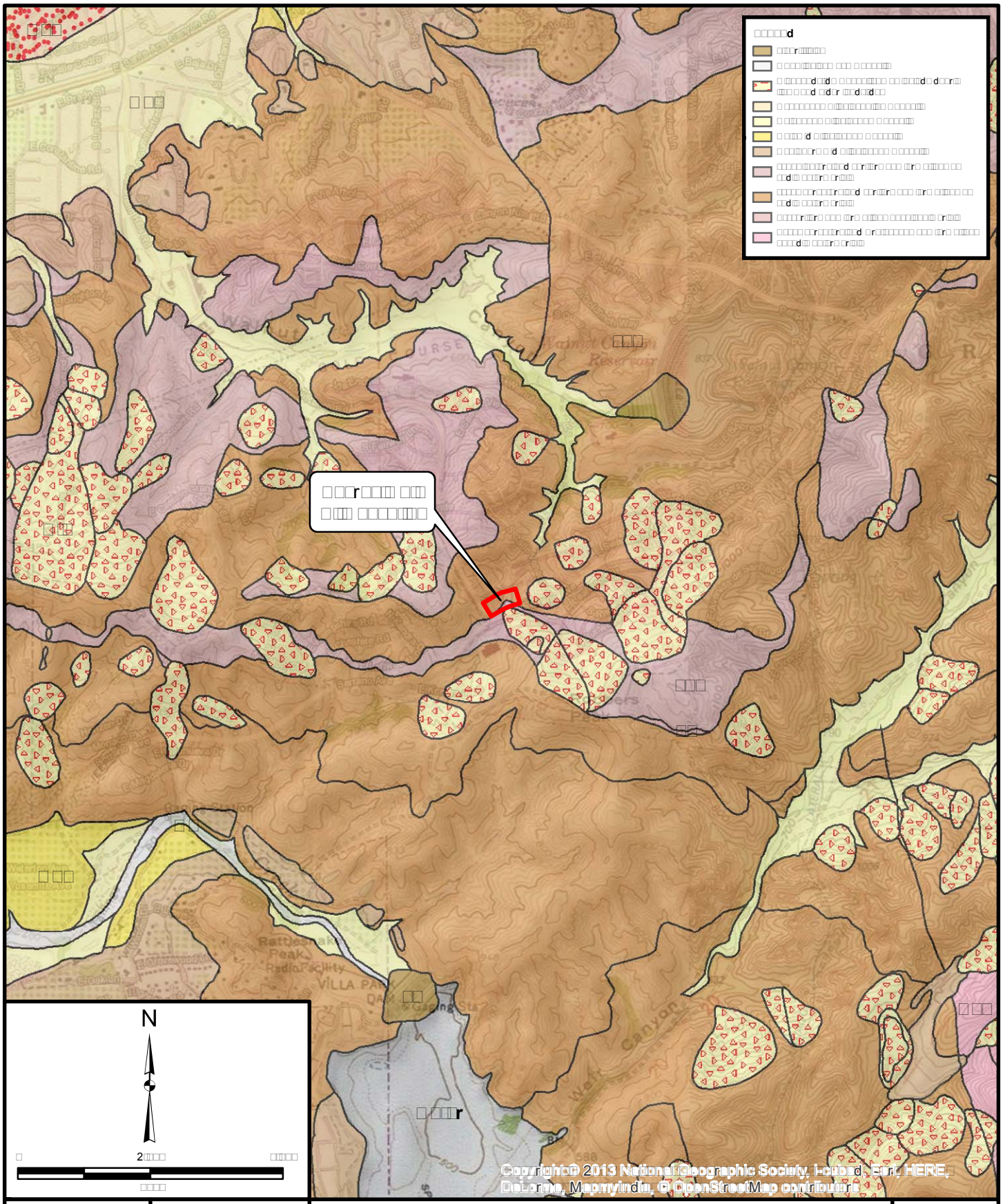
Proposed Residential Development
6501-6513 E. Serrano Avenue
Anaheim, California

Proj: 11737.001	Eng/Geol: VPI/JMP
Scale: 1"=60'	Date: October 2017

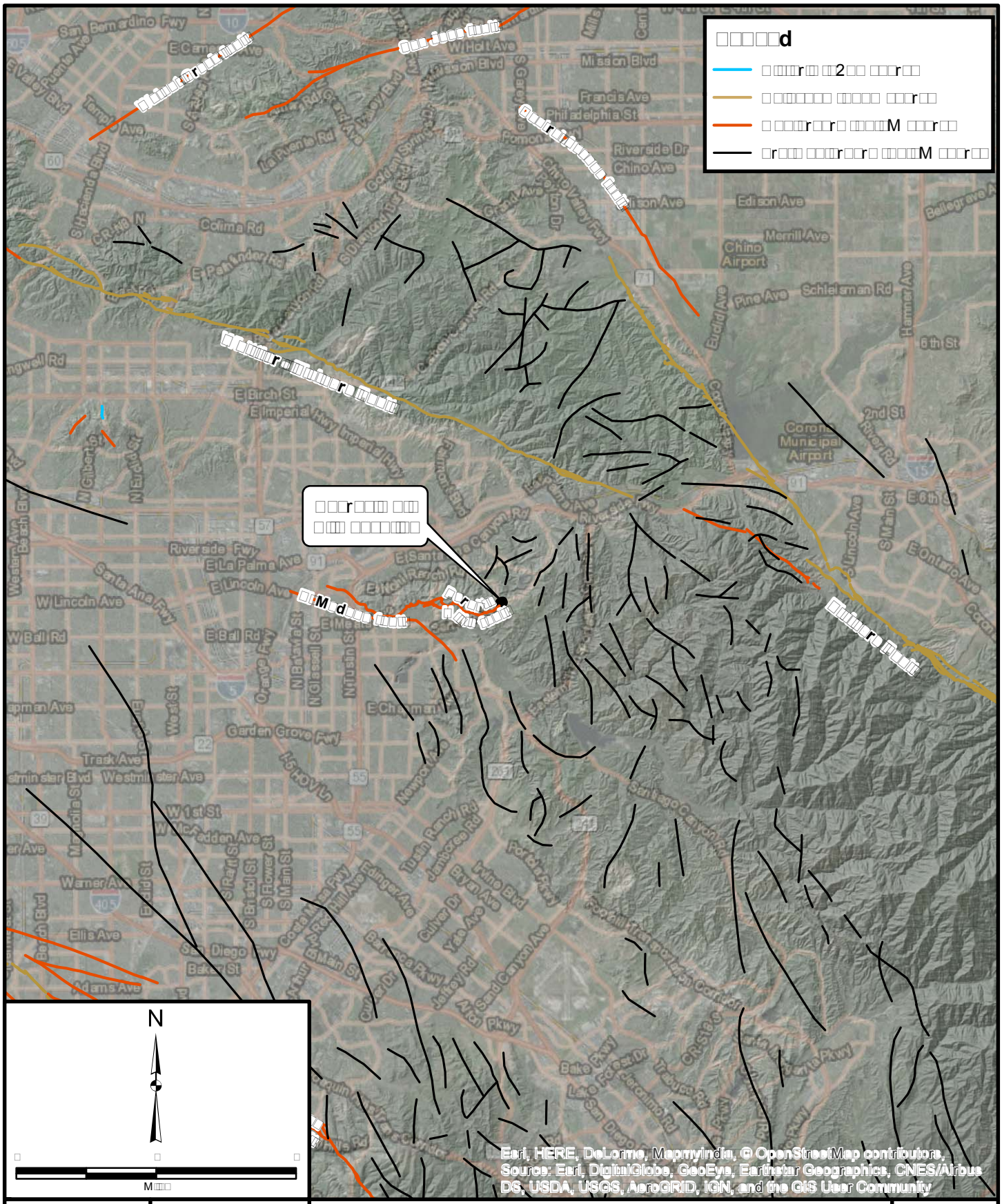
Drafted By: BQT | Checked By: BQT | V:\DRAFTING\11737\001\CAD\2017-09-22\11737-0001_F02_BLM_2017-10-05.DWG (10-05-17 3:58:57PM) Plotted by: btran

