

Water Quality Management Plan

For:

Buffalo Grove

APN 100-706-108 & 100-706-123

Prepared for:

Century Communities

4695 MacArthur Court, Suite 300

Newport Beach, CA 92660

Prepared by:

JLC Engineering and Consulting, Inc.

41660 Ivy Street, Suite A

Murrieta, CA 92562

951-304-9552

Submittal Date: April 29, 2025

Revision Date: _____

Approval Date: _____

Project Owner's Certification

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

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

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	TBD	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN 100-706-108 & 100-706-123
Owner's Signature			
Owner Name: Rao R. Yalamanchili			
Title	Manager		
Company	610 Investments 25-1, LLC		
Address	610 Santa Anita Ave, Arcadia, CA 91006		
Email			
Telephone #	(626) 321-4800		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
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“The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of Regional Water Quality Control Board Order No. R8-2010-0036.”

Engineer: Joseph L. Castaneda		PE Stamp Below
Title	Professional Engineer	
Company	JLC Engineering and Consulting, Inc.	
Address	41660 Ivy Street, Suite A, Murrieta, CA 92562	
Email	joe@jlcengineering.com	
Telephone #	951-304-9552	
Signature		
Date	04/25/2025	

Table of Contents

Section 1	Discretionary Permits	1-1
Section 2	Project Description.....	2-1
	2.1 Project Information.....	2-1
	2.2 Property Ownership / Management	2-2
	2.3 Potential Stormwater Pollutants	2-3
	2.4 Water Quality Credits	2-4
Section 3	Site and Watershed Description	3-1
Section 4	Best Management Practices	4-1
	4.1 Source Control BMP	4-1
	4.1.1 Pollution Prevention	4-1
	4.1.2 Preventative LID Site Design Practices	4-6
	4.2 Project Performance Criteria.....	4-7
	4.3 Project Conformance Analysis.....	4-12
	4.3.1 Site Design Hydrologic Source Control BMP	4-14
	4.3.2 Infiltration BMP	4-16
	4.3.3 Harvest and Use BMP	4-18
	4.3.4 Biotreatment BMP.....	4-19
	4.3.5 Conformance Summary.....	4-23
	4.3.6 Hydromodification Control BMP	4-24
	4.4 Alternative Compliance Plan (if applicable)	4-25
Section 5	Inspection & Maintenance Responsibility Post Construction BMPs.....	5-1
Section 6	Site Plan and Drainage Plan.....	6-1
	6.1. Site Plan and Drainage Plan.....	6-1
	6.2 Electronic Data Submittal	6-2
	6.3 Post Construction (O&M and BMP Agreement)	6-3
	6.4 Water Quality Documentation.....	6-4
	6.5 Precipitation	6-5
	6.6 Infiltration Testing	6-6
	6.7 Hydrologic Conditions of Concern.....	6-7
	6.8 Education Materials.....	6-8
	6.9 Vicinity Map.....	6-9
	6.10 Receiving Waters Map.....	6-10
	6.11 Improvement Plans.....	6-11
	6.12 Hydrologic Soils Map.....	6-12

Forms

Form 1-1 Project Information	1-1
Form 2.1-1 Description of Proposed Project	2-1
Form 2.2-1 Property Ownership/Management	2-2
Form 2.3-1 Pollutants of Concern	2-3
Form 2.4-1 Water Quality Credits	2-4
Form 3-1 Site Location and Hydrologic Features	3-1
Form 3-2 Hydrologic Characteristics.....	3-2
Form 3-3 Watershed Description.....	3-3
Form 4.1-1 Non-Structural Source Control BMP.....	4-2
Form 4.1-2 Structural Source Control BMP	4-4
Form 4.1-3 Site Design Practices Checklist.....	4-6
Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume	4-7
Form 4.2-2 Summary of HCOA Assessment.....	4-8
Form 4.2-3 HCOA Assessment for Runoff Volume	4-9
Form 4.2-4 HCOA Assessment for Time of Concentration	4-10
Form 4.2-5 HCOA Assessment for Peak Runoff.....	4-11
Form 4.3-1 Infiltration BMP Feasibility	4-13
Form 4.3-2 Site Design Hydrologic Source Control BMP	4-14
Form 4.3-3 Infiltration LID BMP.....	4-17
Form 4.3-4 Harvest and Use BMP	4-18
Form 4.3-5 Selection and Evaluation of Biotreatment BMP	4-19
Form 4.3-6 Volume Based Biotreatment – Bioretention and Planter Boxes w/Underdrains	4-20
Form 4.3-7 Volume Based Biotreatment- Constructed Wetlands and Extended Detention	4-21
Form 4.3-8 Flow Based Biotreatment	4-22
Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate	4-23
Form 4.3-10 Hydromodification Control BMP	4-24
Form 5-1 BMP Inspection and Maintenance	5-1

Section 1 Discretionary Permit(s)