Figure 2

Leighton

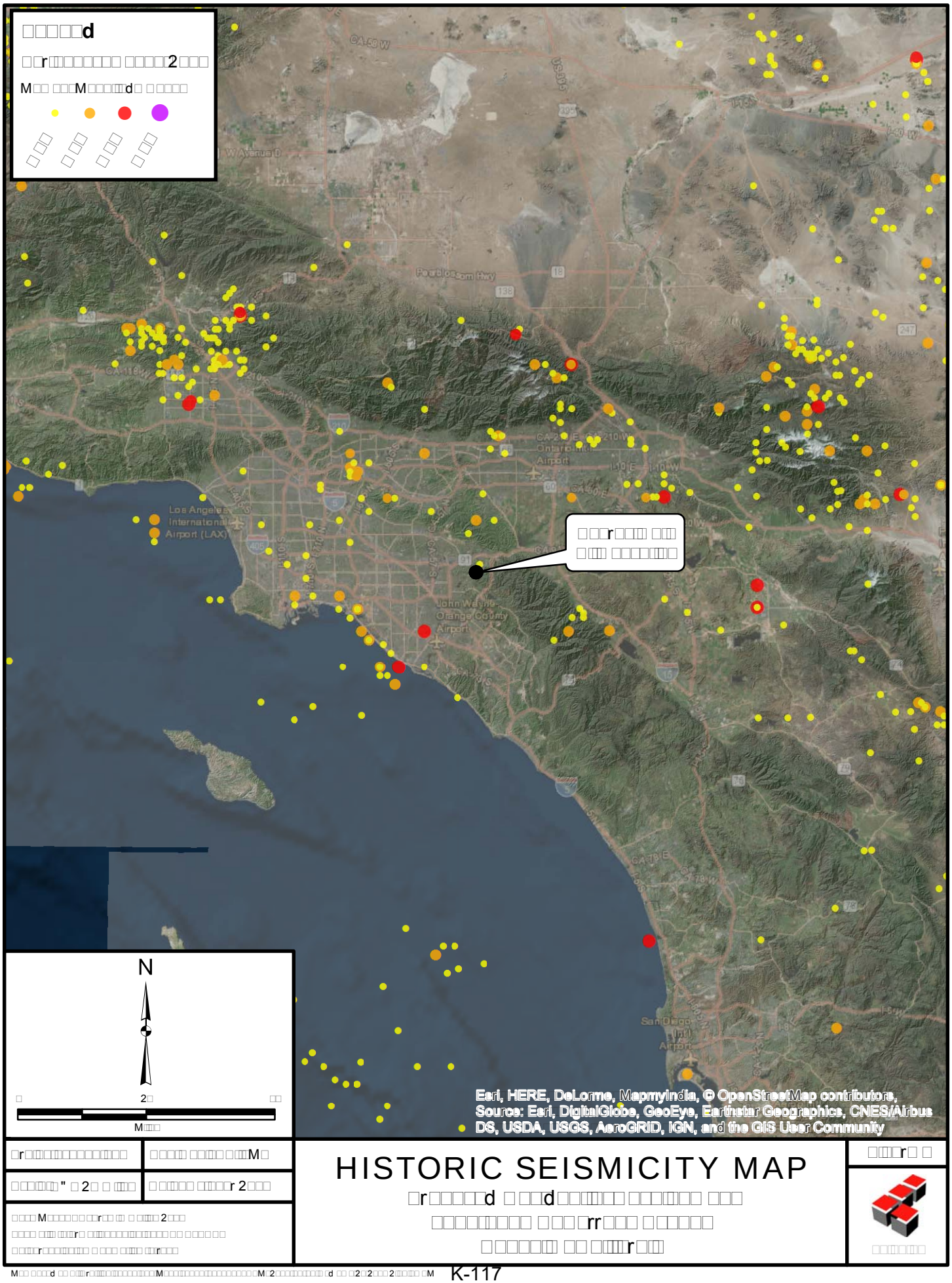


REGIONAL GEOLOGY MAP

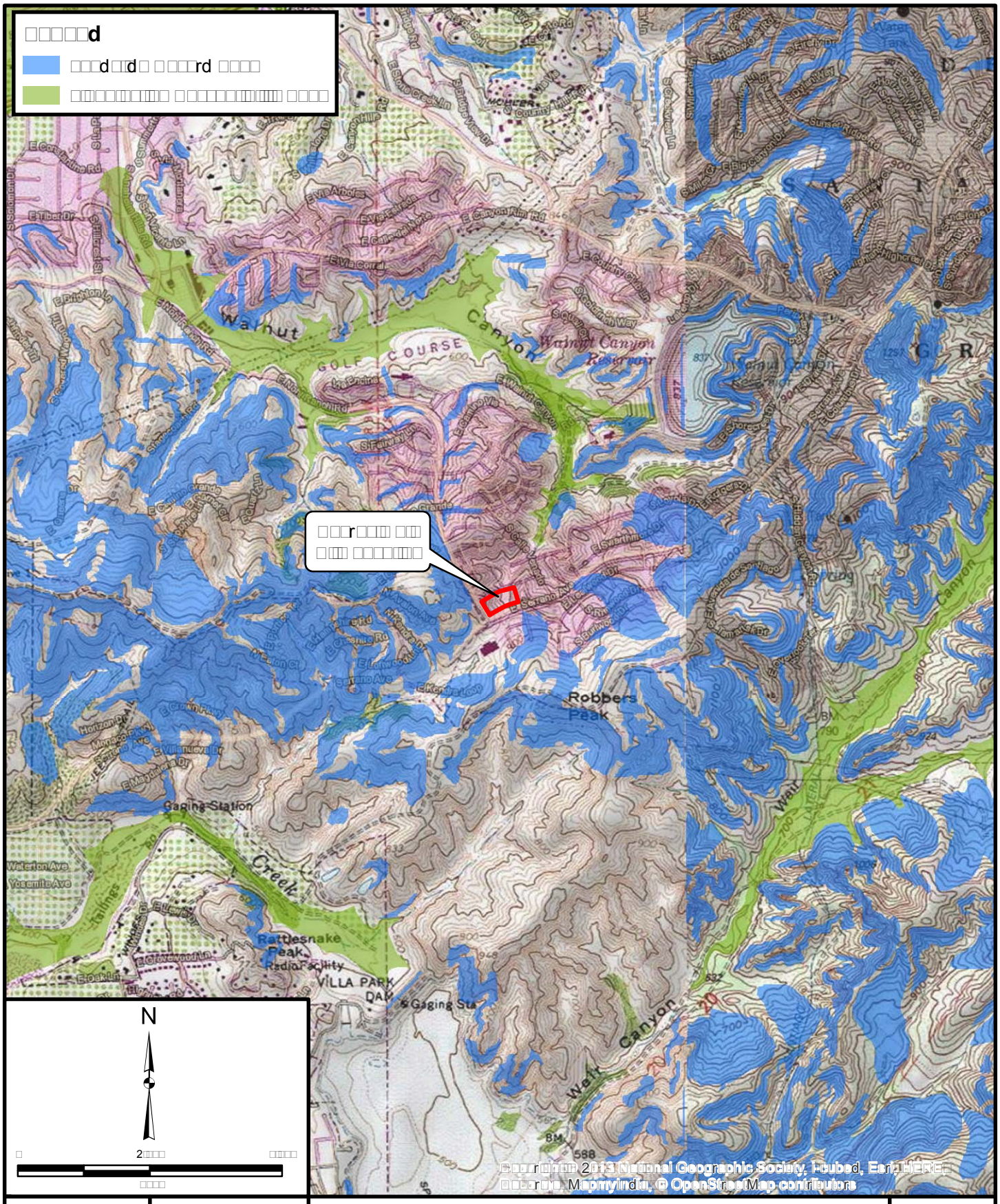


REGIONAL FAULT MAP

K-116

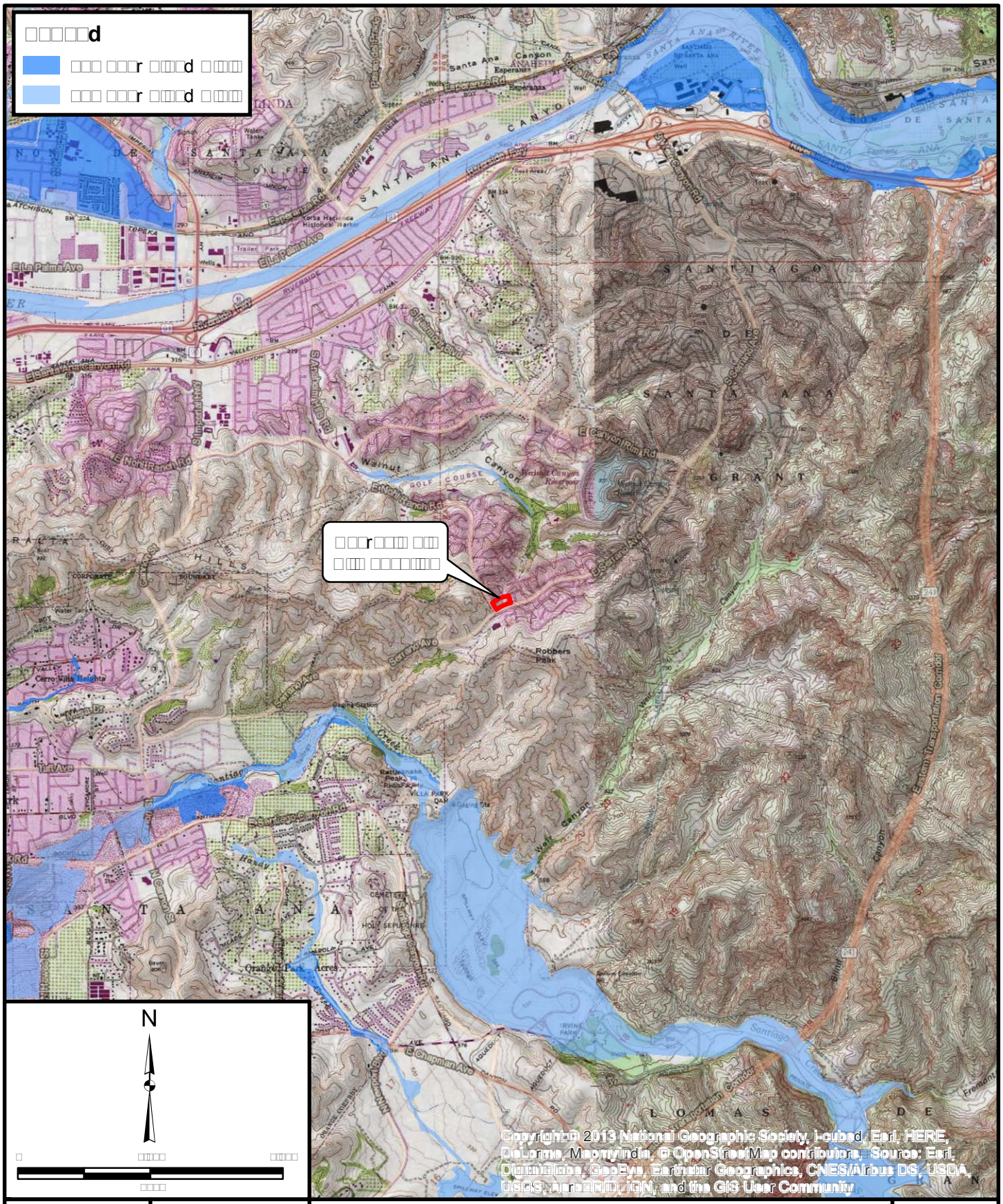


HISTORIC SEISMICITY MAP



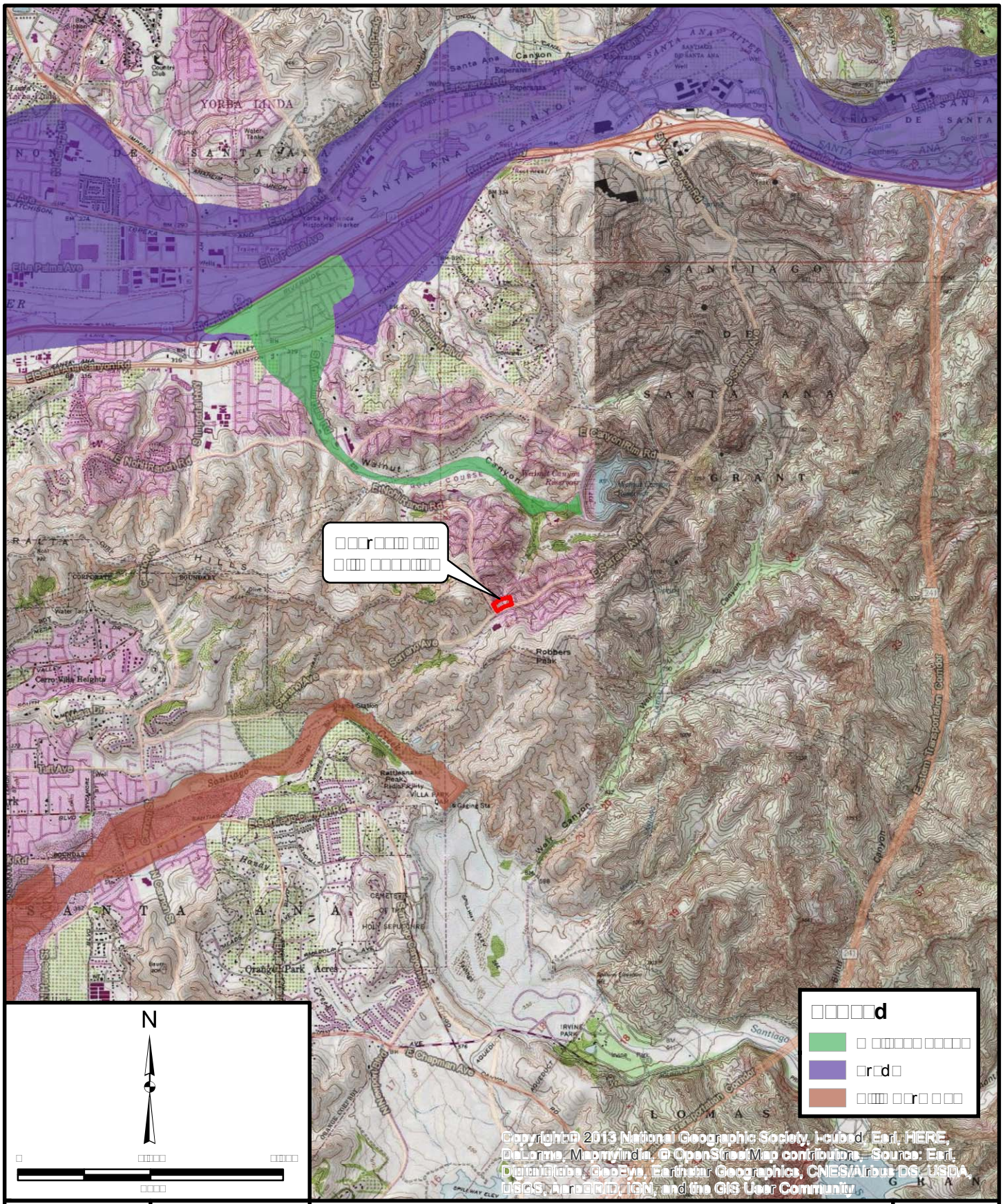
SEISMIC HAZARD MAP

K-118



FLOOD HAZARD ZONE MAP

K-119

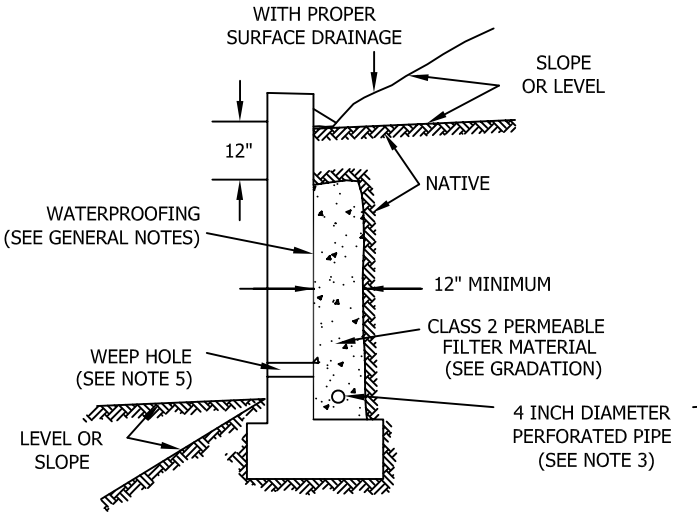


DAM INUNDATION MAP

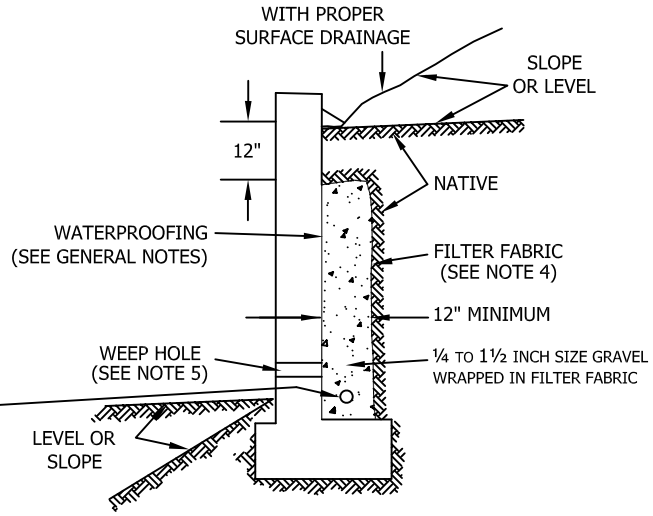
K-120

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

OPTION 1: PIPE SURROUNDED WITH CLASS 2 PERMEABLE MATERIAL



OPTION 2: GRAVEL WRAPPED IN FILTER FABRIC



Class 2 Filter Permeable Material Gradation
Per Caltrans Specifications

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

GENERAL NOTES:

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

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

RETAINING WALL BACKFILL AND SUBDRAIN DETAIL FOR WALLS 6 FEET OR LESS IN HEIGHT

WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

K-121

Leighton

Figure 9

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APPENDIX A

FIELD EXPLORATION LOGS

GEOTECHNICAL BORING LOG LB-1

Project No.	11737.001	**Date Drilled**	8-16-17
Project	Serrano - Nohl Ranch Condos	**Logged By**	JMP
Drilling Co.	Martini Drilling Corp.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	858'
Location	6501-6513 Serrano Avenue, Anaheim, CA	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
858	0			BB-1					@surface: 5-inches asphalt concrete over 5-inches aggregate base	DS,CR, MD,RV, SA
									Bedrock: Puente Formation - Soquel Member (Tpsq):	
855									@0.8': SANDSTONE, gray brown to orange brown, moist, dense, fine to medium sand	
	5			R1	33 50/4"				@5': very dense	
850										
	10			R2	50/4"				@10': limited recovery in sampler shoe only	
845									Total Depth of Boring: 10.3 feet bgs No groundwater encountered during drilling Boring backfilled with soil cuttings and patched with cold-mix asphalt	
	15									
840										
	20									
835										
	25									
830										
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-2

Project No.	11737.001	**Date Drilled**	8-16-17
Project	Serrano - Nohl Ranch Condos	**Logged By**	JMP
Drilling Co.	Martini Drilling Corp.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	859'
Location	6501-6513 Serrano Avenue, Anaheim, CA	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
	0			BB-1				SM	@surface: 5.5-inches asphalt concrete over 3-inches aggregate base **Artificial Fill (Af):** @0.7': Silty SAND, orange brown, moist, tight, fine to medium sand, material derived from local bedrock	SA
855	5			R1	10 11 12	104	21	CL-SC	@5': Sandy CLAY to Clayey SAND, orange brown, moist, stiff/medium dense, some siltstone clasts	
				S1	10 7 10			SM	@7.5': Silty SAND with clay, orange brown, slightly moist to moist, medium dense, fine to medium sand	
850	10			R2	11 14 31	117	13		@10': Silty SAND with clay, orange brown, moist, medium dense, fine to medium sand, some siltstone/sandstone clasts	-200
845	15			R3	16 28 50/5"				@15': Silty SAND, orange brown, moist, very dense, fine to medium sand, some clasts of sandstone	
840	20			R4	10 24 43	119	13		@20': Silty SAND with clay, orange brown, moist, dense, fine to medium sand, some siltstone clasts	-200
835	25			R5	10 18 28			SM-ML	@25': Silty SAND to Sandy SILT, orange brown to gray brown, medium dense/very stiff, fine to medium sand, some sandstone clasts	
830	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

GEOTECHNICAL BORING LOG LB-2

Project No.	11737.001	**Date Drilled**	8-16-17
Project	Serrano - Nohl Ranch Condos	**Logged By**	JMP
Drilling Co.	Martini Drilling Corp.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	859'
Location	6501-6513 Serrano Avenue, Anaheim, CA	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30			S2	2 3 7			SM	@30': Silty SAND with clay, orange brown to gray brown, moist, stiff, some siltstone/sandstone clasts	-200
825										
	35			R6	10 18 29	109	16	SM-SC	@35': Silty SAND to Clayey SAND, orange brown, moist, medium dense, fine to medium sand, some siltstone/sandstone clasts	
820										
	40			S3	7 7 11				@40': same as above	
815										
	45			R7	15 40 45			SC	@45': Clayey SAND with gravel, orange brown, very moist, hard/very dense, fine to medium sand	-200, CN
810										
	50			S4	4 5 7			CL	@50': Sandy Lean CLAY with silt, orange brown to gray brown, moist to very moist, medium stiff, some siltstone/sandstone clasts	AL
805										
	55			R8	7 20 30	99	24	SC	@55': Clayey SAND to Sandy CLAY, orange brown to gray brown, moist to very moist, dense/very stiff, fine to medium sand, some siltstone/sandstone clasts	
800										
	60									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG LB-2

Project No.	11737.001	**Date Drilled**	8-16-17
Project	Serrano - Nohl Ranch Condos	**Logged By**	JMP
Drilling Co.	Martini Drilling Corp.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	859'
Location	6501-6513 Serrano Avenue, Anaheim, CA	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	60			S5	6 7 9			SC	@60': Clayey SAND, orange brown, moist to very moist, medium dense, some siltstone/sandstone clasts	-200
795										
	65			R9	7 16 37	96	28	SM	@65': Silty SAND, gray to bluish green, moist to very moist, very dense, fine to medium sand, abundant siltstone/sandstone clasts	
790										
	70			S6	4 9 12			CL	@70': Sandy Lean CLAY, gray to orange brown, moist to very moist, very stiff, with abundant siltstone/sandstone clasts	-200
785										
	75			R10	8 24 34	97	27		@75': Silty CLAY, gray brown to bluish green, moist to very moist, hard, with siltstone clasts	
									Total Depth of Boring: 76.5 feet bgs No groundwater encountered during drilling Boring backfilled with soil cuttings and patched with cold-mix asphalt	
780										
	80									
775										
	85									
770										
	90									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

GEOTECHNICAL BORING LOG LB-3

Project No.	11737.001	**Date Drilled**	8-16-17
Project	Serrano - Nohl Ranch Condos	**Logged By**	JMP
Drilling Co.	Martini Drilling Corp.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	859'
Location	6501-6513 Serrano Avenue, Anaheim, CA	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
	0			BB1				SM	@surface: 3.5-inches asphalt concrete over 3-inches aggregate base	SA
									Artificial Fill (Af):	
855									@0.6': Silty SAND with clay, orange brown to gray brown, moist, tight, fine to medium sand	
	5			R1	5 21 45			CL-SC	@5': Sandy CLAY to Clayey SAND, orange brown to brown, moist, hard/dense, fine to medium sand	
				S1	8 9 10			SM	@7.5': Silty SAND, orange brown to gray, moist, medium dense, fine to medium sand, some siltstone/sandstone clasts	
850	10			R2	16 21 27				@10': Silty SAND, orange brown to blue gray, moist, dense, fine to medium sand, some siltstone/sandstone clasts	
845										
	15			R3	8 35 50/2"			CL	@15': Sandy CLAY, orange brown, moist, stiff, fine sand, some siltstone/sandstone clasts	
									Bedrock: Puente Formation - La Vida Member (Tplv):	
840									@16': SILTSTONE, gray to orange brown, slightly moist, hard	
	20			R4	50/5"				@20': SILTSTONE, orange brown to gray, slightly moist, hard, oxidized	
									Total Depth of Boring: 20.5 feet bgs No groundwater encountered during drilling Boring backfilled with soil cuttings and patched with cold-mix asphalt	
835	25									
830	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-4

Project No.	11737.001	**Date Drilled**	8-16-17
Project	Serrano - Nohl Ranch Condos	**Logged By**	JMP
Drilling Co.	Martini Drilling Corp.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	860'
Location	6501-6513 Serrano Avenue, Anaheim, CA	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
860	0								@surface: 3.5-inches asphalt concrete over 3-inches aggregate base **Artificial Fill (Af):** @0.6': Silty SAND, orange brown, slightly moist, tight, fine to medium sand, few gravels	
855	5			R1	11 15 20			SM	@5': Silty SAND, orange brown to gray brown, slightly moist, medium dense, fine to medium sand, some sandstone clasts	SA
									Bedrock: Puente Formation - Soquel Member (Tpsq): @6.5': harder drilling, approximate bedrock contact assumed	
				R2	50/5"				@8': no recovery, hard	
850	10			S1	37 50/4"				@9': SANDSTONE, light yellow brown, slightly moist, hard, fine to medium sand	
									Total Depth of Boring: 9.8 feet bgs No groundwater encountered during drilling Boring backfilled with soil cuttings and patched with cold-mix asphalt	
845	15									
840	20									
835	25									
830	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-5

Project No.	11737.001	**Date Drilled**	8-16-17
Project	Serrano - Nohl Ranch Condos	**Logged By**	JMP
Drilling Co.	Martini Drilling Corp.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	861'
Location	6501-6513 Serrano Avenue, Anaheim, CA	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
860	0			BB1				SM	@surface: 3.5-inches asphalt concrete over 3-inches aggregate base	SA
									Artificial Fill (Af):	
									@0.6': Silty SAND, medium brown to orange brown, moist, tight, fine to medium sand, few gravels	
855	5			R1	11 13 17				@5': Silty SAND, medium brown to orange brown, moist, medium dense, fine to medium sand, some fine siltstone/sandstone clasts	
850	10			R2	17 40 41				@10': dense	
									Bedrock: Puente Formation - Soquel Member (Tpsq):	
									@12': harder drilling, approximate bedrock contact assumed	
845	15			R3	50/5"				@15': SANDSTONE, light gray with orange oxidation, moist, hard, fine to medium sand	
									Total Depth of Boring: 15.4 feet bgs No groundwater encountered during drilling Boring backfilled with soil cuttings and patched with cold-mix asphalt	
840	20									
835	25									
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-6

Project No.	11737.001	**Date Drilled**	8-16-17
Project	Serrano - Nohl Ranch Condos	**Logged By**	JMP
Drilling Co.	Martini Drilling Corp.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	860'
Location	6501-6513 Serrano Avenue, Anaheim, CA	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
860	0			BB1				SM	*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.* @surface: 2.5-inches asphalt concrete over 3.5-inches aggregate base **Artificial Fill (Af):** @0.6': Silty SAND, medium orange brown, moist, tight, fine to medium sand	
855	5			R1	14 27 50/5"	119	10		@5': Silty SAND, orange brown, moist, very dense, fine to medium sand, some sandstone clasts	
850	10			R2	10 21 48				@10': some large siltstone clasts	
845	15			R3	9 15 21	95	23	SC-CL	@15': Clayey SAND to Sandy CLAY, orange brown to gray, moist, medium dense/very stiff, some siltstone clasts	
840	20			R4	8 31 50/5"			SM	@20': Silty SAND, orange brown, moist, very dense, fine to medium sand, some sandstone clasts	
835	25			R5	20 50/6"	116	12			
830	30									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG LB-6

Project No.	11737.001	**Date Drilled**	8-16-17
Project	Serrano - Nohl Ranch Condos	**Logged By**	JMP
Drilling Co.	Martini Drilling Corp.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	860'
Location	6501-6513 Serrano Avenue, Anaheim, CA	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
830	30			R6	22 42 50/5"			SM-SC	@30': Silty SAND to Clayey SAND, orange brown, moist, very dense, fine to medium sand, some fine siltstone/sandstone clasts	
825	35			R7	15 28 49	117	14		@35': dense, abundant siltstone	
820	40			R8	38 38 42				@40': dense, abundant siltstone/sandstone clasts	
815	45			R9	7 21 50/4"	116	14		@45': orange brown to blue gray, dense, abundant siltstone/sandstone clasts	
810	50			R10	50/4"				@50': no recovery, possible cobble at head of auger	
805	55			R11	25 50/6"				@55': no recovery, possible cobble at head of auger	
800	60									

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG LB-6

Project No.	11737.001	**Date Drilled**	8-16-17
Project	Serrano - Nohl Ranch Condos	**Logged By**	JMP
Drilling Co.	Martini Drilling Corp.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	860'
Location	6501-6513 Serrano Avenue, Anaheim, CA	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
800	60			S1	39 38 42				@60': limited recovery in sampler shoe limited to mechanically broken cobble fragments	
795	65			S2	6 8 18			SM	@65': Silty SAND, orange brown to gray brown, moist, medium dense, fine to medium sand, some siltstone/sandstone clasts	
790	70			R12	12 28 50/4"	102	22	CL	@70': Silty CLAY, blue gray, moist, hard, large siltstone clasts	
785	75			R13	15 19 20			SM	@75': Silty SAND, blue gray, very moist to wet, medium dense, fine to medium sand, some sandstone clasts	CN, AL
									Total Depth of Boring: 76.5 feet bgs No groundwater encountered during drilling Boring backfilled with soil cuttings and patched with cold-mix asphalt	
780	80									
775	85									
770	90									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG LP-1

Project No.	11737.001	**Date Drilled**	8-16-17
Project	Serrano - Nohl Ranch Condos	**Logged By**	JMP
Drilling Co.	Martini Drilling Corp.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	859'
Location	6501-6513 Serrano Avenue, Anaheim, CA	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
855	0							SM	@surface: 5.5-inches asphalt concrete over 3-inches aggregate base **Artificial Fill (Af):** @0.7': Silty SAND, orange brown, moist, tight, fine to medium sand, material derived from local bedrock	
	5							CL-SC	@5': Sandy CLAY to Clayey SAND, orange brown, moist, some siltstone fragments	
850								SM	@7.5': Silty SAND with clay, orange brown, slightly moist to moist, fine to medium sand	
	10								No sampling performed, lithology inferred from adjacent boring LB-2 Total Depth of Boring: 9 feet bgs No groundwater encountered during drilling Temporary percolation well installed: 2-inch solid PVC @ 0-4 feet bgs 2-inch slotted PVC (0.020") @ 4-9 feet bgs #3 Monterey Sand @ 3-9 feet bgs Well casing removed upon completion of testing and boring backfilled with soil cuttings and patched with cold-mix asphalt	
845	15									
840	20									
835	25									
830	30									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LP-2

Project No.	11737.001	**Date Drilled**	8-16-17
Project	Serrano - Nohl Ranch Condos	**Logged By**	JMP
Drilling Co.	Martini Drilling Corp.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	859'
Location	6501-6513 Serrano Avenue, Anaheim, CA	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
	0							SM	@surface: 3.5-inches asphalt concrete over 3-inches aggregate base **Artificial Fill (Af):** @0.6': Silty SAND with clay, orange brown to gray brown, moist, tight, fine to medium sand	
855	5							CL-SC	@5': Sandy CLAY to Clayey SAND, orange brown to brown, moist, fine to medium sand	
								SM	@7.5': Silty SAND, orange brown to gray, moist, fine to medium sand, some siltstone/sandstone clasts	
850	10								No sampling performed, lithology inferred from adjacent boring LB-3 Total Depth of Boring: 9 feet bgs No groundwater encountered during drilling Temporary percolation well installed: 2-inch solid PVC @ 0-4 feet bgs 2-inch slotted PVC (0.020") @ 4-9 feet bgs #3 Monterey Sand @ 3-9 feet bgs Well casing removed upon completion of testing and boring backfilled with soil cuttings and patched with cold-mix asphalt	
845	15									
840	20									
835	25									
830	30									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

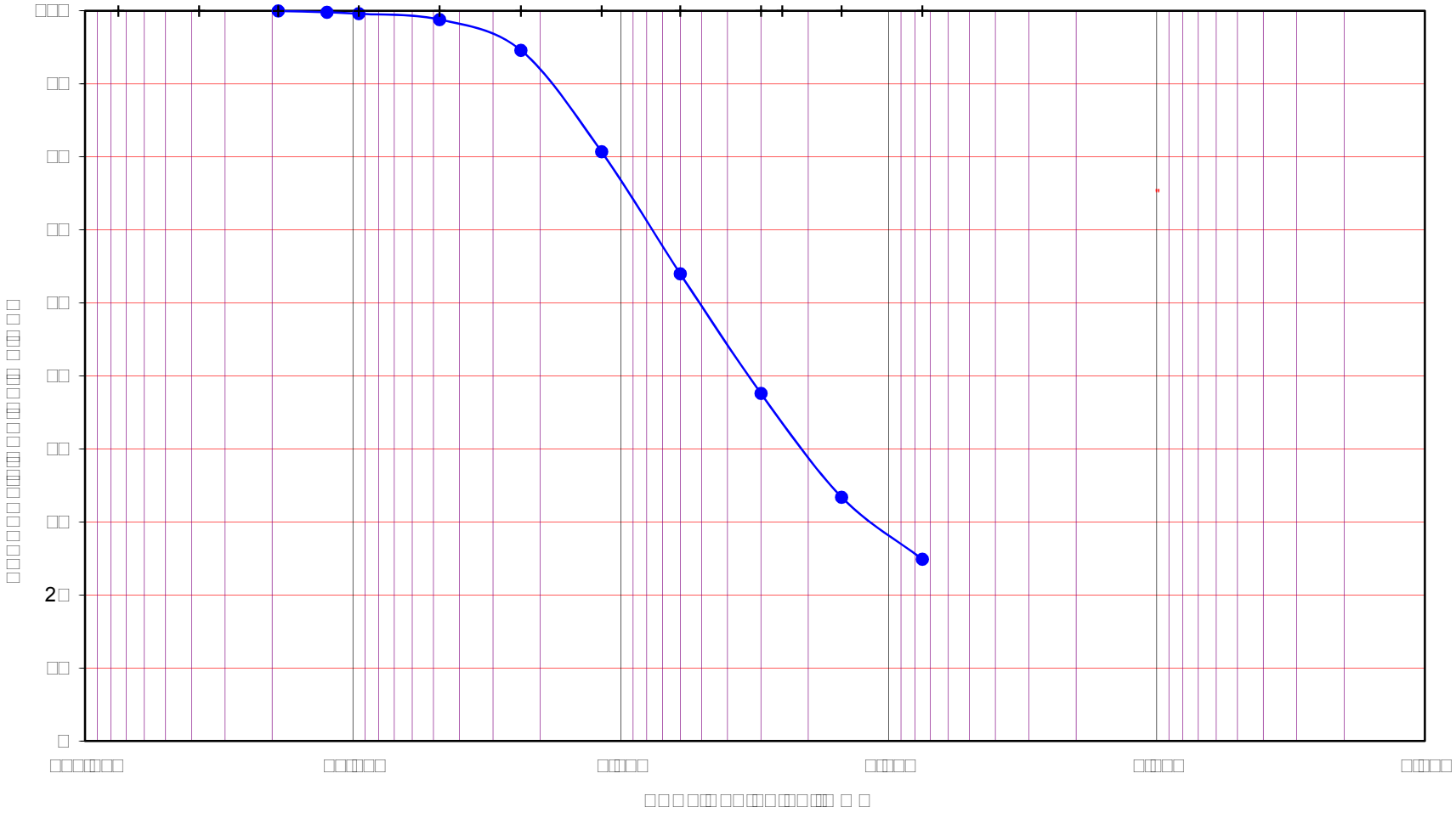
APPENDIX B

LABORATORY TEST RESULTS

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING — U.S. STANDARD SIEVE NUMBER — HYDROMETER

3.0" 1 1/2" 3/4" 3/8" #4 #8 #16 #30 #50 #100 #200



Project Name: Serrano

Project No.: 11737.001

Boring No.: LB-1 Sample No.: BB1

Depth (feet): 0-5 Soil Type : SC

Soil Identification: Olive brown silty, clayey sand (SC-SM)

GR:SA:FI : (%) 1 : 74 : 25

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 6913

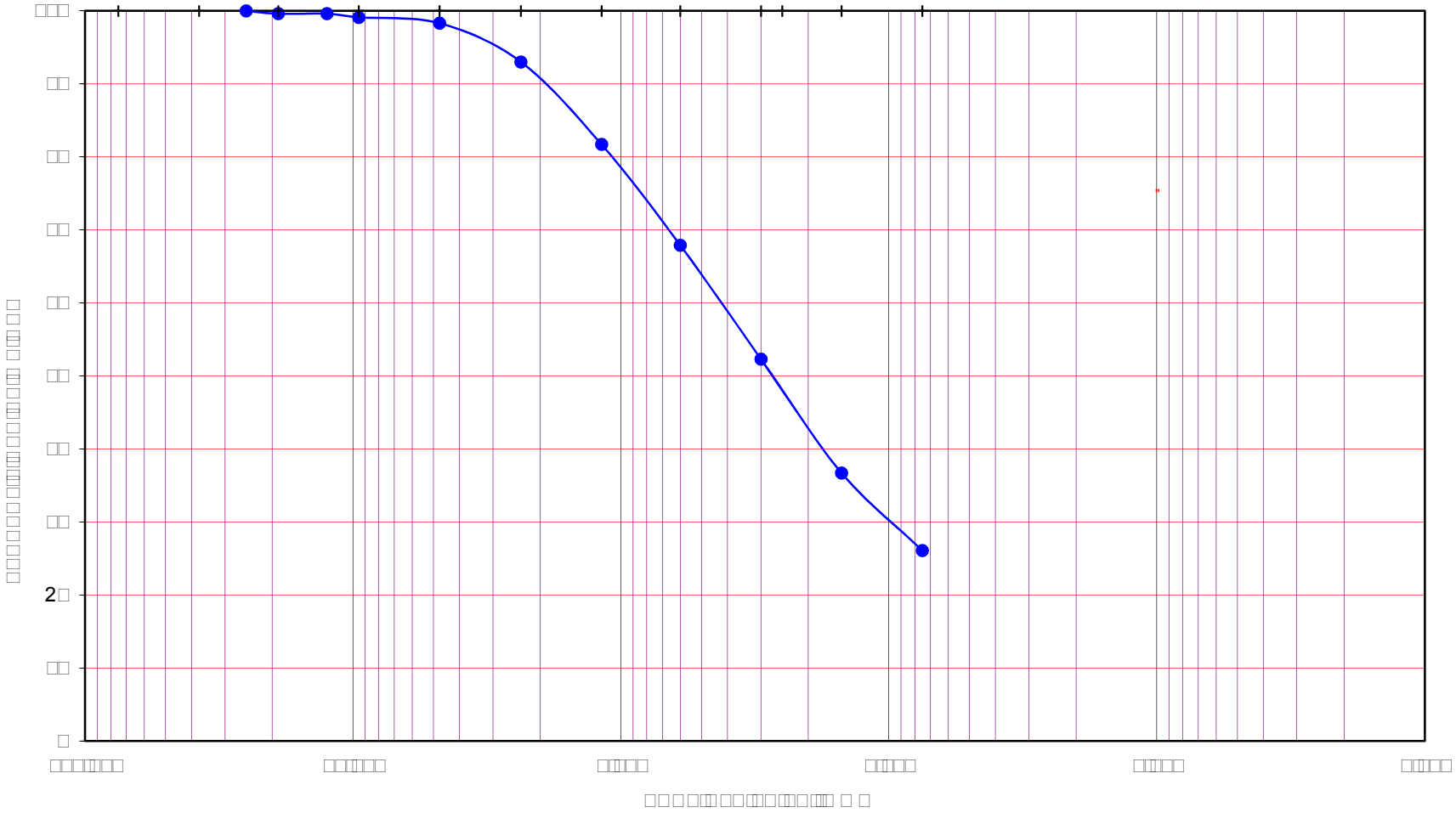
Sep-17

SA LB-1, BB1 @ 0-5

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING — U.S. STANDARD SIEVE NUMBER — HYDROMETER

3.0" 1 1/2" 3/4" 3/8" #4 #8 #16 #30 #50 #100 #200



Project Name: Serrano

Project No.: 11737.001

Boring No.: LB-2 Sample No.: BB1

Depth (feet): 0-5 Soil Type : SM

Soil Identification: Yellowish brown silty sand (SM)

GR:SA:FI : (%) 2 : 72 : 26

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 6913

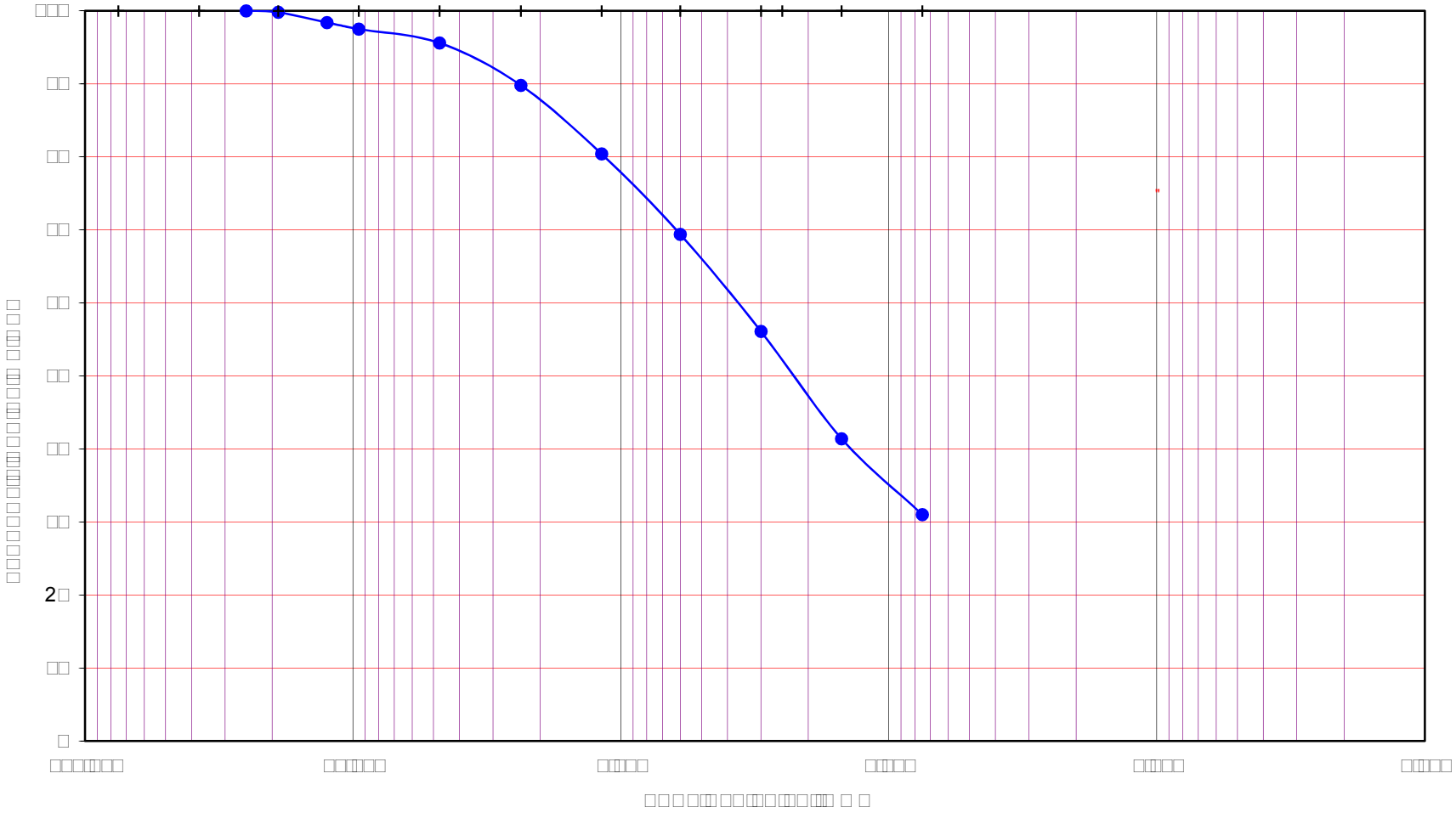
Sep-17

SA LB-2, BB1 @ 0-5

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING — U.S. STANDARD SIEVE NUMBER — HYDROMETER

3.0" 1 1/2" 3/4" 3/8" #4 #8 #16 #30 #50 #100 #200



Project Name: Serrano

Project No.: 11737.001

Boring No.: LB-3 Sample No.: BB1

Depth (feet): 0-5 Soil Type : SM

Soil Identification: Yellowish brown silty sand (SM)

GR:SA:FI : (%) 4 : 65 : 31

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 6913

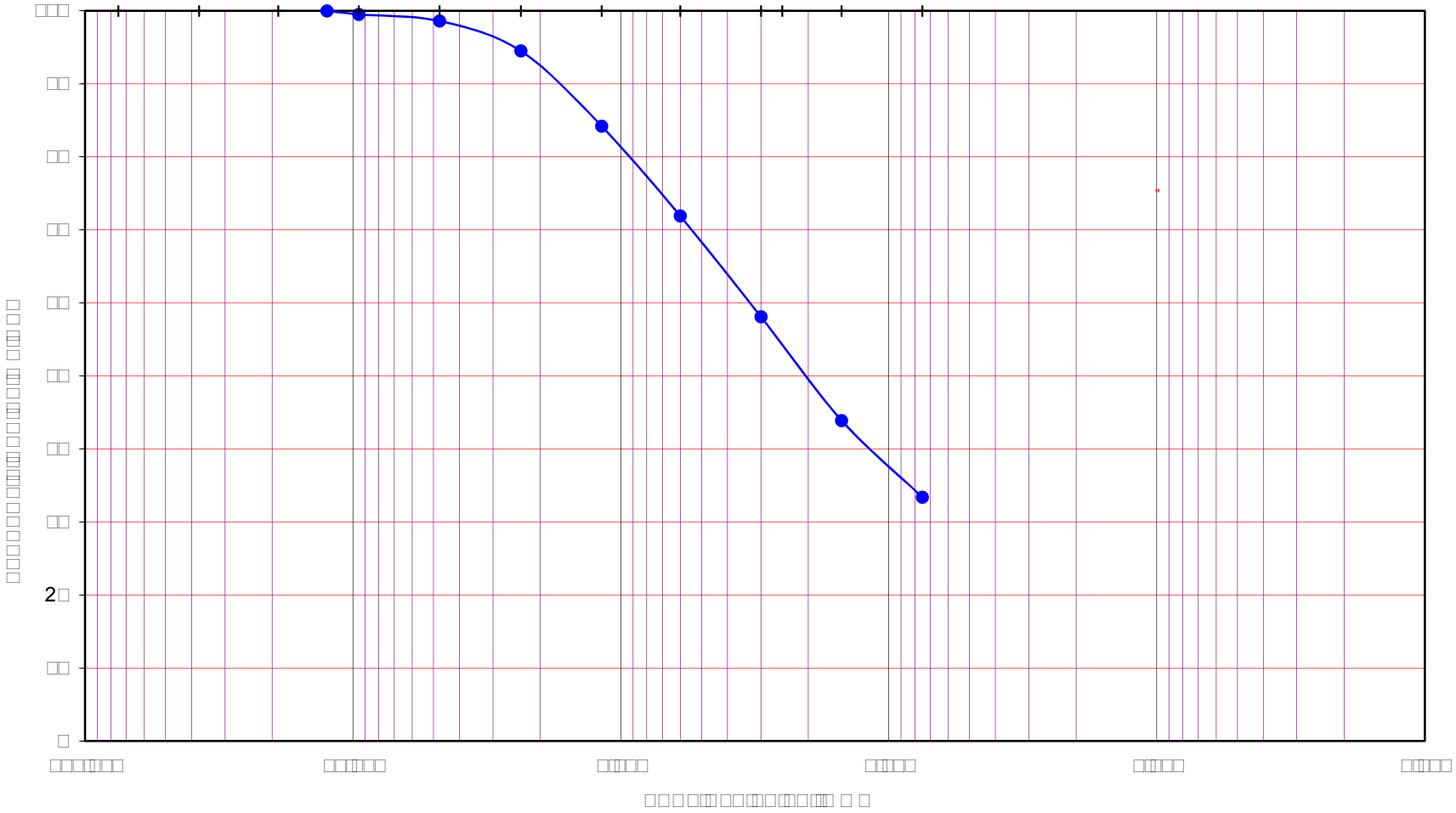
Sep-17

SA LB-3, BB1 @ 0-5

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING | U.S. STANDARD SIEVE NUMBER | HYDROMETER

3.0" 1 1/2" 3/4" 3/8" #4 #8 #16 #30 #50 #100 #200



Project Name: Serrano

Project No.: 11737.001

Boring No.: LB-4 Sample No.: R1

Depth (feet): 5.0 Soil Type : SM

Soil Identification: Yellowish brown silty sand (SM)

GR:SA:FI : (%) 1 : 66 : 33

Leighton

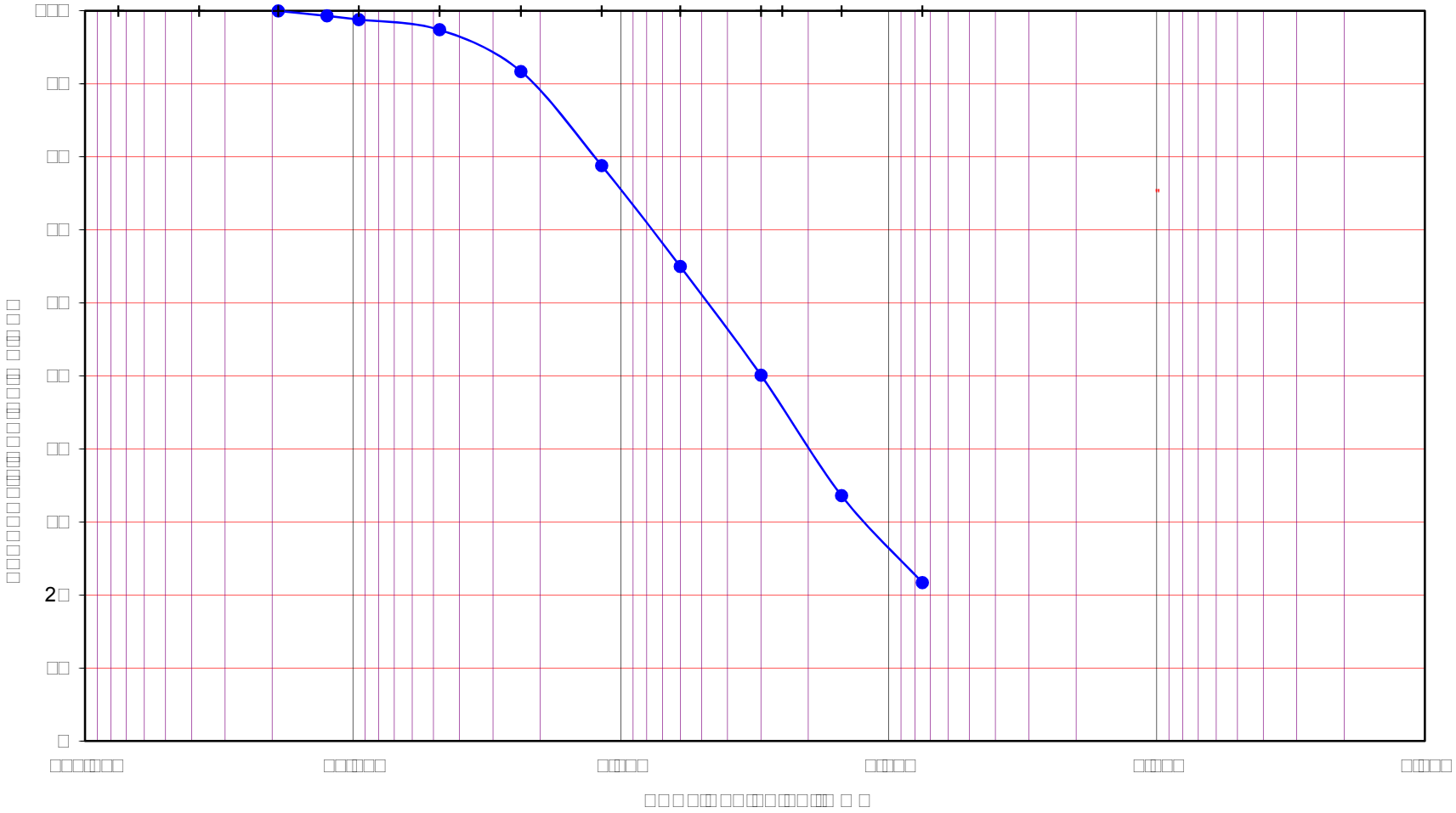
PARTICLE - SIZE DISTRIBUTION ASTM D 6913

Sep-17

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING — U.S. STANDARD SIEVE NUMBER — HYDROMETER

3.0" 1 1/2" 3/4" 3/8" #4 #8 #16 #30 #50 #100 #200



Project Name: Serrano

Project No.: 11737.001

Boring No.: LB-5 Sample No.: BB1

Depth (feet): 0-5 Soil Type : SM

Soil Identification: Yellowish brown silty sand (SM)

GR:SA:FI : (%) 3 : 75 : 22

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 6913

Sep-17

SA LB-5, BB1 @ 0-5

Boring No.	LB-2	LB-2	LB-2	LB-2	LB-2	LB-2		
Sample No.	R2	R4	S2	R7	S5	S6		
Depth (ft.)	10.0	20.0	30.0	45.0	60.0	70.0		
Sample Type	Ring	Ring	SPT	Ring	SPT	SPT		
Soil Identification	Brown silty sand (SM)	Brown silty sand (SM)	Brown silty sand (SM)	Olive yellow clayey sand with gravel (SC)g (one 2.5" gravel, 227.8 g)	Grayish brown clayey sand (SC)	Grayish brown sandy lean clay s(CL)		
Moisture Correction								
Wet Weight of Soil + Container (g)	0.0	0.0	0.0	0.0	0.0	0.0		
Dry Weight of Soil + Container (g)	0.0	0.0	0.0	0.0	0.0	0.0		
Weight of Container (g)	1.0	1.0	1.0	1.0	1.0	1.0		
Moisture Content (%)	0.0	0.0	0.0	0.0	0.0	0.0		
Sample Dry Weight Determination								
Weight of Sample + Container (g)	863.4	811.6	1087.7	997.6	1014.2	955.6		
Weight of Container (g)	108.5	107.8	201.4	96.0	215.1	206.4		
Weight of Dry Sample (g)	754.9	703.8	886.3	901.6	799.1	749.2		
Container No.:	929	57	XP	IP-2	PHD	D-7		
After Wash								
Method (A or B)	A	A	A	A	A	A		
Dry Weight of Sample + Cont. (g)	713.6	652.2	741.2	835.4	747.1	566.0		
Weight of Container (g)	108.5	107.8	201.4	96.0	215.1	206.4		
Dry Weight of Sample (g)	605.1	544.4	539.8	739.4	532.0	359.6		
% Passing No. 200 Sieve	**19.8**	**22.6**	**39.1**	**18.0**	**33.4**	**52.0**		
% Retained No. 200 Sieve	80.2	77.4	60.9	82.0	66.6	48.0		