Form 1-1 Project Information					
Project Name		Buffalo Grove			
Project Owner Contact Name:		Rao R. Yalamanchili			
Mailing Address:	610 Santa Anita Ave, Arcadia, CA 91006	E-mail Address:		Telephone:	(626) 321-4800
Permit/Application Number(s):	TBD	Tract/Parcel Map Number(s):	TBD		
Additional Information/ Comments:	APN 100-706-108 & 100-706-123 South side of Foothill Blvd, east of Central Ave and west of Benson Ave, Upland, CA				
Description of Project:	The project is a proposed residential development that will construct approximately 74 units. The existing site topography drains to the south with runoff discharging into the parking lot to the south of the project site. In the proposed condition, runoff discharges to the south of the project site. The project proposes two subsurface system to infiltrate the water quality volume emanating from the project site and to provide storage for increased runoff mitigation.				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.					

Section 2 Project Description

2.1 Project Information

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

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

Form 2.1-1 Description of Proposed Project					
1 Development Category (Select all that apply):					
<input type="checkbox"/> Significant re-development involving the addition or replacement of 5,000 ft ² or more of impervious surface on an already developed site	<input checked="" type="checkbox"/> New development involving the creation of 10,000 ft ² or more of impervious surface collectively over entire site	<input type="checkbox"/> Automotive repair shops with standard industrial classification (SIC) codes 5013, 5014, 5541, 7532- 7534, 7536-7539	<input type="checkbox"/> Restaurants (with SIC code 5812) where the land area of development is 5,000 ft ² or more		
<input type="checkbox"/> Hillside developments of 5,000 ft ² or more which are located on areas with known erosive soil conditions or where the natural slope is 25 percent or more	<input type="checkbox"/> Developments of 2,500 ft ² of impervious surface or more adjacent to (within 200 ft) or discharging directly into environmentally sensitive areas or waterbodies listed on the CWA Section 303(d) list of impaired waters.	<input type="checkbox"/> Parking lots of 5,000 ft ² or more exposed to storm water	<input type="checkbox"/> Retail gasoline outlets that are either 5,000 ft ² or more, or have a projected average daily traffic of 100 or more vehicles per day		
<input type="checkbox"/> Non-Priority / Non-Category Project <i>May require source control LID BMPs and other LIP requirements. Please consult with local jurisdiction on specific requirements.</i>					
2 Project Area (ft ²):	188,179	3 Number of Dwelling Units:	74	4 SIC Code:	N/A
5 Is Project going to be phased? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.</i>					
6 Does Project include roads? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, ensure that applicable requirements for transportation projects are addressed (see Appendix A of TGD for WQMP)</i>					

2.2 Property Ownership/Management

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

Form 2.2-1 Property Ownership/Management

Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities:

The entire site is proposed to be owned and maintained by the applicant. As a result, the long term maintenance will be the responsibility of the property owner.

2.3 Potential Stormwater Pollutants

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

Form 2.3-1 Pollutants of Concern			
Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	
Pathogens (Bacterial / Virus)	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Domestic Refuse
Nutrients - Phosphorous	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Fertilizer
Nutrients - Nitrogen	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Fertilizer
Noxious Aquatic Plants	E <input type="checkbox"/>	N <input checked="" type="checkbox"/>	The proposed development does not include any areas where water will be standing long enough to allow the growth of aquatic plants.
Sediment	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Pavement and Landscaped Areas
Metals	E <input type="checkbox"/>	N <input checked="" type="checkbox"/>	The project is a residential site and is unlikely to contains the metal pollution that occurs within commercial sites.
Oil and Grease	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Motor Vehicles
Trash/Debris	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Outdoor Trash Receptacles
Pesticides / Herbicides	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Landscaped Areas
Organic Compounds	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Motor Vehicles, Fertilizers
Other: Oxygen Demanding Compounds	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Motor Vehicles
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	

2.4 Water Quality Credits

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

The project will not utilize water quality credits.

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

Section 3 Site and Watershed Description

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

Form 3-1 Site Location and Hydrologic Features			
Site coordinates take GPS measurement at approximate center of site	Latitude 34°06'21.2"N	Longitude 117°41'16.6"W	Thomas Bros Map page 301
<p>¹ San Bernardino County climatic region: <input checked="" type="checkbox"/> Valley <input type="checkbox"/> Mountain</p>			
<p>² Does the site have more than one drainage area (DA): Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> <i>If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached</i></p>			
<pre> graph TD DA1[DA 1 DMA A] --> O1[OUTLET 1] DA2[DA 2 DMA B] --> O2[OUTLET 2] </pre>			
Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA		
DA1 DMA A to Outlet 1	<i>Runoff is collected from DMA A and conveyed to subsurface infiltration Basin A. Runoff which is not infiltrated will be conveyed to Outlet 1 at the southern edge of the project site.</i>		
DA2 DMA B to Outlet 2	<i>Runoff is collected from DMA B and conveyed to subsurface infiltration Basin B. Runoff which is not infiltrated will be conveyed to Outlet 2 at the southern edge of the project site.</i>		