Leighton

PERCENT PASSING
No. 200 SIEVE
ASTM D 1140

Project Name: Serrano
Project No.: 11737.001
Client Name: 6509 Serrano LP
Tested By: S. Felter Date: 08/24/17

Passing #200 LB-2 & LB-6

Boring No.	LB-6	LB-6	LB-6	LB-6	LB-6	LB-6		
Sample No.	R1	R3	R5	R7	R9	R12		
Depth (ft.)	5.0	15.0	25.0	35.0	45.0	70.0		
Sample Type	Ring	Ring	Ring	Ring	Ring	Ring		
Soil Identification	Grayish brown silty sand (SM)	Grayish brown silty sand (SM)	Grayish brown silty sand (SM)	Grayish brown silty sand (SM)	Grayish brown silty, clayey sand (SC-SM)	Grayish brown silty, clayey sand (SC-SM)		
Moisture Correction								
Wet Weight of Soil + Container (g)	0.0	0.0	0.0	0.0	0.0	0.0		
Dry Weight of Soil + Container (g)	0.0	0.0	0.0	0.0	0.0	0.0		
Weight of Container (g)	1.0	1.0	1.0	1.0	1.0	1.0		
Moisture Content (%)	0.0	0.0	0.0	0.0	0.0	0.0		
Sample Dry Weight Determination								
Weight of Sample + Container (g)	850.5	625.8	824.3	838.0	1011.9	757.6		
Weight of Container (g)	106.7	108.4	107.5	109.0	300.3	108.0		
Weight of Dry Sample (g)	743.8	517.4	716.8	729.0	711.6	649.6		
Container No.:	912	934	A-15	927	IMC-1	R-2		
After Wash								
Method (A or B)	A	A	A	A	A	A		
Dry Weight of Sample + Cont. (g)	714.2	452.7	673.9	662.1	856.5	550.9		
Weight of Container (g)	106.7	108.4	107.5	109.0	300.3	108.0		
Dry Weight of Sample (g)	607.5	344.3	566.4	553.1	556.2	442.9		
% Passing No. 200 Sieve	**18.3**	**33.5**	**21.0**	**24.1**	**21.8**	**31.8**		
% Retained No. 200 Sieve	81.7	66.5	79.0	75.9	78.2	68.2		

Leighton

PERCENT PASSING
No. 200 SIEVE
ASTM D 1140

Project Name: Serrano
Project No.: 11737.001
Client Name: 6509 Serrano LP
Tested By: S. Felter Date: 08/24/17

ATTERBERG LIMITS

ASTM D 4318

Project Name:	Serrano	Tested By:	R. Manning	Date:	09/01/17
Project No. :	11737.001	Input By:	G. Bathala	Date:	09/13/17
Boring No.:	LB-2	Checked By:	J. Ward		
Sample No.:	S4	Depth (ft.)	50.0		
Soil Identification:	Yellowish brown sandy lean clay s(CL)				

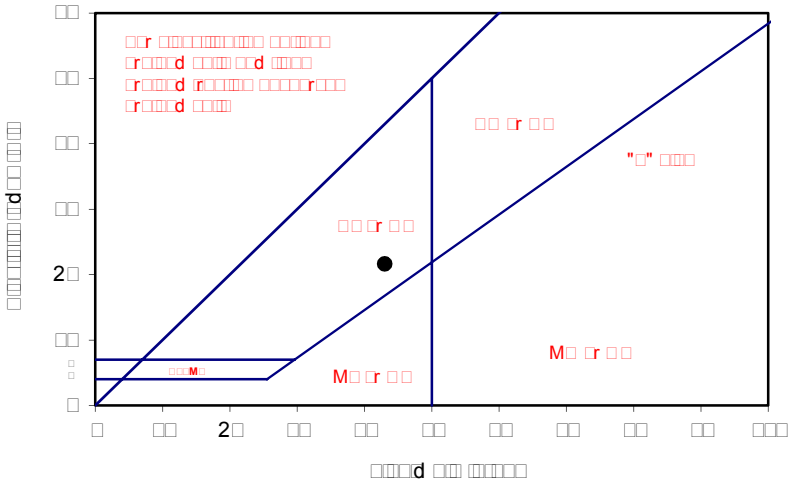
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	27	22	
Wet Wt. of Soil + Cont. (g)	20.33	20.49	24.85	23.17	22.42	
Dry Wt. of Soil + Cont. (g)	19.15	19.27	21.61	20.33	19.72	
Wt. of Container (g)	13.64	13.55	13.61	13.63	13.60	
Moisture Content (%) [Wn]	21.42	21.33	40.50	42.39	44.12	

Liquid Limit	**43**
Plastic Limit	**21**
Plasticity Index	**22**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 16.79

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

[ ] Wet Preparation

Multipoint - Wet

[X] Dry Preparation

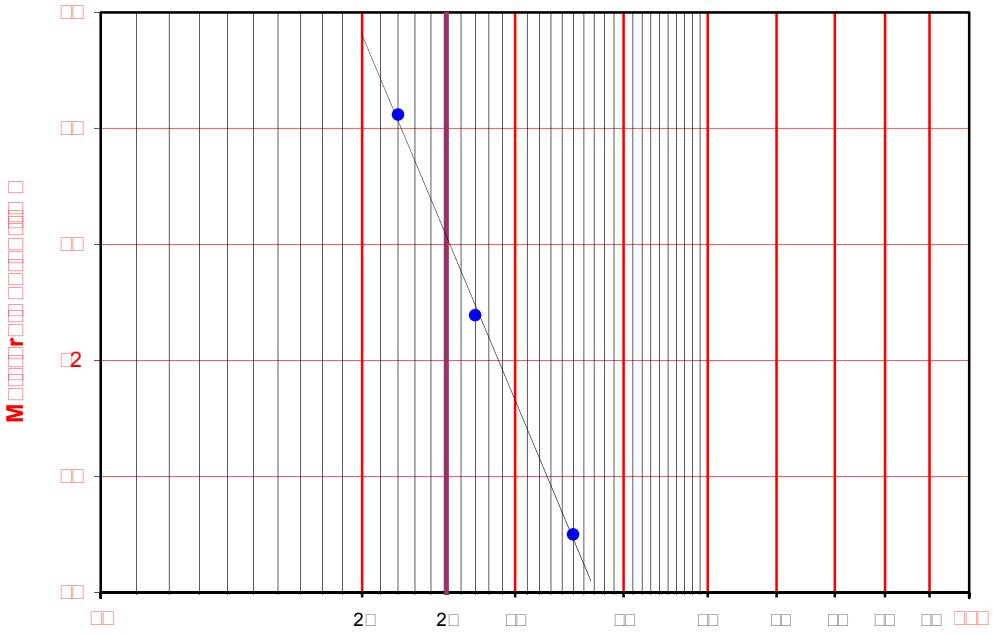
Multipoint - Dry

[X] Procedure A

Multipoint Test

[ ] Procedure B

One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	Serrano	Tested By:	R. Manning	Date:	08/30/17
Project No. :	11737.001	Input By:	G. Bathala	Date:	09/13/17
Boring No.:	LB-6	Checked By:	J. Ward		
Sample No.:	R13	Depth (ft.)	75.0		
Soil Identification:	Olive yellow silty sand (SM)				

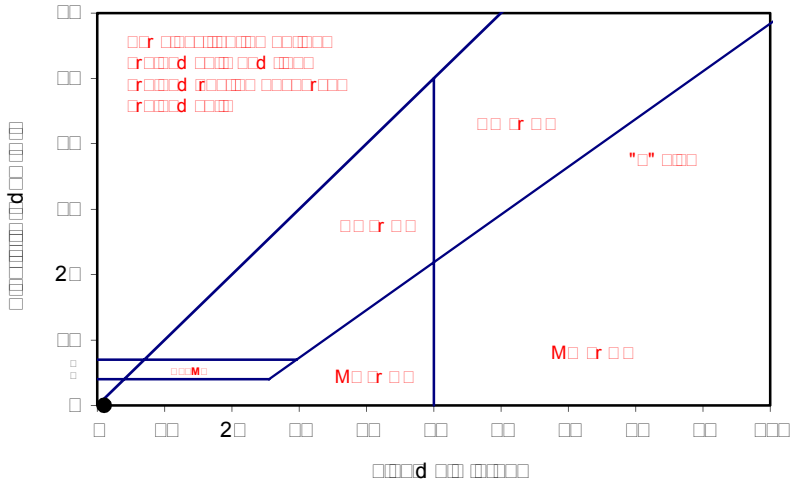
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			13			
Wet Wt. of Soil + Cont. (g)	**Cannot be rolled:**		26.29	**Cannot get more than 13 blows:**		
Dry Wt. of Soil + Cont. (g)	**NonPlastic**		23.84	**NonPlastic**		
Wt. of Container (g)			13.67			
Moisture Content (%) [Wn]			24.09			

Liquid Limit	**NP**
Plastic Limit	**NP**
Plasticity Index	**NP**
Classification	**NP**

PI at "A" - Line = 0.73(LL-20) =

One - Point Liquid Limit Calculation

LL =Wn(N/25)^0.121



PROCEDURES USED

[ ] Wet Preparation

Multipoint - Wet

[X] Dry Preparation

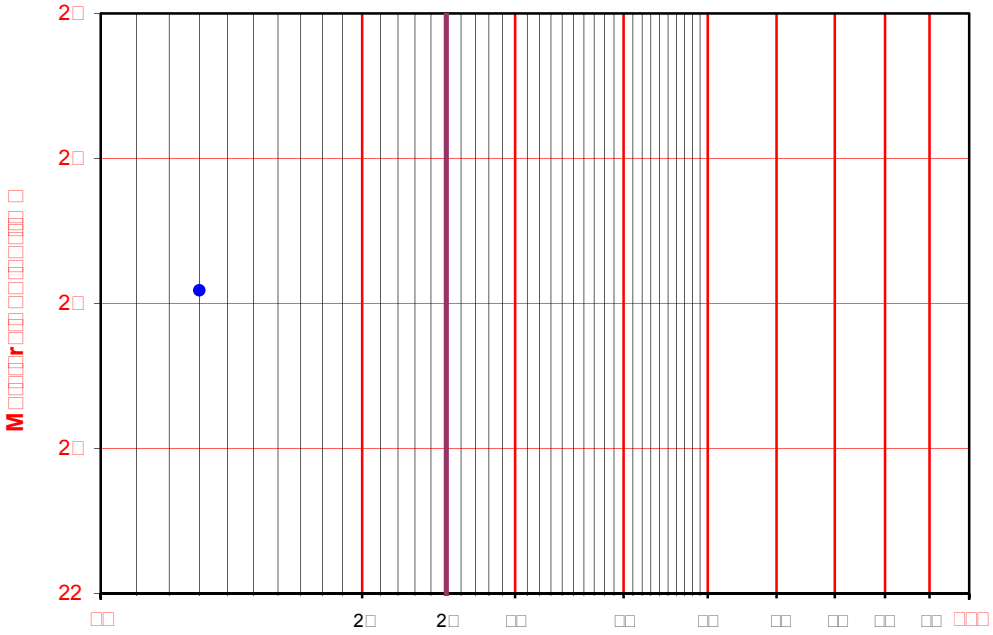
Multipoint - Dry

[X] Procedure A

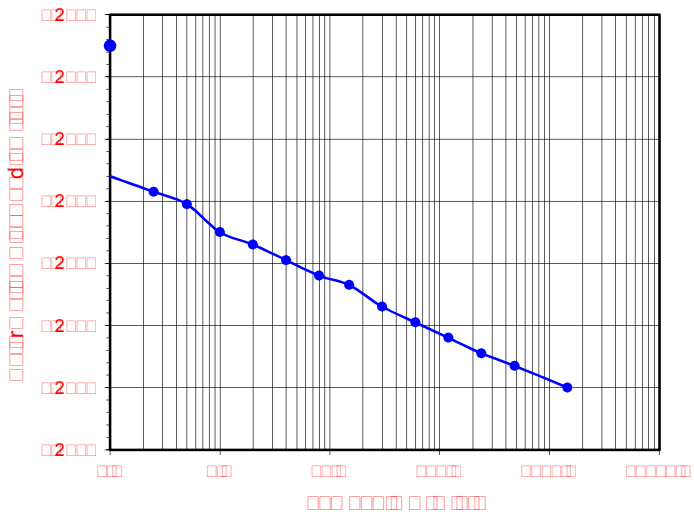
Multipoint Test

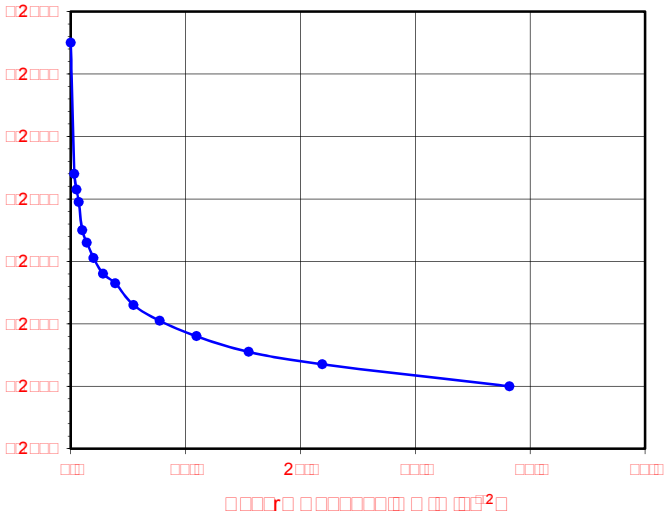
[ ] Procedure B

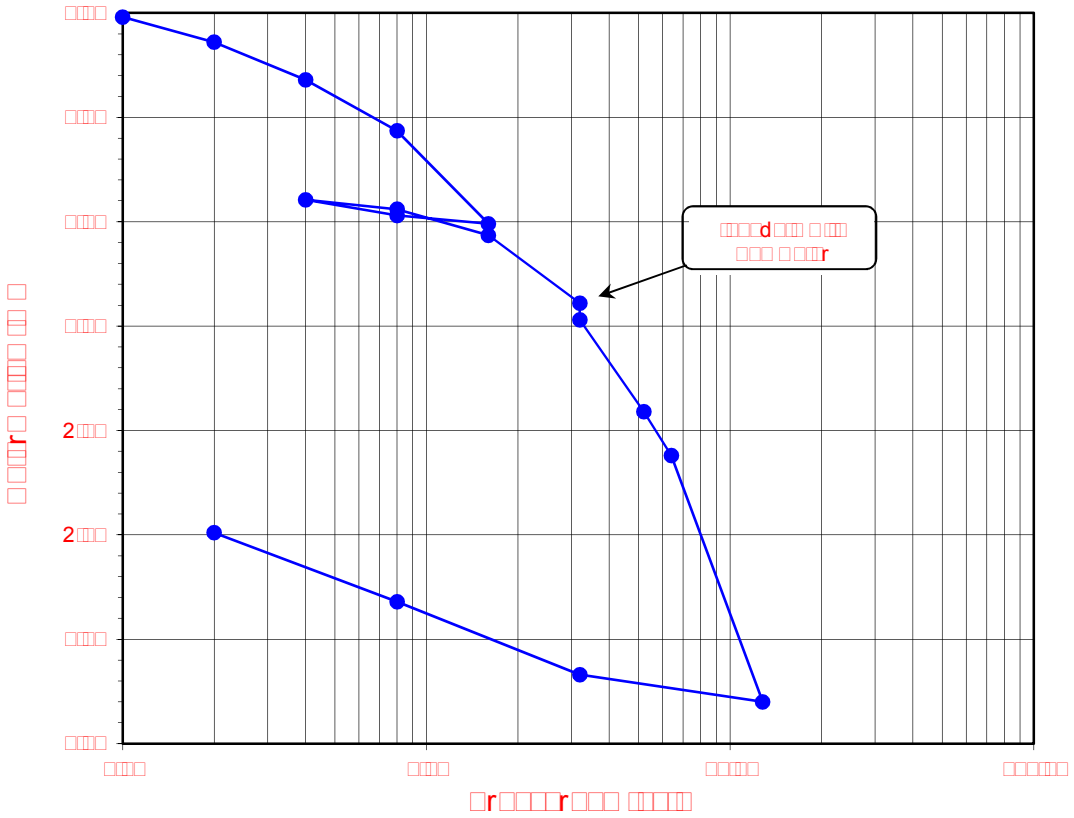
One-point Test



Time Readings @ 5.2 ksf







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-2	**R7**	**45.0**	**13.3**	**12.7**	**116.4**	**120.3**	**0.448**	**0.412**	**80**	**86**

Soil Identification: Olive yellow clayey sand with gravel (SC)g

Leighton

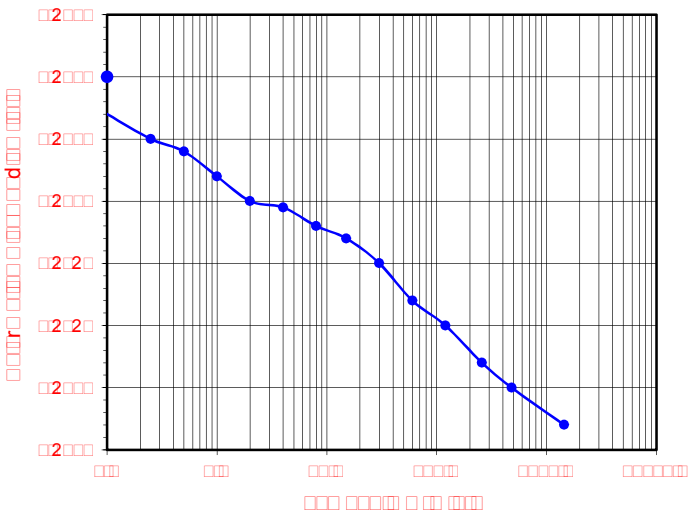
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

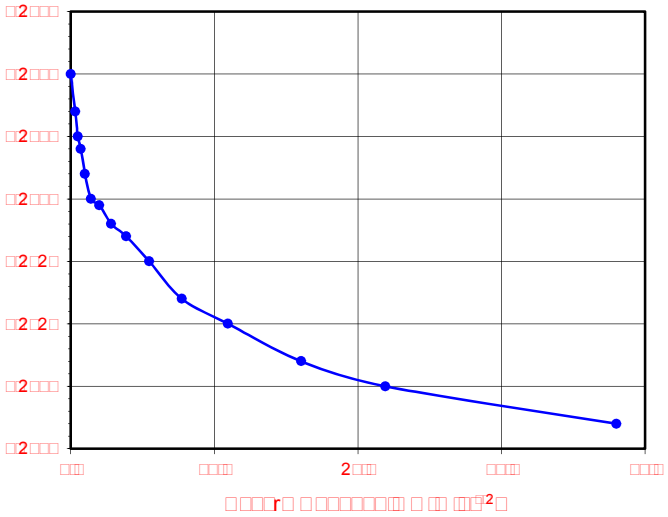
Project No.: 11737.001

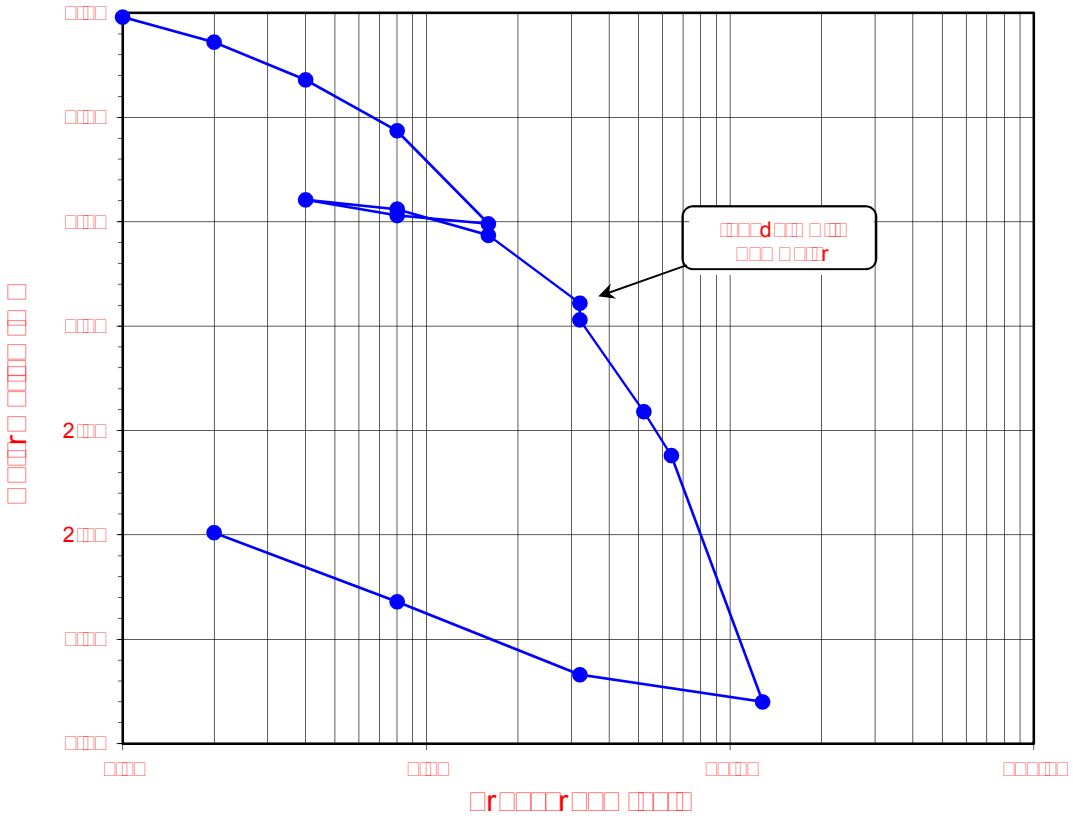
Serrano

09-17

Time Readings @ 6.4 ksf







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-2	**R7**	**45.0**	**13.3**	**12.7**	**116.4**	**120.3**	**0.448**	**0.412**	**80**	**86**