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B		
1 DMA drainage area (ft ²)	144,619	50,530		
2 Existing site impervious area (ft ²)	0	0		
3 Antecedent moisture condition <i>For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf</i>	1	1		
4 Hydrologic soil group <i>Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/</i>	A	A		
5 Longest flowpath length (ft)	624	596		
6 Longest flowpath slope (ft/ft)	0.04	0.05		
7 Current land cover type(s) <i>Select from Fig C-3 of Hydrology Manual</i>	Barren Graded land	Barren Graded land		
8 Pre-developed pervious area condition: <i>Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating</i>	Poor	Poor		

Form 3-3 Watershed Description for Drainage Area	
<p>Receiving waters</p> <p><i>Refer to Watershed Mapping Tool -</i> http://permitrack.sbcounty.gov/wap/</p> <p><i>See "Drainage Facilities" link at this website</i></p>	<p>Onsite Storm Drain System City Storm Drain System San Antonio Channel Chino Creek Prado Flood Control Basin Santa Ana River, Reach 2 Santa Ana River, Reach 1</p>
<p>Applicable TMDLs</p> <p><i>Refer to Local Implementation Plan</i></p>	<p>Nitrate</p>
<p>303(d) listed impairments</p> <p><i>Refer to Local Implementation Plan and Watershed Mapping Tool -</i> http://permitrack.sbcounty.gov/wap/ and State Water Resources Control Board website - http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml</p>	<p>Cadmium, Indicator Bacteria, pH</p>
<p>Environmentally Sensitive Areas (ESA)</p> <p><i>Refer to Watershed Mapping Tool -</i> http://permitrack.sbcounty.gov/wap/</p>	<p>N/A</p>
<p>Unlined Downstream Water Bodies</p> <p><i>Refer to Watershed Mapping Tool -</i> http://permitrack.sbcounty.gov/wap/</p>	<p>N/A</p>
<p>Hydrologic Conditions of Concern</p>	<p><input type="checkbox"/> Yes Complete Hydrologic Conditions of Concern (HCOC) Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-10 in submittal</p> <p><input checked="" type="checkbox"/> No</p>
<p>Watershed-based BMP included in a RWQCB approved WAP</p>	<p><input type="checkbox"/> Yes Attach verification of regional BMP evaluation criteria in WAP</p> <ul style="list-style-type: none"> • More Effective than On-site LID • Remaining Capacity for Project DCV • Upstream of any Water of the US • Operational at Project Completion • Long-Term Maintenance Plan <p><input checked="" type="checkbox"/> No</p>

Section 4 Best Management Practices (BMP)

4.1 Source Control BMP

4.1.1 Pollution Prevention

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

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

Form 4.1-1 Non-Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Project owner shall be familiar with the contents of this WQMP document and shall provide BMP Educational Training Materials from Section 6.4 of this document to employees at time of hire.
N2	Activity Restrictions	<input type="checkbox"/>	<input checked="" type="checkbox"/>	The project does not include activity restrictions.
N3	Landscape Management BMPs	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The landscaped areas within the project site are to be tended to and maintained by outside contractor in compliance with CASQA BMP Factsheet #SC-41. Landscape maintenance shall including mowing and trimming.
N4	BMP Maintenance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	BMP maintenance will be provided by the HOA and will take place at a minimum of twice a year and after any major rainfall event.
N5	Title 22 CCR Compliance (How development will comply)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	The project site does not incorporate hazardous waste.
N6	Local Water Quality Ordinances	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The project will comply with the local water quality ordinances, ensuring clean stormwater discharges to public properties.
N7	Spill Contingency Plan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	There will be no hazardous materials stored onsite that require a spill contingency plan.
N8	Underground Storage Tank Compliance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	The project site does not incorporate underground storage tanks.
N9	Hazardous Materials Disclosure Compliance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	The project site will not incorporate hazardous materials onsite.

Form 4.1-1 Non-Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner shall comply with all Fire Code regulations.
N11	Litter/Debris Control Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The project will implement the maintenance and removal of litter from common areas by private contractor that will collect trash weekly.
N12	Employee Training	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Training will be required within 6 months of hire dates for new employees, and then annually thereafter. HOA will be required to educate and train new employees.
N13	Housekeeping of Loading Docks	<input type="checkbox"/>	<input checked="" type="checkbox"/>	The project does not incorporate loading docks.
N14	Catch Basin Inspection Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The project site will incorporate a catch basin inspection program that will be done by a private contractor semi annually by visual inspection of facilities. The intent of the program is to ensure catch basin insert are cleaned and operational, identify any illegal dumping or identify any illicit discharges.
N15	Vacuum Sweeping of Private Streets and Parking Lots	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The project will perform vacuum sweeping along the common street and parking lot areas. Street sweeping shall be done on a bi-monthly basis and it is recommended to be performed after waste management company picks-up trash for the project area.
N16	Other Non-structural Measures for Public Agency Projects	<input type="checkbox"/>	<input checked="" type="checkbox"/>	The project is not a Public Agency Project.
N17	Comply with all other applicable NPDES permits	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The project owner will comply with all other applicable NPDES permits, including the statewide General Construction Stormwater Permit, before and during the entire period of construction and the State's General Industrial Permit requirements.