Soil Identification: Olive yellow clayey sand with gravel (SC)g

Leighton

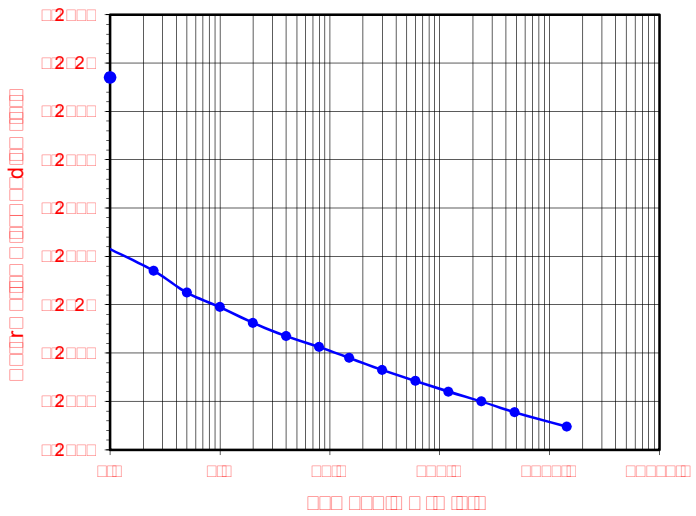
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

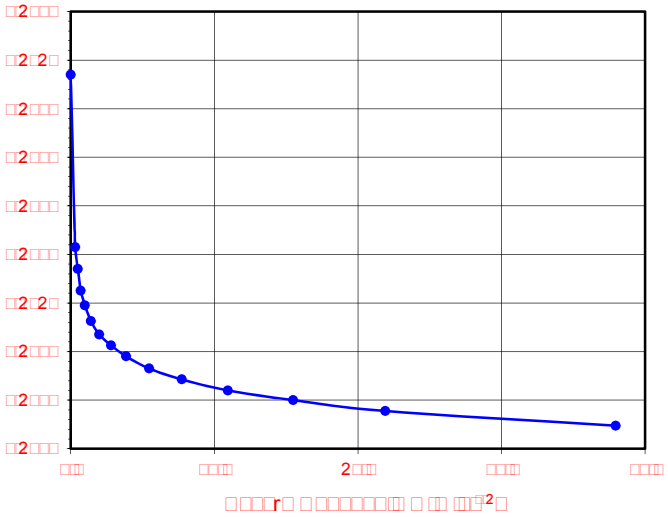
Project No.: 11737.001

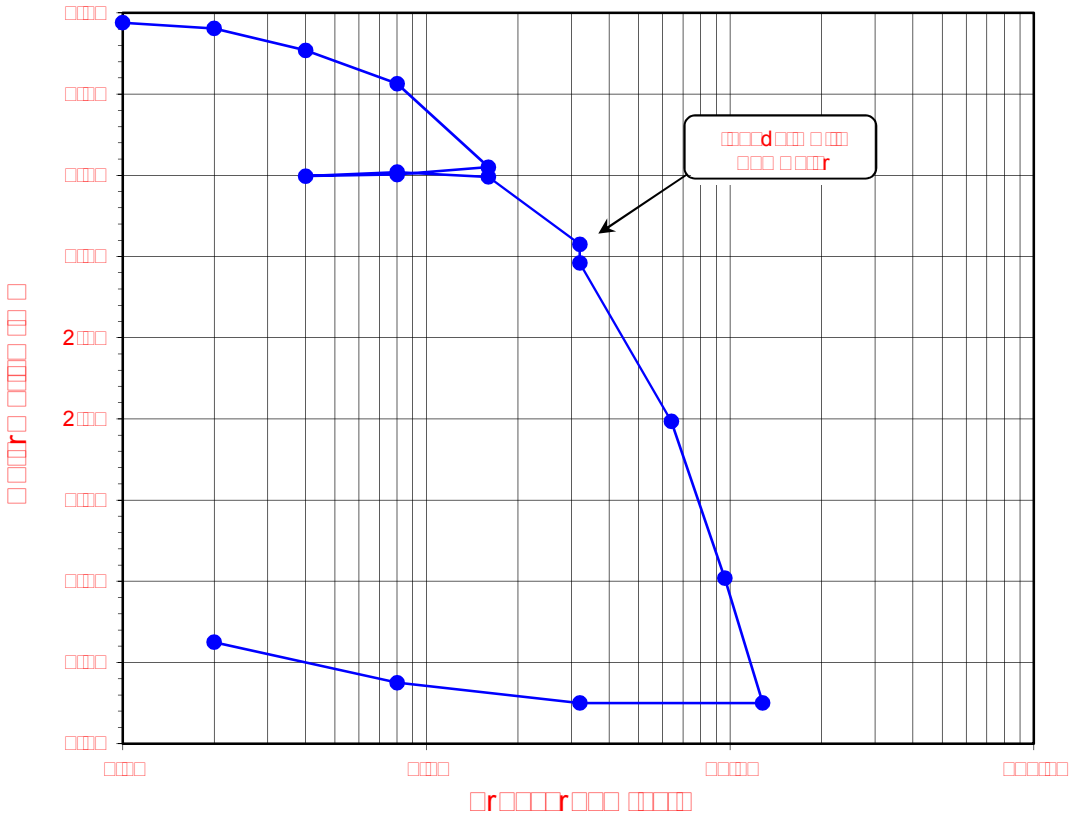
Serrano

09-17

Time Readings @ 6.4 ksf







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-6	**R13**	**75.0**	**8.8**	**18.2**	**114.9**	**109.5**	**0.468**	**0.411**	**51**	**91**

Soil Identification: Olive yellow silty sand (SM)

Leighton

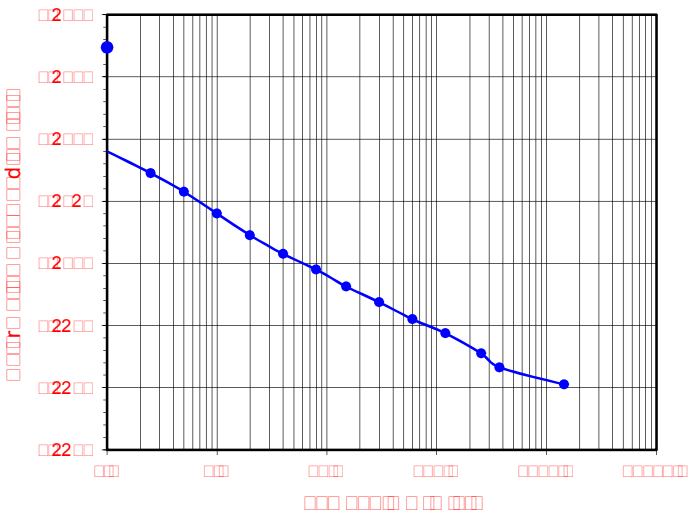
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

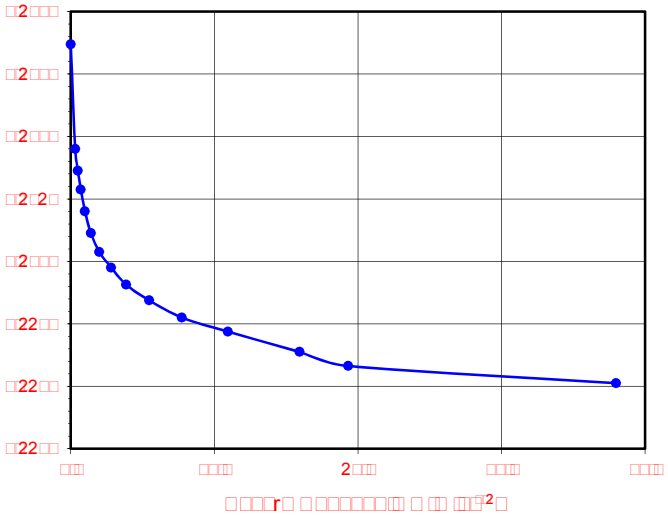
Project No.: 11737.001

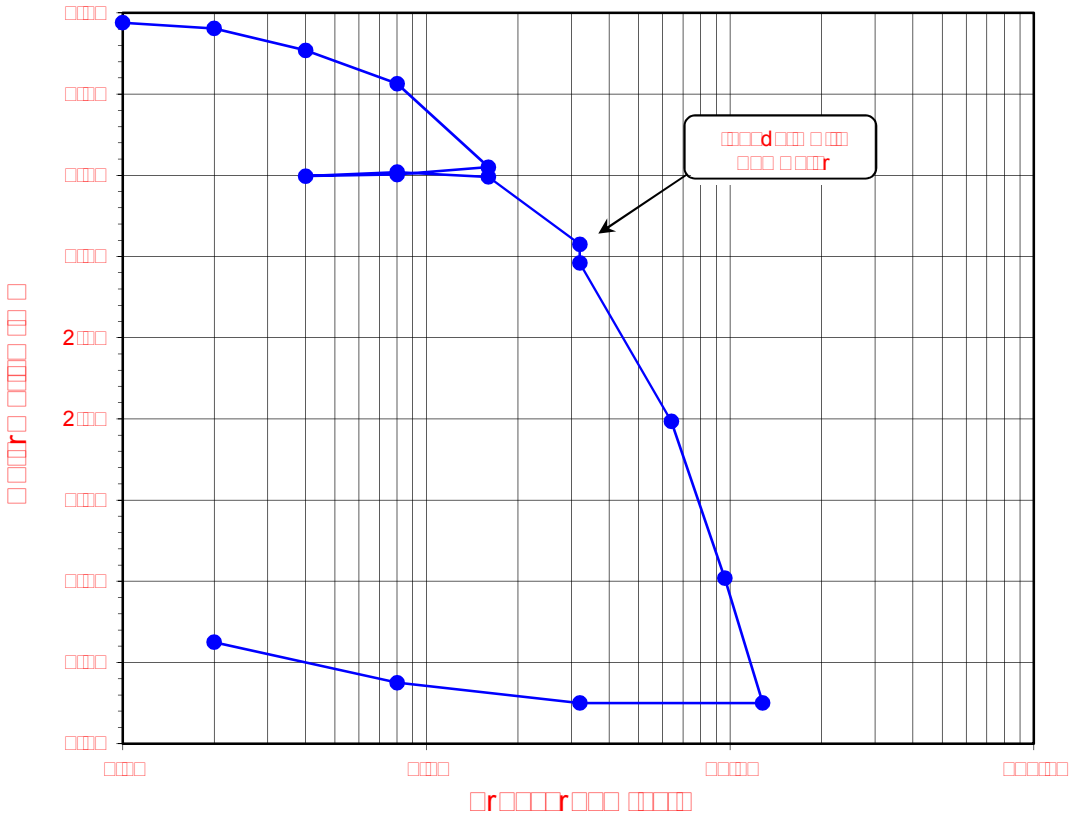
Serrano

09-17

Time Readings @ 9.6 ksf







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-6	**R13**	**75.0**	**8.8**	**18.2**	**114.9**	**109.5**	**0.468**	**0.411**	**51**	**91**

Soil Identification: Olive yellow silty sand (SM)

Leighton

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 11737.001

Serrano

09-17

Leighton

ONE-DIMENSIONAL SWELL OR SETTLEMENT POTENTIAL OF COHESIVE SOILS

ASTM D 4546

□r□□□□□□ □□ □□	□□rr□□□	□□□□d □□□	□□□□□□□□	□ □□□□	□□2□□□□
□r□□□□□□ □□□	□□□□□□□□□□	□□□□□d □□□	□□□ □rd	□ □□□□	□□2□□□□
□□r□□□ □ □□□	□□ □□	□□□ □□□ □□□□□	□ □□□		
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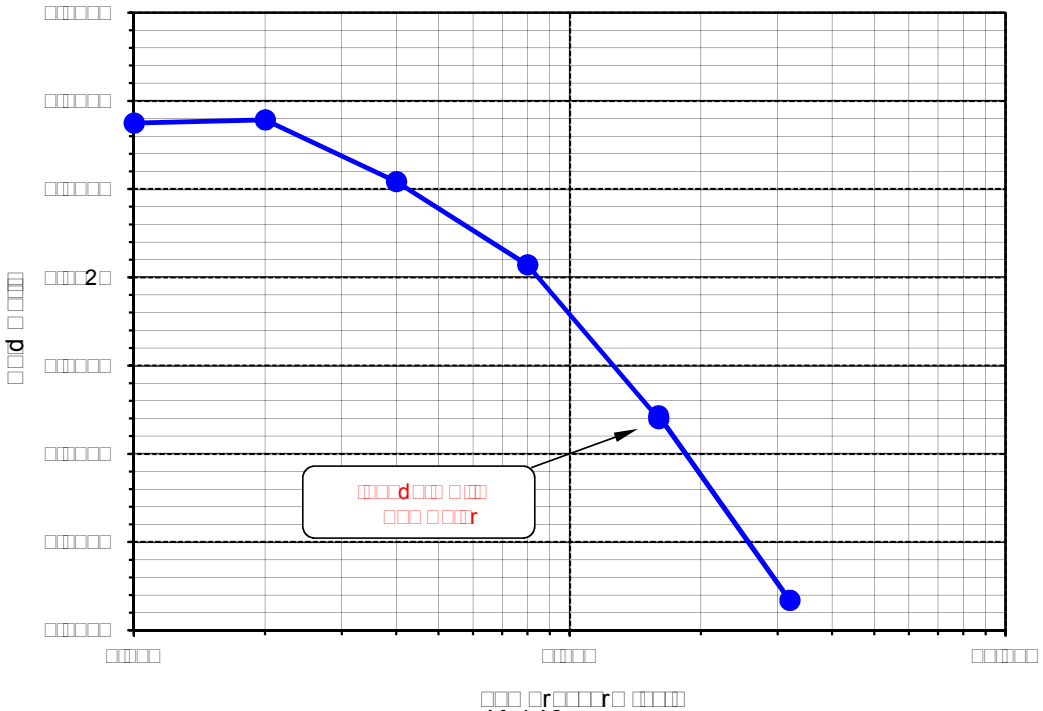

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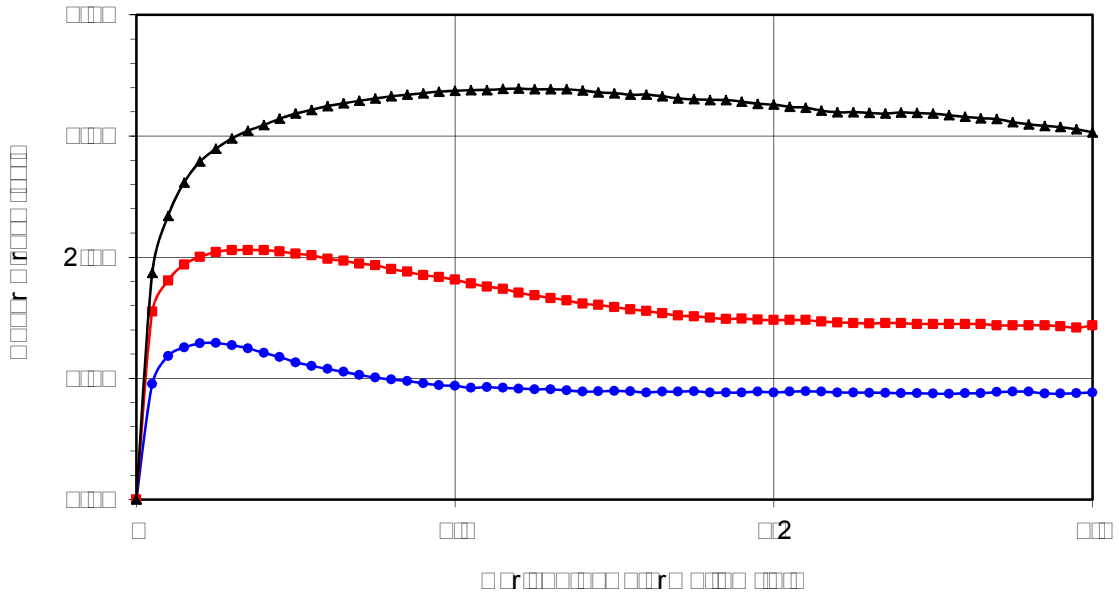

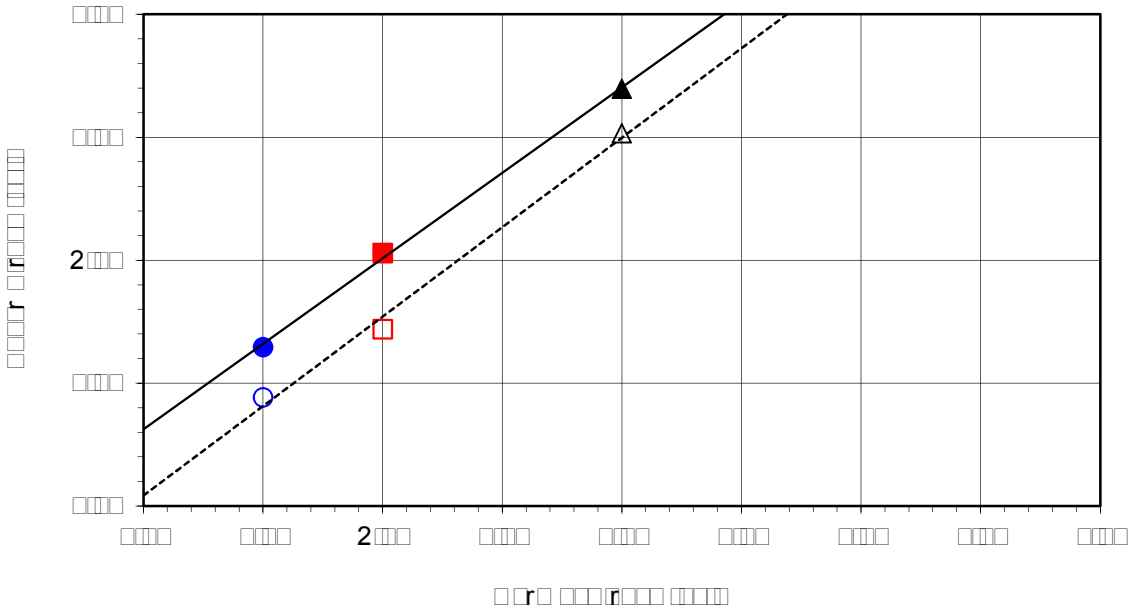

Boring No.	**LB-1**
Sample No.	**BB1**
Depth (ft)	**0-5**
Sample Type: 90% Remold	
Soil Identification: Olive brown silty, clayey sand (SC-SM)	

Strength Parameters

		ϕ (^{o})
	2	

Normal Stress (kip/ft²)	1.000	2.000	4.000
Peak Shear Stress (kip/ft²)	● 1.292	■ 2.059	▲ 3.392
Shear Stress @ End of Test (ksf)	○ 0.883	□ 1.437	△ 3.031
Deformation Rate (in./min.)	0.0500	0.0500	0.0500
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	8.70	8.70	8.70
Dry Density (pcf)	117.9	117.9	117.8
Saturation (%)	54.6	54.6	54.6
Soil Height Before Shearing (in.)	0.9935	0.9916	0.9820
Final Moisture Content (%)	14.1	13.7	13.4

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DIRECT SHEAR TEST RESULTS

Consolidated Undrained

Project No.: 11737.001

Serrano

08-17

K-150

DS LB-1, BB1 @ 0-5

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name:	Serrano	Tested By:	O. Figueroa	Date:	08/25/17
Project No.:	11737.001	Input By:	J. Ward	Date:	08/28/17
Boring No.:	LB-1	Depth (ft.):	0-5		
Sample No.:	BB1				
Soil Identification:	Olive brown silty, clayey sand (SC-SM)				

Preparation Method: [X] Moist [ ] Dry

[X] Mechanical Ram [ ] Manual Ram

Mold Volume (ft³) 0.03330 *Ram Weight = 10 lb.; Drop = 18 in.*

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3901	4002	3958			
Weight of Mold (g)	1857	1857	1857			
Net Weight of Soil (g)	2044	2145	2101			
Wet Weight of Soil + Cont. (g)	340.2	416.4	445.1			
Dry Weight of Soil + Cont. (g)	323.0	386.8	404.6			
Weight of Container (g)	39.2	39.6	39.5			
Moisture Content (%)	6.06	8.53	11.09			
Wet Density (pcf)	135.3	142.0	139.1			
Dry Density (pcf)	127.6	130.9	125.2			