Form 4.1-2 Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The project will place stencilling/signage at storm drain inlet locations with language stating “No Dumping – Drains to River” or the most current language adopted by the City of Rialto to discourage the illegal dumping of improper materials. Stenciling shall be inspected annually and replace as needed, to ensure legibility.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	The project site does not produce pollutants which require specialized handling or storage.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	The project site does not include waste storage areas.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Landscaped irrigation systems will be designed efficiently to reduce excessive runoff (i.e. drought tolerant landscaping and/or drip system irrigation).
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Landscaped areas will incorporate a minimum of 1-2" below top of curb/sidewalk/pavement and top of landscape areas.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Project does not incorporate slopes and channels.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Project does not include dock areas.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Project does not include maintenance bays.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Project does not include vehicle wash areas.

Water Quality Management Plan (WQMP)

S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Project does not include outdoor processing areas.
Form 4.1-2 Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Project does not include equipment wash areas
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Project does not include fueling areas
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	The project does not incorporate hillside landscaping in the site design.
S14	Wash water control for food preparation areas	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Project does not include food preparation areas.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Project does not include food preparation areas.

4.1.2 Preventative LID Site Design Practices

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

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

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

Form 4.1-3 Preventative LID Site Design Practices Checklist
<p>Site Design Practices <i>If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets</i></p>
<p>Minimize impervious areas: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Explanation: The project site will minimize the impervious areas by incorporating landscaping in all feasible areas to the maximum extent practicable.</p>
<p>Maximize natural infiltration capacity: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Explanation: The project site implements two infiltration subsurface systems.</p>
<p>Preserve existing drainage patterns and time of concentration: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Explanation: The project does not contain existing drainage infrastructure and sheet flows to the south of the project site. The proposed development will discharge into two onsite infiltration basins in the southerly portion of the project site and discharge to the southern edge of the project site.</p>
<p>Disconnect impervious areas: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Explanation: : The roof and paved areas will surface flow into storm drain inlets and disconnect on-site catch basins from the stormwater overflow point. The project implemented the use of an infiltration basins to increase infiltration potential of the site.</p>
<p>Protect existing vegetation and sensitive areas: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Explanation: The project site is composed of mass graded land and does not consist of existing vegetation.</p>
<p>Re-vegetate disturbed areas: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Explanation: The project site is a proposed residential development and will incorporate landscaping where appropriate.</p>
<p>Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Explanation: The project site proposes two infiltration basins. Unnecessary compaction will be minimized.</p>
<p>Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Explanation: The project site does not implement swales in replacement of underground piping.</p>

Water Quality Management Plan (WQMP)

Stake off areas that will be used for landscaping to minimize compaction during construction : Yes No

Explanation: The project will stake landscape the subsurface storage system location to minimize compaction during construction.

4.2 Project Performance Criteria

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

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), the San Bernardino County Stormwater Program requires use of the P₆ method (MS4 Permit Section XI.D.6a.ii) – Form 4.2-1
- For HCOC pre- and post-development hydrologic calculation, the San Bernardino County Stormwater Program requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi²), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for HCOC performance criteria.

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

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1 – DMA A)		
1 Project area DA 1 (ft ²): 108,029	2 Imperviousness after applying preventative site design practices (Imp%): 0.75	3 Runoff Coefficient (Rc): <u>0.5437</u> $R_c = 0.858(\text{Imp}\%)^{0.3} - 0.78(\text{Imp}\%)^{0.2} + 0.774(\text{Imp}\%) + 0.04$
4 Determine 1-hour rainfall depth for a 2-year return period P _{2yr-1hr} (in): 0.63 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P ₆ , Mean 6-hr Precipitation (inches): 0.9328 <i>P₆ = Item 4 * C₁, where C₁ is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)</i>		
6 Drawdown Rate <i>Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.</i>		24-hrs <input type="checkbox"/> 48-hrs <input checked="" type="checkbox"/>
7 Compute design capture volume, DCV (ft ³): 8,963 $DCV = 1/12 * [\text{Item 1} * \text{Item 3} * \text{Item 5} * C_2]$, where C ₂ is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963) <i>Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2</i>		

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 2 – DMA B)		
1 Project area DA 1 (ft ²): 80,150	2 Imperviousness after applying preventative site design practices (Imp%): 0.8	3 Runoff Coefficient (Rc): _0.5993 $R_c = 0.858(\text{Imp}\%)^{0.3} - 0.78(\text{Imp}\%)^{0.2} + 0.774(\text{Imp}\%) + 0.04$
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2\text{yr-1hr}}$ (in): 0.63 http://hdsc.nws.noaa.gov/hdsc/pfds/so/sca_pfds.html		
5 Compute P_6 , Mean 6-hr Precipitation (inches): 0.9328 <i>$P_6 = \text{Item 4} * C_1$, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)</i>		
6 Drawdown Rate <i>Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.</i>		24-hrs <input type="checkbox"/> 48-hrs <input checked="" type="checkbox"/>
7 Compute design capture volume, DCV (ft ³): 7,330 <i>$DCV = 1/12 * [\text{Item 1} * \text{Item 3} * \text{Item 5} * C_2]$, where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)</i> <i>Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2</i>		

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

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

Go to: <http://permitrack.sbcounty.gov/wap/>

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

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

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

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

Weighted Curve Number Determination for: Pre-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type								
2a Hydrologic Soil Group (HSG)								
3a DMA Area, ft ² sum of areas of DMA should equal area of DA								
4a Curve Number (CN) use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP								
Weighted Curve Number Determination for: Post-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type								
2b Hydrologic Soil Group (HSG)								
3b DMA Area, ft ² sum of areas of DMA should equal area of DA								
4b Curve Number (CN) use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP								
5 Pre-Developed area-weighted CN:	7 Pre-developed soil storage capacity, S (in): $S = (1000 / \text{Item 5}) - 10$					9 Initial abstraction, I _a (in): $I_a = 0.2 * \text{Item 7}$		
6 Post-Developed area-weighted CN:	8 Post-developed soil storage capacity, S (in): $S = (1000 / \text{Item 6}) - 10$					10 Initial abstraction, I _a (in): $I_a = 0.2 * \text{Item 8}$		
11 Precipitation for 2 yr, 24 hr storm (in): Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html								
12 Pre-developed Volume (ft ³): $V_{pre} = (1 / 12) * (\text{Item sum of Item 3}) * [(\text{Item 11} - \text{Item 9})^2 / ((\text{Item 11} - \text{Item 9} + \text{Item 7}))]$								
13 Post-developed Volume (ft ³): $V_{pre} = (1 / 12) * (\text{Item sum of Item 3}) * [(\text{Item 11} - \text{Item 10})^2 / ((\text{Item 11} - \text{Item 10} + \text{Item 8}))]$								
14 Volume Reduction needed to meet HCOC Requirement, (ft ³): $V_{HOC} = (\text{Item 13} * 0.95) - \text{Item 12}$								

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

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

Variables	Pre-developed DA1 <i>Use additional forms if there are more than 4 DMA</i>				Post-developed DA1 <i>Use additional forms if there are more than 4 DMA</i>			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) <i>Use Form 3-2 Item 5 for pre-developed condition</i>								
2 Change in elevation (ft)								
3 Slope (ft/ft), $S_o = \text{Item 2} / \text{Item 1}$								
4 Land cover								
5 Initial DMA Time of Concentration (min) <i>Appendix C-1 of the TGD for WQMP</i>								
6 Length of conveyance from DMA outlet to project site outlet (ft) <i>May be zero if DMA outlet is at project site outlet</i>								
7 Cross-sectional area of channel (ft ²)								
8 Wetted perimeter of channel (ft)								
9 Manning's roughness of channel (n)								
10 Channel flow velocity (ft/sec) $V_{fps} = (1.49 / \text{Item 9}) * (\text{Item 7}/\text{Item 8})^{0.67} * (\text{Item 3})^{0.5}$								
11 Travel time to outlet (min) $T_t = \text{Item 6} / (\text{Item 10} * 60)$								
12 Total time of concentration (min) $T_c = \text{Item 5} + \text{Item 11}$								
13 Pre-developed time of concentration (min):	<i>Minimum of Item 12 pre-developed DMA</i>							
14 Post-developed time of concentration (min):	<i>Minimum of Item 12 post-developed DMA</i>							
15 Additional time of concentration needed to meet HCOC requirement (min):	$T_{C-HCOC} = (\text{Item 13} * 0.95) - \text{Item 14}$							