Maximum Dry Density (pcf) 131.0 **Optimum Moisture Content (%)** 8.5

PROCEDURE USED

[X] **Procedure A**
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

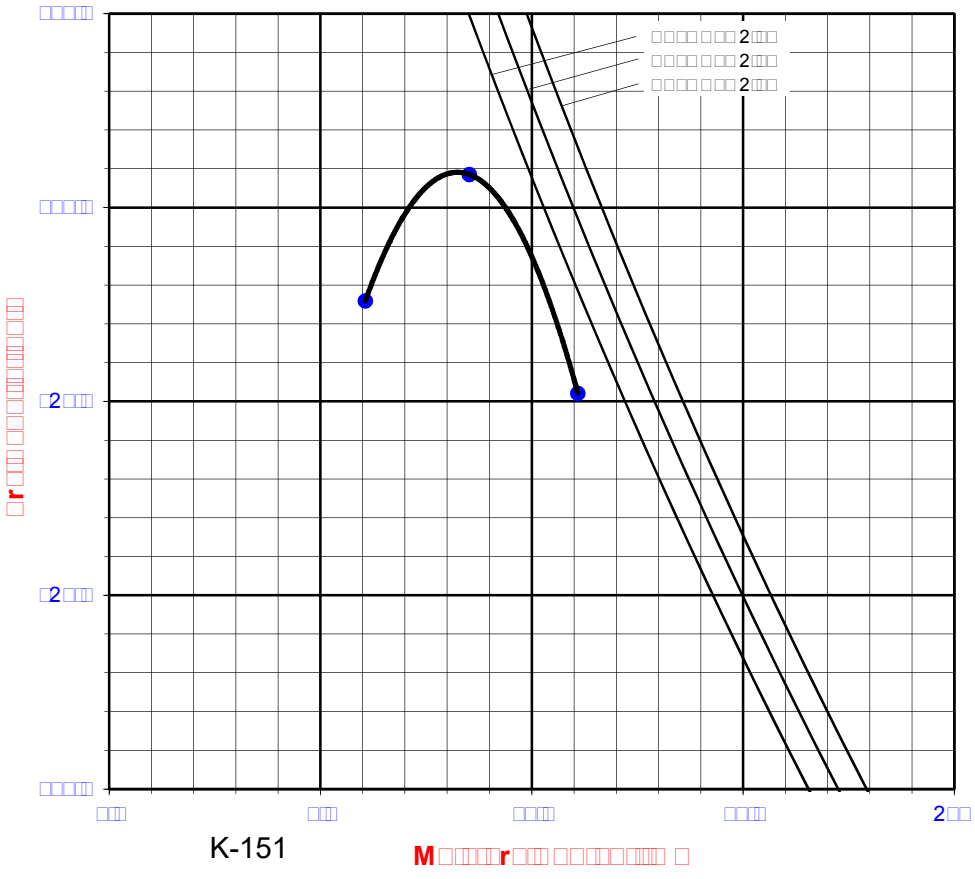
[ ] **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

[ ] **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:
1:74:25
GR:SA:FI

Atterberg Limits:

LL,PL,PI



MX LB-1, BB1 @ 0-5

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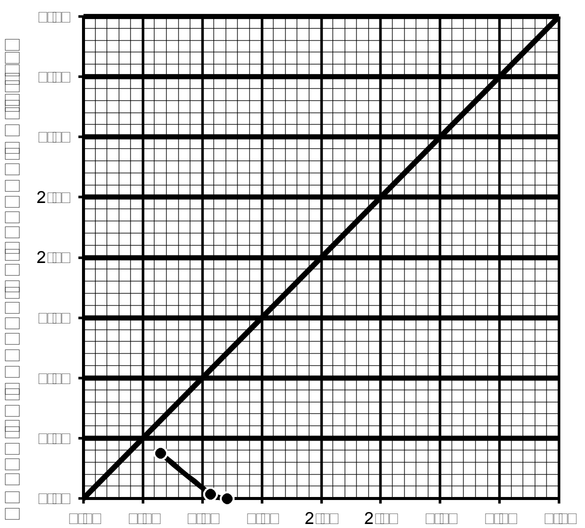

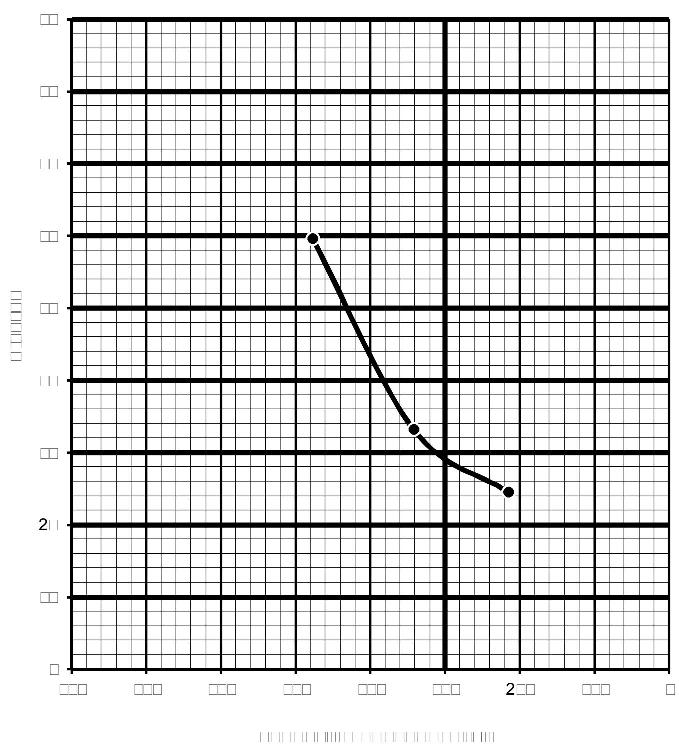

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TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: Serrano Tested By : G. Berdy Date: 08/24/17

Project No. : 11737.001 Data Input By: G. Bathala Date: 09/15/17

Boring No.	LB-1			
Sample No.	BB1			
Sample Depth (ft)	0-5			
Soil Identification:	Olive brown (SC-SM)			
Wet Weight of Soil + Container (g)	208.31			
Dry Weight of Soil + Container (g)	195.72			
Weight of Container (g)	58.70			
Moisture Content (%)	9.19			
Weight of Soaked Soil (g)	100.54			

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	92			
Crucible No.	26			
Furnace Temperature (°C)	860			
Time In / Time Out	9:00/9:45			
Duration of Combustion (min)	45			
Wt. of Crucible + Residue (g)	20.9369			
Wt. of Crucible (g)	20.9349			
Wt. of Residue (g) (A)	0.0020			
PPM of Sulfate (A) x 41150	82.30			
PPM of Sulfate, Dry Weight Basis	**91**			

CHLORIDE CONTENT, DOT California Test 422

ml of Extract For Titration (B)	30			
ml of AgNO3 Soln. Used in Titration (C)	0.3			
PPM of Chloride (C -0.2) * 100 * 30 / B	10			
PPM of Chloride, Dry Wt. Basis	**11**			

pH TEST, DOT California Test 643

pH Value	**7.74**			
Temperature °C	20.5			

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SOIL RESISTIVITY TEST

DOT CA TEST 643

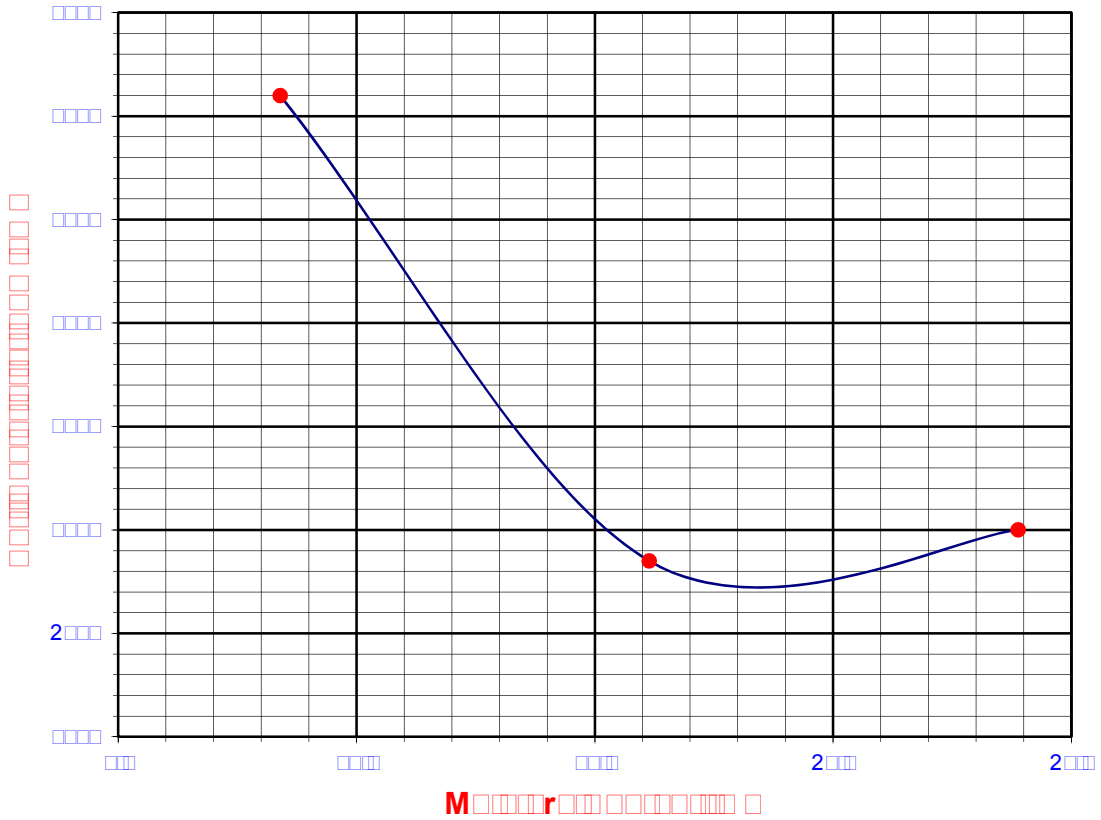
Project Name: Serrano
Project No. : 11737.001
Boring No.: LB-1
Sample No. : BB1
Soil Identification:* Olive brown (SC-SM)

Tested By : G. Berdy Date: 08/28/17
Data Input By: G. Bathala Date: 09/15/17
Depth (ft.) : 0-5

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	10	8.40	7200	7200
2	20	16.14	2700	2700
3	30	23.88	3000	3000
4				
5				

Moisture Content (%) (MCi)	0.66
Wet Wt. of Soil + Cont. (g)	90.64
Dry Wt. of Soil + Cont. (g)	90.47
Wt. of Container (g)	64.68
Container No.	
Initial Soil Wt. (g) (Wt)	130.03
Box Constant	1.000
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 643	
2400	**18.4**	**91**	**11**	**7.74**	**20.5**



APPENDIX C

PERCOLATION TEST RESULTS

Boring Percolation Test Data Sheet

Project Number:	11737.001	**Test Hole Number:**	LP-1
Project Name:	Serrano	**Date Excavated:**	8/16/2017
Earth Description:	Artificial Fill	**Date Tested:**	8/17/2017
Liquid Description:	Tap water	**Depth of boring (ft):**	9
Tested By:	JMP	**Diameter of boring (in):**	8
Time Interval Standard		**Diameter of casing (in):**	2
Start Time for Pre-Soak:	8/16/2017 9:00AM	**Length of slotted of casing (ft):**	5
Start Time for Standard:	8/17/2017 7:47AM	**Depth to Initial Water Depth (ft):**	4
Standard Time Interval		**Porosity of Annulus Material, *n* :**	0.35
Between Readings, mins:	30	**Bentonite Plug at Bottom:** No	

Percolation Data

Reading	Time	Time Interval, Δt (min.)	Initial/Final Depth to Water (ft.)	Initial/Final Water Height, H_0/H_f (in.)	Total Water Drop, Δd (in.)	Percolation Rate (min./in.)	Infiltration Rate (in./hr.)
1	7:47	30	4.40	55.2	3.4	8.93	0.09
	8:17		4.68	51.8			
2	8:17	30	4.68	51.8	2.4	12.50	0.07
	8:47		4.88	49.4			
3	8:47	30	4.88	49.4	2.0	14.71	0.06
	9:17		5.05	47.4			
4	9:17	30	4.95	48.6	1.9	15.63	0.06
	9:47		5.11	46.7			
5	9:47	30	4.95	48.6	2.5	11.90	0.08
	10:17		5.16	46.1			
6	10:17	30	4.96	48.5	2.4	12.50	0.08
	10:47		5.16	46.1			
7	10:47	30	4.97	48.4	2.2	13.89	0.07
	11:17		5.15	46.2			
8	11:17	30	4.95	48.6	2.3	13.16	0.07
	11:47		5.14	46.3			
9	11:47	30	4.97	48.4	2.0	14.71	0.06
	12:17		5.14	46.3			
10	12:17	30	4.96	48.5	2.0	14.71	0.06
	12:47		5.13	46.4			
11	12:47	30	4.97	48.4	1.9	15.63	0.06
	13:17		5.13	46.4			
12	13:17	30	4.96	48.5	1.9	15.63	0.06
	13:47		5.12	46.6			

Infiltration Rate (I) = Flow Volume/Flow Area/Δt

Infiltration Rate, I (Last Reading) = **0.06** **in./hr.**

Boring Percolation Test Data Sheet

Project Number:	11737.001	**Test Hole Number:**	LP-2
Project Name:	Serrano	**Date Excavated:**	8/16/2017
Earth Description:	Artificial Fill	**Date Tested:**	8/17/2017
Liquid Description:	Tap water	**Depth of boring (ft):**	9
Tested By:	JMP	**Diameter of boring (in):**	8
Time Interval Standard		**Diameter of casing (in):**	2
Start Time for Pre-Soak:	8/16/2017 9:00AM	**Length of slotted of casing (ft):**	5
Start Time for Standard:	8/17/2017 8:01AM	**Depth to Initial Water Depth (ft):**	4
Standard Time Interval		**Porosity of Annulus Material, *n* :**	0.35
Between Readings, mins:	30	**Bentonite Plug at Bottom:** No	

Percolation Data

Reading	Time	Time Interval, Δt (min.)	Initial/Final Depth to Water (ft.)	Initial/Final Water Height, H_0/H_f (in.)	Total Water Drop, Δd (in.)	Percolation Rate (min./in.)	Infiltration Rate (in./hr.)
1	8:01	30	4.25	57.0	1.4	20.83	0.04
	8:31		4.37	55.6			
2	8:31	30	4.37	55.6	1.3	22.73	0.04
	9:01		4.48	54.2			
3	9:01	30	4.48	54.2	1.2	25.00	0.03
	9:31		4.58	53.0			
4	9:31	30	4.58	53.0	1.2	25.00	0.03
	10:01		4.68	51.8			
5	10:01	30	4.68	51.8	1.1	27.78	0.03
	10:31		4.77	50.8			
6	10:31	30	4.77	50.8	1.2	25.00	0.04
	11:01		4.87	49.6			
7	11:01	30	4.87	49.6	1.1	27.78	0.03
	11:31		4.96	48.5			
8	11:31	30	4.96	48.5	1.2	25.00	0.04
	12:01		5.06	47.3			
9	12:01	30	4.99	48.1	-10.6	-2.84	-0.30
	12:31		4.11	58.7			
10	12:31	30	4.97	48.4	1.6	19.23	0.05
	13:01		5.10	46.8			
11	13:01	30	4.96	48.5	1.6	19.23	0.05
	13:31		5.09	46.9			
12	13:31	30	4.98	48.2	1.4	20.83	0.05
	14:01		5.10	46.8			

Infiltration Rate (I) = Flow Volume/Flow Area/Δt

Infiltration Rate, I (Last Reading) = **0.05** **in./hr.**

APPENDIX D

SEISMICITY DATA

USGS Design Maps Detailed Report

ASCE 7-10 Standard (33.83172°N, 117.76003°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1]	S_S = 1.569 g
From Figure 22-2 [2]	S_1 = 0.604 g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\overline{v}_s$	$\overline{N}$ or $\overline{N}_{ch}$	$\overline{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index *PI* > 20, • Moisture content *w* ≥ 40%, and • Undrained shear strength $\overline{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk–Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4–1: Site Coefficient F_a

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at Short Period				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = D and S_S = 1.569 g, F_a = 1.000

Table 11.4–2: Site Coefficient F_v

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at 1–s Period				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.604 g, F_v = 1.500

Equation (11.4–1): $S_{MS} = F_a S_S = 1.000 \times 1.569 = 1.569$ g

Equation (11.4–2): $S_{M1} = F_v S_1 = 1.500 \times 0.604 = 0.906$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

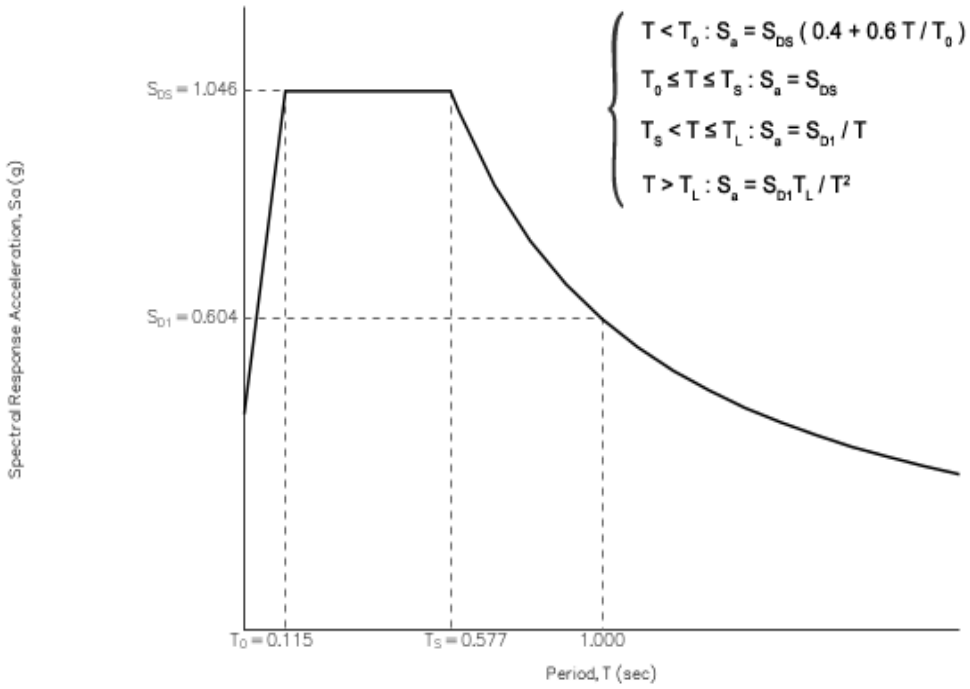
Equation (11.4–3): $S_{DS} = \frac{2}{3} S_{MS} = \frac{2}{3} \times 1.569 = 1.046$ g

Equation (11.4–4): $S_{D1} = \frac{2}{3} S_{M1} = \frac{2}{3} \times 0.906 = 0.604$ g

Section 11.4.5 — Design Response Spectrum

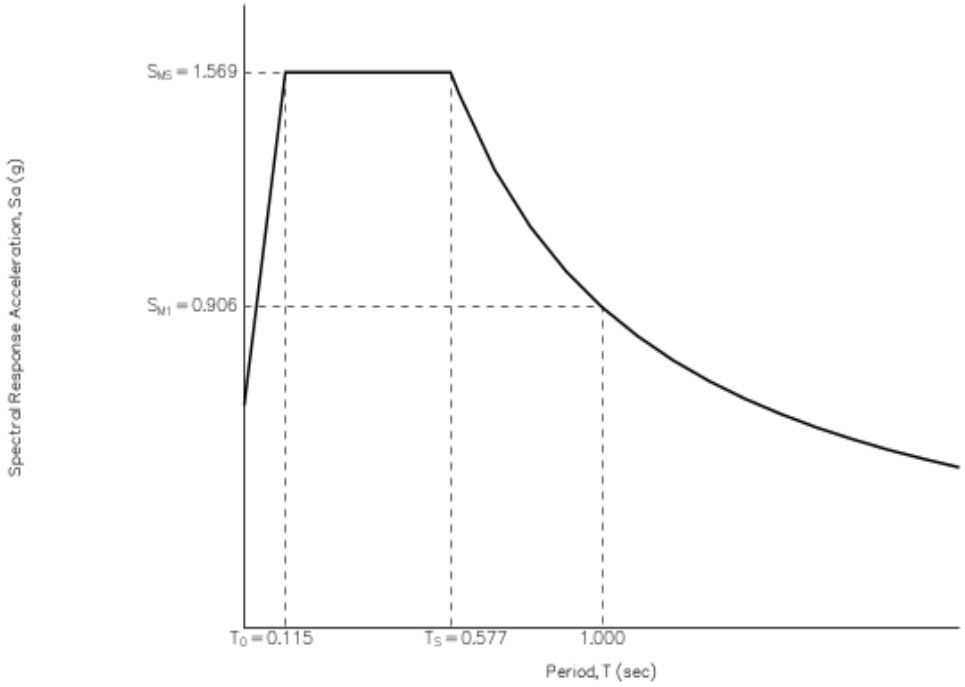
From Figure 22-12 [3] $T_L = 8$ seconds

Figure 11.4–1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.599

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.000 \times 0.599 = 0.599$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = D and PGA = 0.599 g, F_{PGA} = 1.000

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 1.003

From Figure 22-18 [6] C_{R1} = 1.020

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 1.046 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.604 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = D