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

Compute peak runoff for pre- and post-developed conditions						
Variables	Pre-developed DA to Project Outlet <i>(Use additional forms if more than 3 DMA)</i>			Post-developed DA to Project Outlet <i>(Use additional forms if more than 3 DMA)</i>		
	DMA A	DMA B	DMA C	DMA A	DMA B	DMA C
1 Rainfall Intensity for storm duration equal to time of concentration <i>$I_{peak} = 10^{(LOG Form 4.2-1 Item 4 - 0.6 LOG Form 4.2-4 Item 5 / 60)}$</i>						
2 Drainage Area of each DMA (Acres) <i>For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)</i>						
3 Ratio of pervious area to total area <i>For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)</i>						
4 Pervious area infiltration rate (in/hr) <i>Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP</i>						
5 Maximum loss rate (in/hr) <i>$F_m = Item 3 * Item 4$ Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)</i>						
6 Peak Flow from DMA (cfs) <i>$Q_p = Item 2 * 0.9 * (Item 1 - Item 5)$</i>						
7 Time of concentration adjustment factor for other DMA to site discharge point <i>Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)</i>	DMA A	n/a		n/a		
	DMA B		n/a		n/a	
	DMA C			n/a		n/a
8 Pre-developed Q_p at T_c for DMA A: <i>$Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB}) / (Item 1_{DMAB} - Item 5_{DMAB}) * Item 7_{DMAA/2}] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC}) / (Item 1_{DMAC} - Item 5_{DMAC}) * Item 7_{DMAA/3}]$</i>	9 Pre-developed Q_p at T_c for DMA B: <i>$Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA}) / (Item 1_{DMAA} - Item 5_{DMAA}) * Item 7_{DMAB/1}] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC}) / (Item 1_{DMAC} - Item 5_{DMAC}) * Item 7_{DMAB/3}]$</i>		10 Pre-developed Q_p at T_c for DMA C: <i>$Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA}) / (Item 1_{DMAA} - Item 5_{DMAA}) * Item 7_{DMAC/1}] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB}) / (Item 1_{DMAB} - Item 5_{DMAB}) * Item 7_{DMAC/2}]$</i>			
10 Peak runoff from pre-developed condition confluence analysis (cfs): <i>Maximum of Item 8, 9, and 10 (including additional forms as needed)</i>						
11 Post-developed Q_p at T_c for DMA A: <i>Same as Item 8 for post-developed values</i>	12 Post-developed Q_p at T_c for DMA B: <i>Same as Item 9 for post-developed values</i>		13 Post-developed Q_p at T_c for DMA C: <i>Same as Item 10 for post-developed values</i>			
14 Peak runoff from post-developed condition confluence analysis (cfs): <i>Maximum of Item 11, 12, and 13 (including additional forms as needed)</i>						
15 Peak runoff reduction needed to meet HCOC Requirement (cfs): <i>$Q_{p-HCOC} = (Item 14 * 0.95) - Item 10$</i>						

4.3 Project Conformance Analysis

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

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

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

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

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

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

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

Form 4.3-1 Infiltration BMP Feasibility (DA 1)	
Feasibility Criterion – Complete evaluation for each DA on the Project Site	
<p>¹ Would infiltration BMP pose significant risk for groundwater related concerns? <i>Refer to Section 5.3.2.1 of the TGD for WQMP</i></p>	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
If Yes, Provide basis: (attach)	
<p>² Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? (Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert):</p> <ul style="list-style-type: none"> • The location is less than 50 feet away from slopes steeper than 15 percent • The location is less than eight feet from building foundations or an alternative setback. • A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards. 	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
If Yes, Provide basis: (attach)	
<p>³ Would infiltration of runoff on a Project site violate downstream water rights?</p>	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
If Yes, Provide basis: (attach)	
<p>⁴ Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils?</p>	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
If Yes, Provide basis: (attach)	
<p>⁵ Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)?</p>	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
If Yes, Provide basis: (attach)	
<p>⁶ Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? <i>See Section 3.5 of the TGD for WQMP and WAP</i></p>	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
If Yes, Provide basis: (attach)	
<p>⁷ Any answer from Item 1 through Item 3 is “Yes”: <i>If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Harvest and Use BMP. If no, then proceed to Item 8 below.</i></p>	Yes <input type="checkbox"/> No <input type="checkbox"/>
<p>⁸ Any answer from Item 4 through Item 6 is “Yes”: <i>If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Hydrologic Source Control BMP. If no, then proceed to Item 9, below.</i></p>	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
<p>⁹ All answers to Item 1 through Item 6 are “No”: <i>Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP. Proceed to Form 4.3-2, Hydrologic Source Control BMP.</i></p>	

4.3.1 Site Design Hydrologic Source Control BMP

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

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

Form 4.3-2 Site Design Hydrologic Source Control BMPs			
Form 4.3-2 cont. Site Design Hydrologic Source Control BMPs (DA 1)			
14 Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, complete Items 15-20. If no, proceed to Item 21</i>	DA 1 DMA A BMP Type Infiltration	DA 2 DMA B BMP Type Infiltration	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
15 Rooftop area planned for ET BMP (ft ²)			
16 Average wet season ET demand (in/day) <i>Use local values, typical ~ 0.1</i>			
17 Daily ET demand (ft ³ /day) <i>Item 15 * (Item 16 / 12)</i>			
18 Drawdown time (hrs) <i>Copy Item 6 in Form 4.2-1</i>			
19 Retention Volume (ft ³) <i>V_{retention} = Item 17 * (Item 18 / 24)</i>			
20 Runoff volume retention from evapotranspiration BMPs (ft ³): <i>V_{retention} = Sum of Item 19 for all BMPs</i>			
21 Implementation of Street Trees: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, complete Items 22-25. If no, proceed to Item 26</i>	DA 1 DMA A BMP Type Infiltration	DA 2 DMA B BMP Type Infiltration	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
22 Number of Street Trees			
23 Average canopy cover over impervious area (ft ²)			
24 Runoff volume retention from street trees (ft ³) <i>V_{retention} = Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches</i>			
25 Runoff volume retention from street tree BMPs (ft ³): <i>V_{retention} = Sum of Item 24 for all BMPs</i>			
26 Implementation of residential rain barrel/cisterns: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, complete Items 27-29; If no, proceed to Item 30</i>	DA 1 DMA A BMP Type Infiltration	DA 2 DMA B BMP Type Infiltration	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
27 Number of rain barrels/cisterns			
28 Runoff volume retention from rain barrels/cisterns (ft ³) <i>V_{retention} = Item 27 * 3</i>			
29 Runoff volume retention from residential rain barrels/Cisterns (ft ³): <i>V_{retention} = Sum of Item 28 for all BMPs</i>			
30 Total Retention Volume from Site Design Hydrologic Source Control BMPs: 0 <i>Sum of Items 5, 13, 20, 25 and 29</i>			

4.3.2 Infiltration BMPs

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

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

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

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

1 Remaining LID DCV not met by site design HSC BMP (ft³): 8,963 $V_{unmet} = \text{Form 4.2-1 Item 7} - \text{Form 4.3-2 Item 30}$

BMP Type <i>Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs</i>	DA 1 DMA A BMP Type Infiltration	DA DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
2 Infiltration rate of underlying soils (in/hr) <i>See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods</i>	3.48		
3 Infiltration safety factor <i>See TGD Section 5.4.2 and Appendix D</i>	2		
4 Design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$	1.74		
5 Ponded water drawdown time (hr) <i>Copy Item 6 in Form 4.2-1</i>	48		
6 Maximum ponding depth (ft) <i>BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details</i>	10	Maximum depth within subsurface system	
7 Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$	7	$(1/12) * 1.74 * 48 = 7.0'$	
8 Infiltrating surface area, SA_{BMP} (ft ²) <i>the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP</i>	2200	Row width=10' Row length=55' Number of rows=4 $SA=10*55*4=1350 \text{ sf}$	
9 Amended soil depth, d_{media} (ft) <i>Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details</i>	0		
10 Amended soil porosity	0		
11 Gravel depth, d_{media} (ft) <i>Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details</i>	1		
12 Gravel porosity	0.4		
13 Duration of storm as basin is filling (hrs) <i>Typical ~ 3hrs</i>	3		
14 Above Ground Retention Volume (ft ³) $V_{retention} = \text{Item 8} * [\text{Item 7} + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))]$	0		
15 Underground Retention Volume (ft ³) <i>Volume determined using manufacturer's specifications and calculations</i>	9,642	Infiltration volume per calculation included in attachment	
16 Total Retention Volume from LID Infiltration BMPs: 9,642 <i>(Sum of Items 14 and 15 for all infiltration BMP included in plan)</i>			
17 Fraction of DCV achieved with infiltration BMP: 108% $\text{Retention\%} = \text{Item 16} / \text{Form 4.2-1 Item 7}$			
18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> <i>If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.</i>			

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 2)

1 Remaining LID DCV not met by site design HSC BMP (ft ³): 7,330 $V_{unmet} = \text{Form 4.2-1 Item 7} - \text{Form 4.3-2 Item 30}$			
BMP Type Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs	DA 2 DMA B BMP Type Infiltration	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
2 Infiltration rate of underlying soils (in/hr) See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods	3.48		
3 Infiltration safety factor See TGD Section 5.4.2 and Appendix D	2		
4 Design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$	1.74		
5 Pondered water drawdown time (hr) Copy Item 6 in Form 4.2-1	48		
6 Maximum ponding depth (ft) BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details	9	Maximum depth within subsurface system	
7 Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$	7	$(1/12) * 1.74 * 48 = 7.0'$	
8 Infiltrating surface area, SA_{BMP} (ft ²) the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP	2160	Row width=9' Row length=240' Number of rows=1 $SA=9*240*1=2160 \text{ sf}$	
9 Amended soil depth, d_{media} (ft) Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details	0		
10 Amended soil porosity	0		
11 Gravel depth, d_{media} (ft) Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details	1		
12 Gravel porosity	0.4		
13 Duration of storm as basin is filling (hrs) Typical ~ 3hrs	3		
14 Above Ground Retention Volume (ft ³) $V_{retention} = \text{Item 8} * [\text{Item 7} + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))]$	0		
15 Underground Retention Volume (ft ³) Volume determined using manufacturer's specifications and calculations	7,593	Infiltration volume per calculation included in attachment	
16 Total Retention Volume from LID Infiltration BMPs: 7,593 (Sum of Items 14 and 15 for all infiltration BMP included in plan)			
17 Fraction of DCV achieved with infiltration BMP: 104% $\text{Retention\%} = \text{Item 16} / \text{Form 4.2-1 Item 7}$			
18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.			