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf

APPENDIX E

GENERAL EARTHWORK AND GRADING RECOMMENDATIONS

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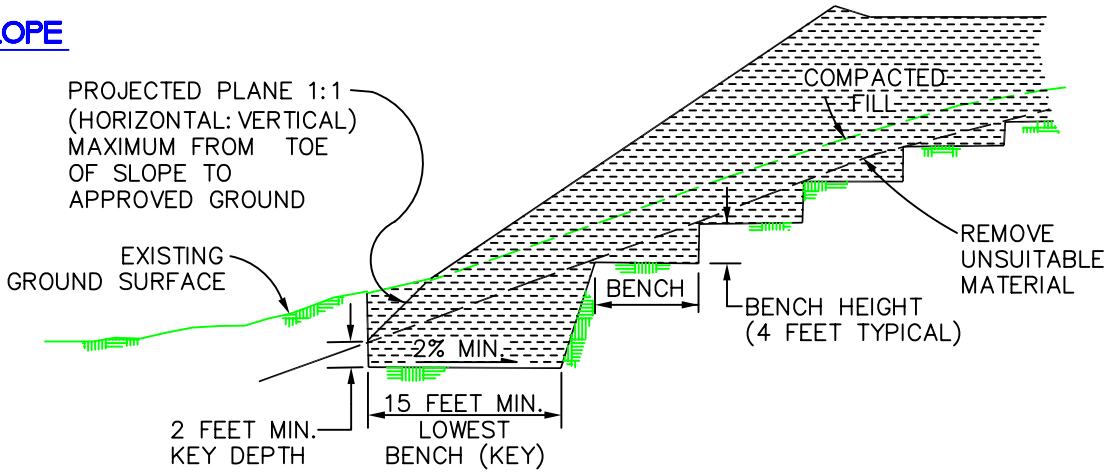
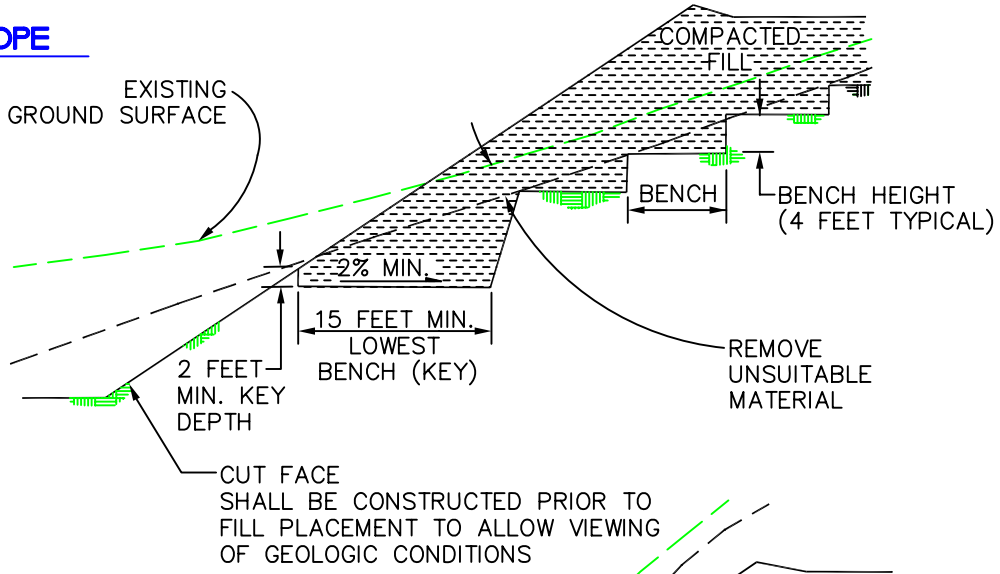
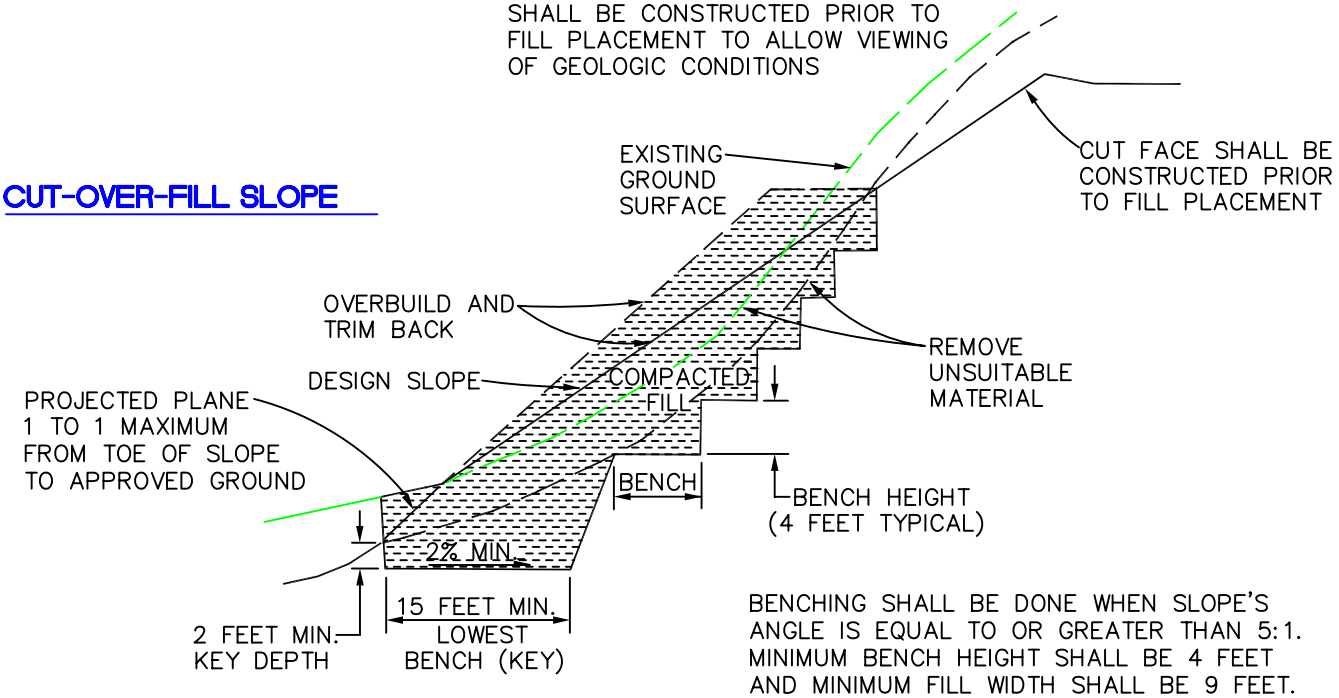
FILL SLOPE



FILL-OVER-CUT SLOPE

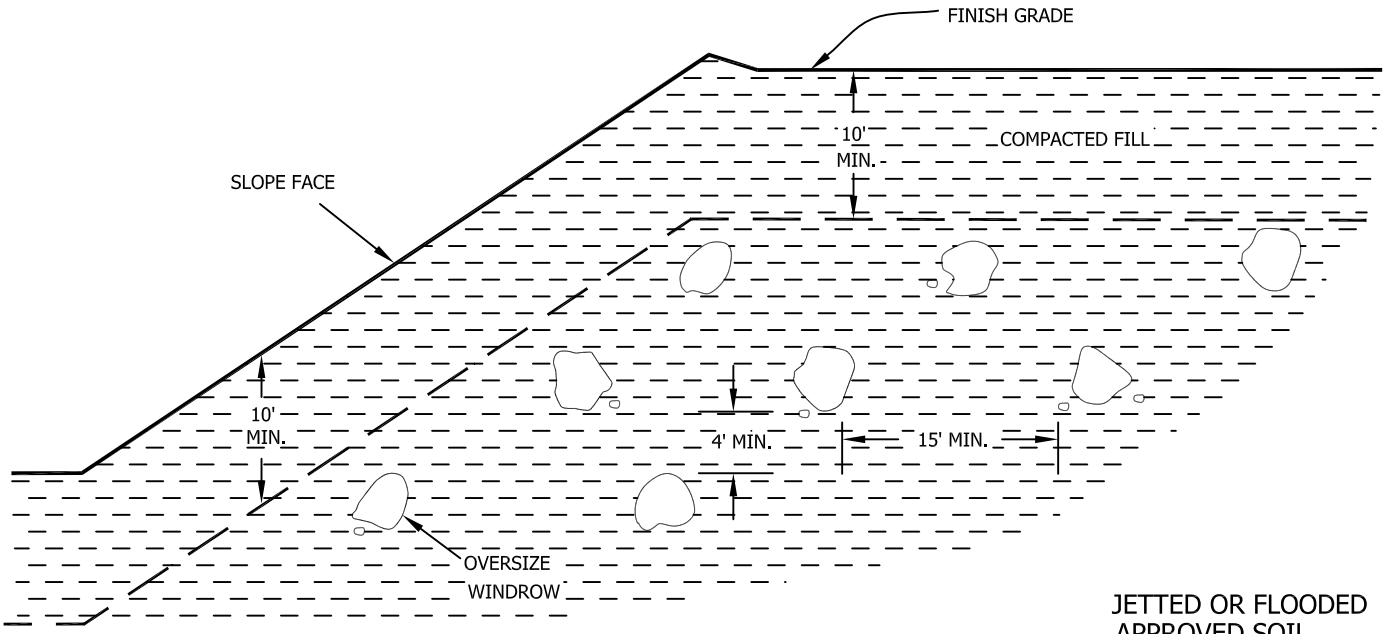


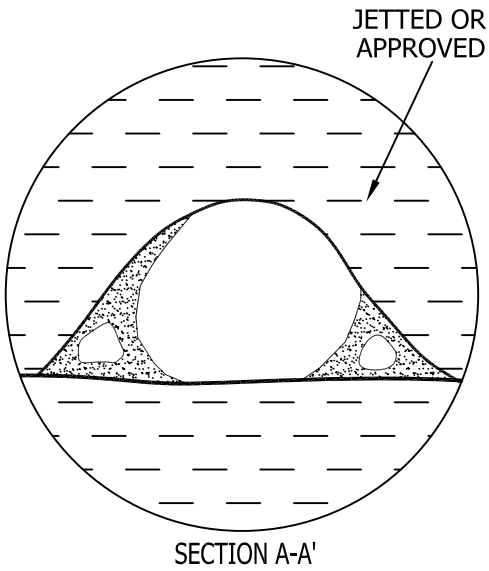
CUT-OVER-FILL SLOPE



BENCHING SHALL BE DONE WHEN SLOPE'S ANGLE IS EQUAL TO OR GREATER THAN 5:1. MINIMUM BENCH HEIGHT SHALL BE 4 FEET AND MINIMUM FILL WIDTH SHALL BE 9 FEET.

KEYING AND BENCHING	GENERAL EARTHWORK AND GRADING SPECIFICATIONS STANDARD DETAILS A K-175	Leighton

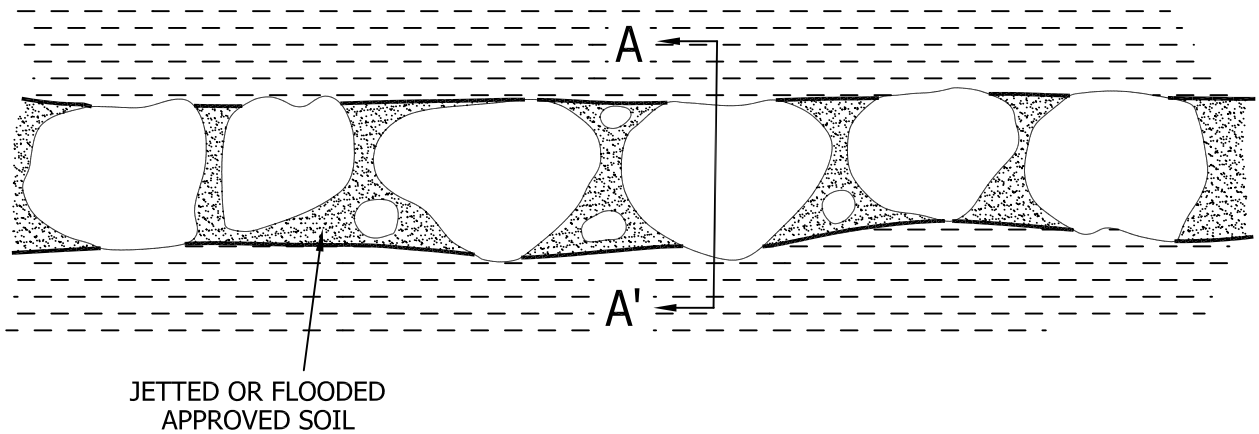




SECTION A-A'

- Oversize rock is larger than 8 inches in largest dimension.
- Backfill with approved soil jetted or flooded in place to fill all the voids.
- Do not bury rock within 10 feet of finish grade.
- Windrow of buried rock shall be parallel to the finished slope face.

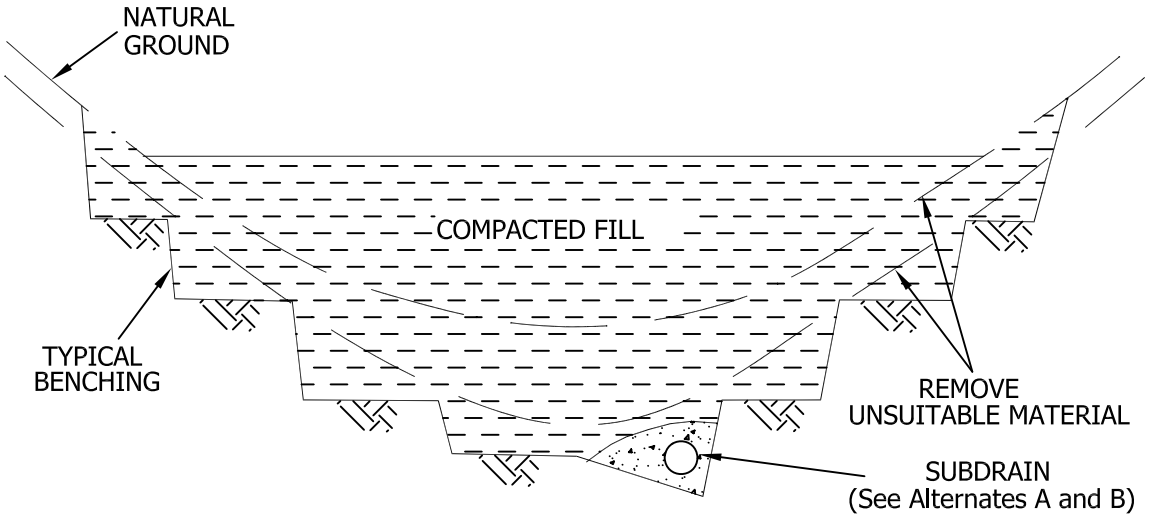
PROFILE ALONG WINDROW



OVERSIZE ROCK DISPOSAL

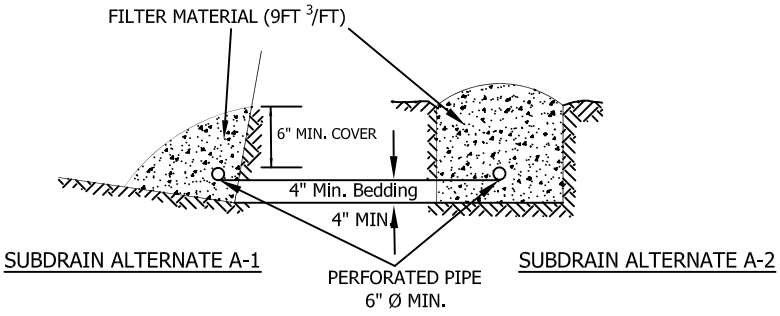
GENERAL EARTHWORK AND GRADING
SPECIFICATIONS
STANDARD DETAILS B
K-176

Leighton



SUBDRAIN ALTERNATE A

PERFORATED PIPE SURROUNDED WITH FILTER MATERIAL

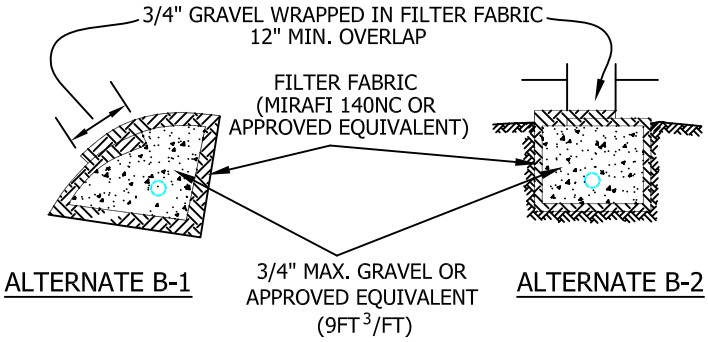


FILTER MATERIAL

FILTER MATERIAL SHALL BE CLASS 2 PERMEABLE MATERIAL PER STATE OF CALIFORNIA STANDARD SPECIFICATION, OR APPROVED ALTERNATE. CLASS 2 GRADING AS FOLLOWS:

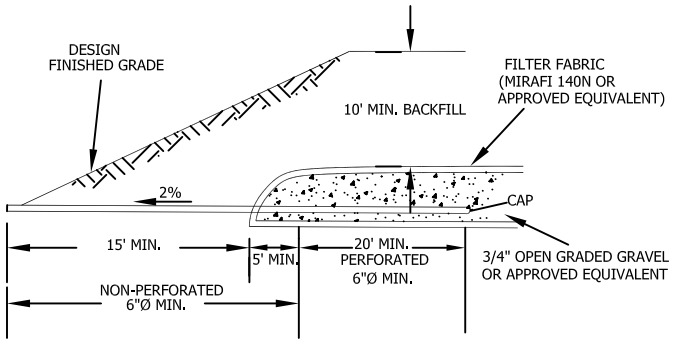
Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

SUBDRAIN ALTERNATE B



○ PERFORATED PIPE IS OPTIONAL PER GOVERNING AGENCY'S REQUIREMENTS

DETAIL OF CANYON SUBDRAIN TERMINAL



CANYON SUBDRAIN	GENERAL EARTHWORK AND GRADING SPECIFICATIONS STANDARD DETAILS C	Leighton

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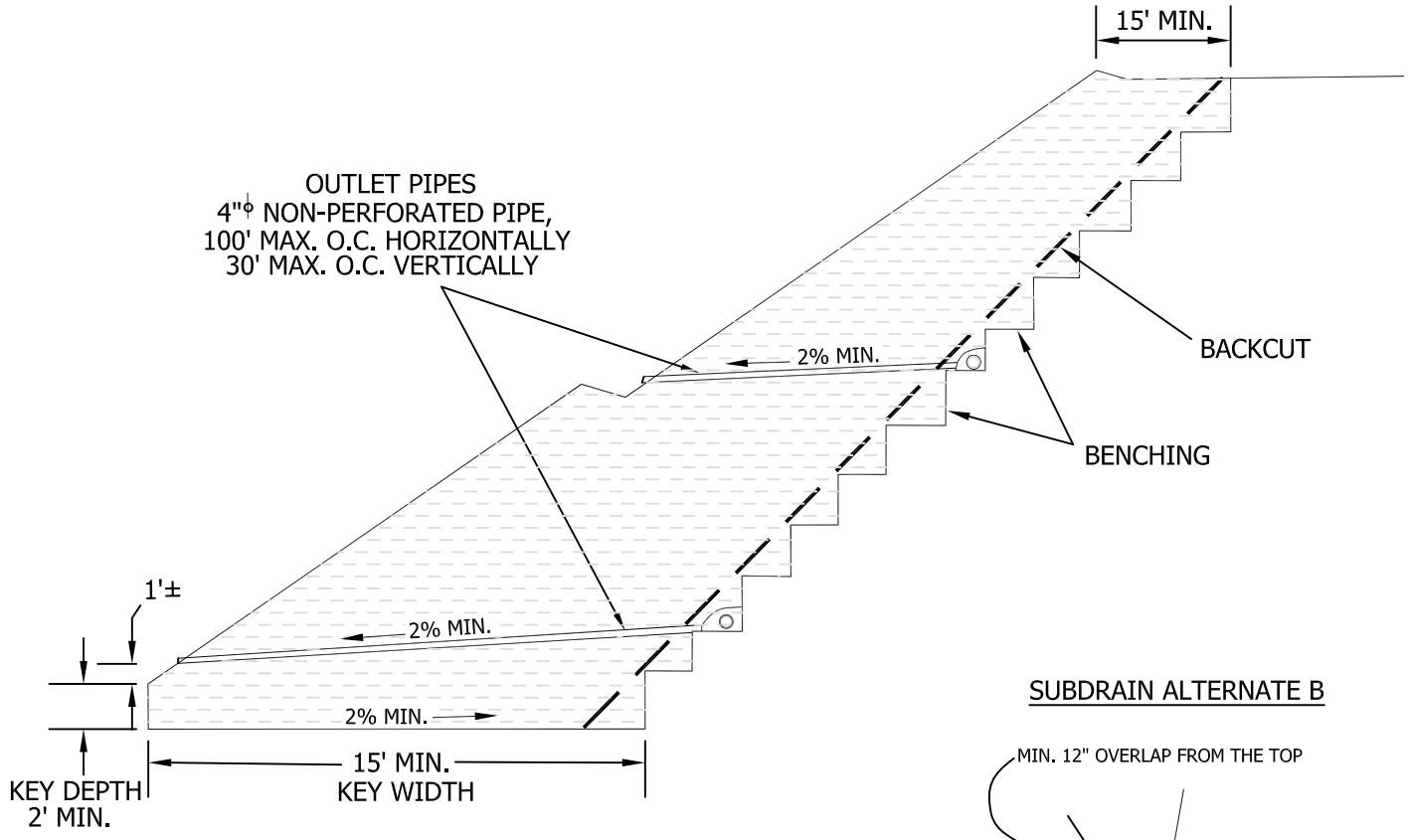
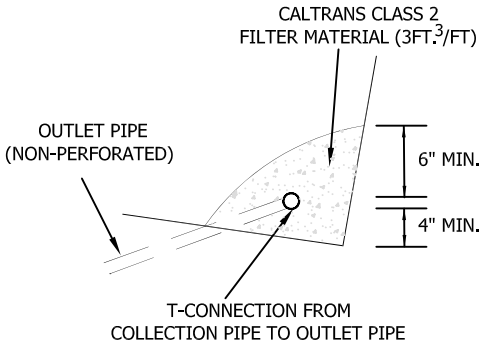


SUBDRAIN ALTERNATE A



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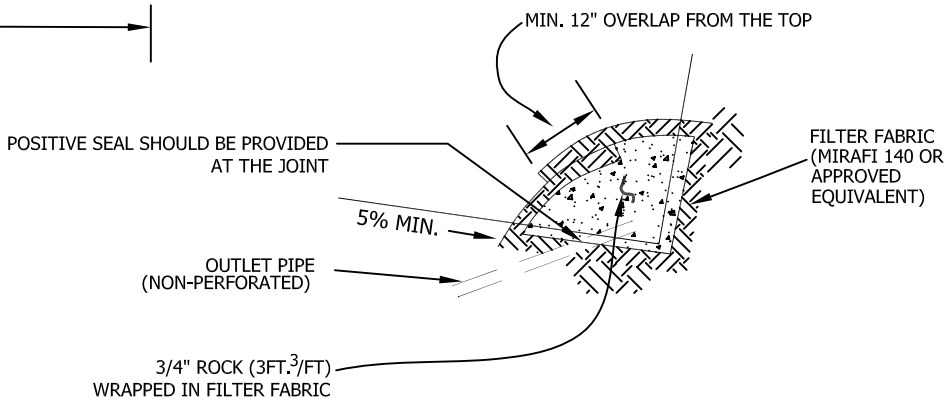

- SUBDRAIN INSTALLATION - Subdrain collector pipe shall be installed with perforations down or, unless otherwise designated by the geotechnical consultant. Outlet pipes shall be non-perforated pipe. The subdrain pipe shall have at least 8 perforations uniformly spaced per foot. Perforation shall be 1/4" to 1/2" if drilled holes are used. All subdrain pipes shall have a gradient at least 2% towards the outlet.
- SUBDRAIN PIPE - Subdrain pipe shall be ASTM D2751, ASTM D1527 (Schedule 40) or SDR 23.5 ABS pipe or ASTM D3034 (Schedule 40) or SDR 23.5 PVC pipe.
- All outlet pipe shall be placed in a trench and, after fill is placed above it, rodded to verify integrity.

BUTTRESS OR REPLACEMENT FILL SUBDRAINS	GENERAL EARTHWORK AND GRADING SPECIFICATIONS STANDARD DETAILS D K-178	Leighton

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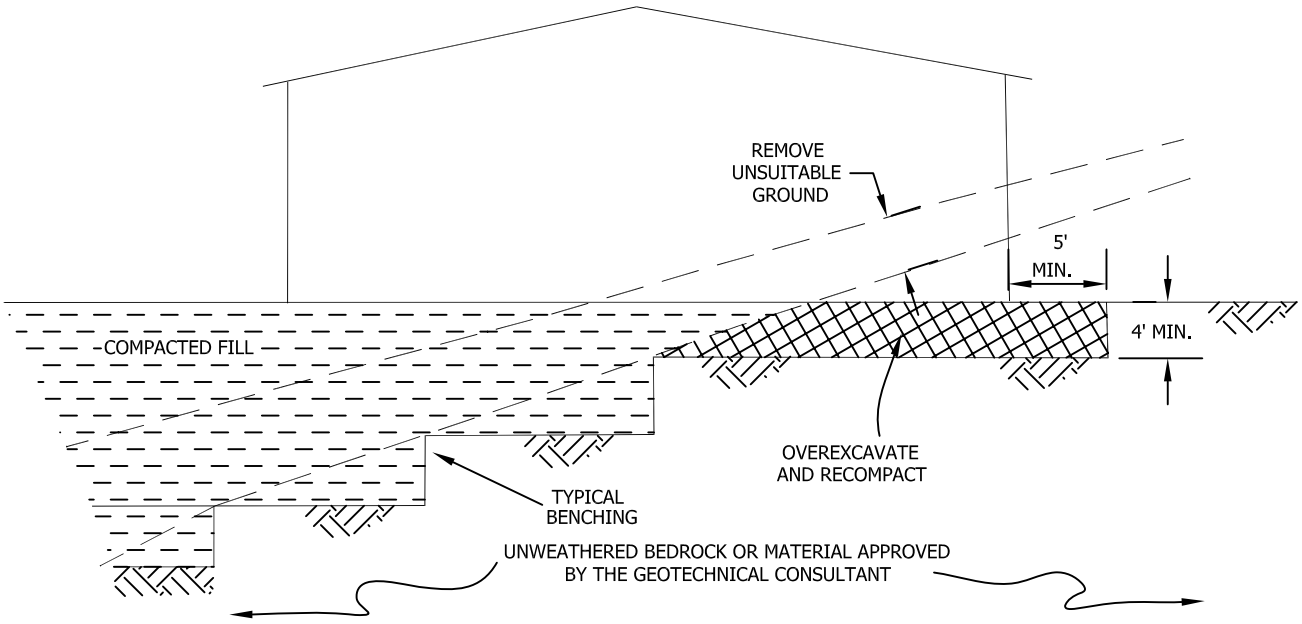
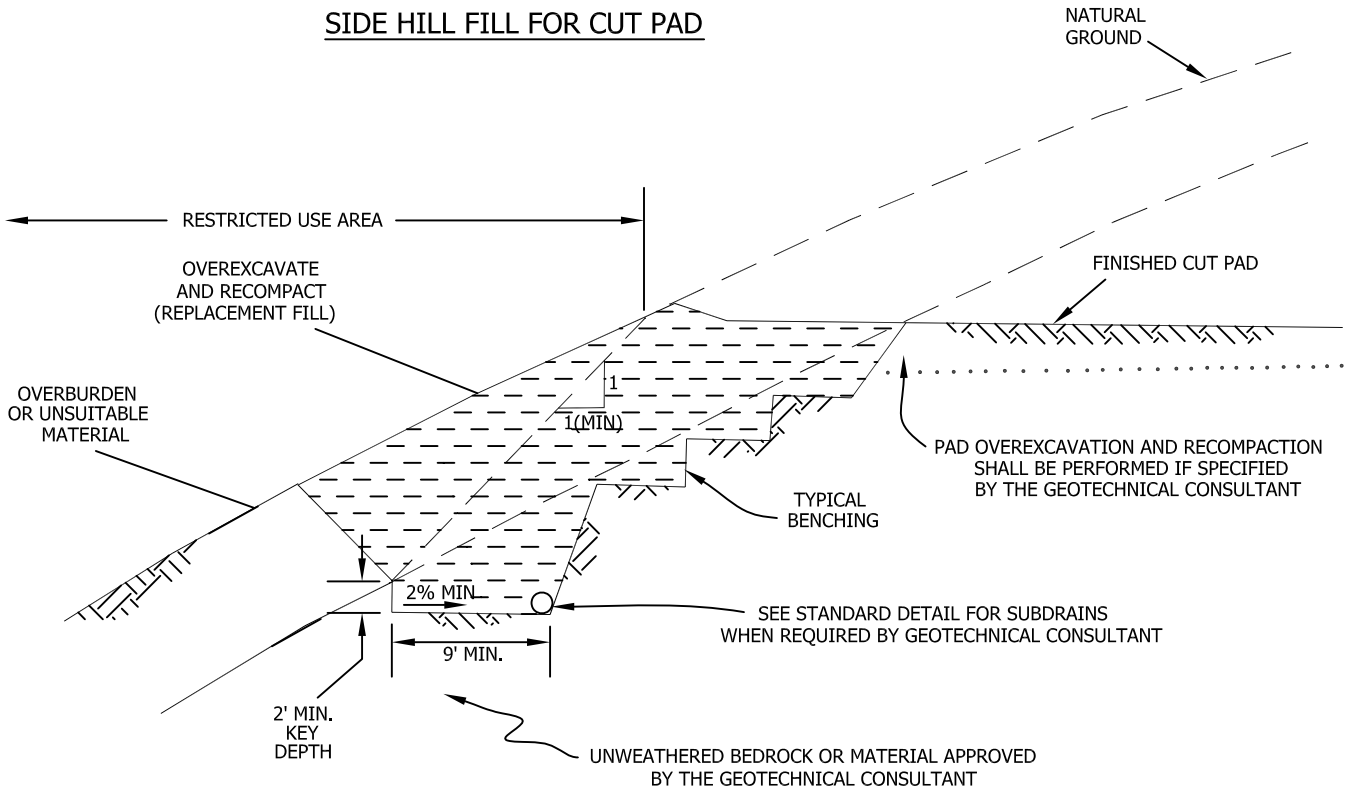
CUT-FILL TRANSITION LOT OVEREXCAVATION



SIDE HILL FILL FOR CUT PAD



TRANSITION LOT FILLS AND SIDE HILL FILLS

GENERAL EARTHWORK AND GRADING SPECIFICATIONS
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As summarized within earlier correspondences prepared by the City of Anaheim, the preliminary soils report must be reviewed by the Santiago Geological Hazard Abatement District (GHAD) prior to approval by the City. Contact information for SGHAD is presented below:

Karen Holthe, CMCA, AMS
Senior Account Manager
kholthe@cardinal-online.com
Cardinal Property Management, AAMC
825 N. Park Center Dr., #101
Santa Ana, CA 92705
P (714) 779-1300 / F (714) 779-3400

Please provide a copy of the review comments and/or consent from the Santiago GHAD.

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Percolation testing was conducted at two locations within the site (LP-1 & LP-2). Both test locations encountered artificial fill to the total depth of the boring. Measured infiltration rates within the test borings were calculated between 0.05 and 0.06 inches per hour. Since the infiltration rates did not meet the County of Orange minimum infiltration rate (0.3 inches per hour), the consultant has concluded that infiltration beneath the site is impractical and not recommended for the proposed development.

The County of Orange, Technical Guidance Document states that infiltration testing should not be conducted in engineered or undocumented fill. While the areas tested

were underlain by significant fill, other areas of the site are not and are reported to have sandstone bedrock located near the surface. As such, the consultant should determine if infiltration is practical within the sandstone unit encountered in various exploratory borings where present near the surface. Keep in mind that while the sandstone unit may exhibit a relatively low permeability, a dry well in the sandstone unit may result in an infiltration rate that is deemed feasible in the TGD (where infiltration rate= well flow rate/wetted area).

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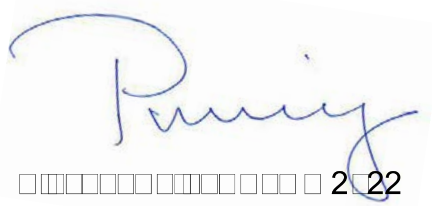

866) LEIGHTON

City of Anaheim
DEPARTMENT OF PUBLIC WORKS

May 25, 2018

To: Jeffrey M. Pflueger, P.G., C.E.G.
Vincent P. Ip, P.E., G.E.
Leighton and Associates, Inc.
17781 Cowan
Irvine, CA 92614
(949) 250-1421

RE: Review of Geotechnical Exploration Report for Proposed Residential Development
6501-6213 E. Serrano Ave.
OTH2018-01060,
First Review

Dear Mr. Pflueger:
The documents reviewed have been submitted to the City of Anaheim as a geotechnical document in support of planning approval. As such, the report was only reviewed for establishing feasibility of the proposed site development. Additional comments may be issued if submitted in support of grading or building plans during Final Engineering. Prior to approval of planning, the following items should be addressed by the consultant. The following will be required for the next plan submittal:

1. The Soils Report Comment Letter from Albus-Keefe & Associates, Inc. and a copy of this letter.
2. Two (2) copies of responses addressing all comments.
3. *Preliminary Soils Report Review Comments:*
   3.1 As summarized within earlier correspondences prepared by the City of Anaheim, the preliminary soils report must be reviewed by the Santiago Geological Hazard Abatement District (SGHAD) prior to approval by the City. Contact information for SGHAD is presented below:

   Karen Holthe, CMCA, AMS
   Senior Account Manager
   kholthe@cardinal-online.com
   Cardinal Property Management, AAMC
   825 N. Park Center Dr., #101
   Santa Ana, CA 92705
   P (714) 779-1300 / F (714) 779-3400

   Please provide a copy of the review comments and/or consent from the Santiago GHAD.

   3.2 Percolation testing was conducted at two locations within the site (LP-1 & LP-2). Both test locations encountered artificial fill to the total depth of the

200 S. Anaheim Blvd., Suite 276
Anaheim, CA 92805
TEL (714) 765-5176
FAX (714) 765-5225
www.anaheim.net

boring. Measured infiltration rates within the test borings were calculated between 0.05 and 0.06 inches per hour. Since the infiltration rates did not meet the County of Orange minimum infiltration rate (0.3 inches per hour), the consultant has concluded that infiltration beneath the site is impractical and not recommended for the proposed development.

The County of Orange, Technical Guidance Document states that infiltration testing should not be conducted in engineered or undocumented fill. While the areas tested were underlain by significant fill, other areas of the site are not and are reported to have sandstone bedrock located near the surface. As such, the consultant should determine if infiltration is practical within the sandstone unit encountered in various exploratory borings where present near the surface. Keep in mind that while the sandstone unit may exhibit a relatively low permeability, a dry well in the sandstone unit may result in an infiltration rate that is deemed feasible in the TGD (where infiltration rate = well flow rate/wetted area).

3.3 The Preliminary Soils Report shall be approved prior to filing for Planning Commission public hearing.

If you have any questions regarding this project, please contact me at (714) 765-4953 or at egarcia2@anaheim.net

Sincerely,

Edgar Garcia

Edgar Garcia
Associate Engineer

Attachment: Comment Letter from Albus-Keefe & Associates, Inc. dated May 9, 2018

cc;
Raul Garcia, Development Services Manager
Mike Eskander, Principal Civil Engineer
File

Albus-Keefe & Associates, Inc.
1011 N. Armando Street
Anaheim, California 92806
(714) 630-1626
(714) 630-1916 FAX

GEOTECHNICAL ENGINEERING REVIEW SHEET
CITY OF ANAHEIM

Plan Check # OTH 2018-01060

AKA Project No. 2714.00

Date: May 9, 2018

Project Name: Nohl Ranch Condos

Location: 6501 – 6513 E Serrano Avenue, Anaheim, CA

Consultant: Leighton and Associates, Inc.

Geotechnical Engineer: Vincent P. Ip, GE 2522

Engineering Geologist: Jeffrey M. Pflueger, CEG2499

Documents Reviewed:

1.) *Geotechnical Exploration Report, Proposed Residential Development, 6501-6513 East Serrano Avenue, Anaheim, California,* prepared by Leighton and Associates, Inc., dated October 9, 2017 (Project No. 11737.001).

2.) *Conceptual Grading Plan, Nohl Ranch Condos, City of Anaheim,* Prepared by Hunsaker & Associates, Inc. Sheet C-4, dated April 16, 2018.

Action:

____ Recommended Approval of Document(s) Submitted
____ Conditional Approval of Document(s) Submitted – see comments
_X_ Request Additional Data for Review – see comments

Reviewed By:

David E. Albus
Principal Engineer
G.E. 2455

REGISTERED PROFESSIONAL ENGINEER
DAVID E. ALBUS
No. 2455
Exp. 12/31/18
GEOTECHNICAL
STATE OF CALIFORNIA

Patrick M. Keefe
Principal Engineering Geologist
CEG 2022

REGISTERED GEOLOGIST
PATRICK M. KEEFE
NO. 2022
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

Albus-Keefe & Associates, Inc.
1011 N. Armando Street
Anaheim, California 92806
(714) 630-1626
(714) 630-1916 FAX

AKA Project No. 2714.00

Date: May 9, 2018

COMMENTS

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Project No.
14174.000.000

June 29, 2018

Ms. Karen Holthe
Santiago Geologic Hazard Abatement District
Cardinal Property Management
825 N. Park Center Drive, Suite 101
Santa Ana, CA 92705

Subject: 6501-6513 East Serrano Avenue
Anaheim, California

RESIDENTIAL GRADING PLAN REVIEW

References:

1. Leighton and Associates, Inc., Geotechnical Exploration Report, 6501- 6513 East Serrano Avenue, Anaheim, CA 92807; October 9, 2017, Project No. 11737.001.
2. City of Anaheim, Department of Public Works; Review of Geotechnical Exploration Report for Proposed Residential Development, 6501-6513 East Serrano Avenue, Anaheim, CA 92807; OTH2018-01060, First Review, May 25, 2018.
3. Eberhart and Stone, Plan of Control, Prepared for Proposed Santiago Geologic Hazard Abatement District, Anaheim Hills, Anaheim, California, February 22, 1999.
4. Eberhart and Stone, Santiago Landslide Area Anaheim Hills, Geologic Hazard Abatement District Benefit Area, Anaheim, California.

Dear Ms. Holthe:

ENGEO, acting as the Santiago Geologic Hazard Abatement District (GHAD) Manager, reviewed the Leighton Geotechnical Exploration Report and City of Anaheim, Department of Public Works Review of Geotechnical Exploration Report for Proposed Residential Development (References 1 and 2) for 6501-6513 East Serrano Avenue in Anaheim, California (Subject Property). The purpose of our review was to address the City of Anaheim's request that the applicant obtain written consent from the GHAD indicating that the proposed project will not significantly impact stability of the existing Santiago landslide.

As described in Reference 1, the planned residences will replace the existing commercial buildings and improvements. The residences will be two- to three-story attached multi-family residential buildings, with private drive aisles and guest parking. Onsite biofiltration is being considered for stormwater treatment and surface drainage will be directed away from the structures.

As described in the Leighton Geotechnical Exploration Report, artificial fill thickness varied beneath the Subject Property from 1 foot to greater than 76½ feet. Puente Formation bedrock was encountered in six of the eight exploratory borings underlying the artificial fill. Groundwater was not observed in the exploratory borings at the time of the Leighton exploration. Percolation testing was conducted at two of the exploratory boring locations to support design of the planned biofiltration improvements.

The Subject Property is located northwest of the Santiago GHAD as shown on the Benefit Area Site Plan (Reference 4). The planned addition is not located within the Santiago GHAD or the mapped "Limit of Surface Damage" area. As stated in the Plan of Control (Reference 3), the formation on the Santiago landslide was caused by four primary factors:

1. North-facing hillside topography.
2. Geologic structure as north-dipping strata and south-ancient faults.
3. Geologically weak materials along critical sedimentary beds and faults.
4. Rising groundwater.

Based on our review, it does not appear that construction of the planned residences and associated improvements, including biofiltration improvements, if constructed, would affect the Santiago landslide or the ongoing mitigation efforts by the Santiago GHAD. We make no representations as to the accuracy of dimensions, measurements, calculations or any portion of the design.

If you have any questions regarding the contents of this letter, please contact us.

Very truly yours,

ENGEO INCORPORATED

Haley Trindle

Eric Harrell

CERTIFIED ENGINEERING GEOLOGIST
ERIC HARRELL
No. 2189
STATE OF CALIFORNIA

Haley Trindle
Eric Harrell, CEG
ht/eh/jf

Project No.
14174.000.000

June 29, 2018

Ms. Karen Holthe
Santiago Geologic Hazard Abatement District
Cardinal Property Management
825 N. Park Center Drive, Suite 101
Santa Ana, CA 92705

Subject: 6501-6513 East Serrano Avenue
Anaheim, California

RESIDENTIAL GRADING PLAN REVIEW

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GEOTECHNICAL ENGINEERING REVIEW SHEET
CITY OF ANAHEIM

Plan Check # OTH 2018-01060

AKA Project No. 2714.00

Date: August 15, 2018

Project Name: Nohl Ranch Condos

Location: 6501 – 6513 E Serrano Avenue, Anaheim, CA

Consultant: Leighton and Associates, Inc.

Geotechnical Engineer: Vincent P. Ip, GE 2522

Engineering Geologist: Jeffrey M. Pflueger, CEG2499

Documents Reviewed:

1.) *Response to Review Comments Regarding Leighton's Geotechnical Exploration Report for the Proposed Residential Development, 6501 – 6513 East Serrano Avenue, Anaheim, California*, prepared by Leighton and Associates, Inc., dated August 10, 2018 (Project No. 11737.002).

2.) *Geotechnical Exploration Report, Proposed Residential Development, 6501-6513 East Serrano Avenue, Anaheim, California*, prepared by Leighton and Associates, Inc., dated October 9, 2017 (Project No. 11737.001).

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