4.3.3 Harvest and Use BMP

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

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

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

4.3.4 Biotreatment BMP

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

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

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

Form 4.3-5 Selection and Evaluation of Biotreatment BMP (DA 1)		
1 Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment (ft ³): 0 Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16- Form 4.3-4 Item 9	List pollutants of concern Copy from Form 2.3-1.	
2 Biotreatment BMP Selected <i>(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)</i>	Volume-based biotreatment <i>Use Forms 4.3-6 and 4.3-7 to compute treated volume</i> <input type="checkbox"/> Bioretention with underdrain <input type="checkbox"/> Planter box with underdrain <input type="checkbox"/> Constructed wetlands <input type="checkbox"/> Wet extended detention <input type="checkbox"/> Dry extended detention	Flow-based biotreatment <i>Use Form 4.3-8 to compute treated volume</i> <input type="checkbox"/> Vegetated swale <input type="checkbox"/> Vegetated filter strip <input type="checkbox"/> Proprietary biotreatment
3 Volume biotreated in volume based biotreatment BMP (ft ³): Form 4.3-6 Item 15 + Form 4.3-7 Item 13	4 Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft ³): Item 1 – Item 3	5 Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % Item 4 / Item 1
6 Flow-based biotreatment BMP capacity provided (cfs): Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)		
7 Metrics for MEP determination: <ul style="list-style-type: none"> • Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: <input type="checkbox"/> If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribed minimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP. 		

Form 4.3-6 Volume Based Biotreatment (DA 1) – Bioretention and Planter Boxes with Underdrains			
Biotreatment BMP Type <i>(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)</i>	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
1 Pollutants addressed with BMP <i>List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP</i>			
2 Amended soil infiltration rate <i>Typical ~ 5.0</i>			
3 Amended soil infiltration safety factor <i>Typical ~ 2.0</i>			
4 Amended soil design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$			
5 Ponded water drawdown time (hr) <i>Copy Item 6 from Form 4.2-1</i>			
6 Maximum ponding depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
7 Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$			
8 Amended soil surface area (ft ²)			
9 Amended soil depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
10 Amended soil porosity, <i>n</i>			
11 Gravel depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
12 Gravel porosity, <i>n</i>			
13 Duration of storm as basin is filling (hrs) <i>Typical ~ 3hrs</i>			
14 Biotreated Volume (ft ³) $V_{biotreated} = \text{Item 8} * [(\text{Item 7}/2) + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))]$			
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: <i>Sum of Item 14 for all volume-based BMPs included in this form</i>			

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

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

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

4.3.5 Conformance Summary

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

Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)	
1	Total LID DCV for the Project DA-1 (ft ³): 8,963 <i>Copy Item 7 in Form 4.2-1</i>
2	On-site retention with site design hydrologic source control LID BMP (ft ³): 0 <i>Copy Item 30 in Form 4.3-2</i>
3	On-site retention with LID infiltration BMP (ft ³): 9,642 <i>Copy Item 16 in Form 4.3-3</i>
4	On-site retention with LID harvest and use BMP (ft ³): 0 <i>Copy Item 9 in Form 4.3-4</i>
5	On-site biotreatment with volume based biotreatment BMP (ft ³): 0 <i>Copy Item 3 in Form 4.3-5</i>
6	Flow capacity provided by flow based biotreatment BMP (cfs): 0 <i>Copy Item 6 in Form 4.3-5</i>
7	<p>LID BMP performance criteria are achieved if answer to any of the following is "Yes":</p> <ul style="list-style-type: none"> • Full retention of LID DCV with site design HSC, infiltration, or harvest and use BMP: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> <i>If yes, sum of Items 2, 3, and 4 is greater than Item 1</i> • Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> <i>If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3-5 Item 6 and Items 2, 3 and 4 are maximized</i> ▪ On-site retention and infiltration is determined to be infeasible and biotreatment BMP provide biotreatment for all pollutants of concern for full LID DCV: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, Form 4.3-1 Items 7 and 8 were both checked yes</i>
8	<p>If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:</p> <ul style="list-style-type: none"> • Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: <input type="checkbox"/> <i>Checked yes for Form 4.3-5 Item 7, Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, $V_{alt} = (Item\ 1 - Item\ 2 - Item\ 3 - Item\ 4 - Item\ 5) * (100 - Form\ 2.4-1\ Item\ 2)\%$</i> • An approved Watershed Action Plan (WAP) demonstrates that water quality and hydrologic impacts of urbanization are more effective when managed in at an off-site facility: <input type="checkbox"/> <i>Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed</i>

Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA 2)

1 Total LID DCV for the Project DA-1 (ft³): 5,516 *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design hydrologic source control LID BMP (ft³): 0 *Copy Item 30 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft³): 7,593 *Copy Item 16 in Form 4.3-3*

4 On-site retention with LID harvest and use BMP (ft³): 0 *Copy Item 9 in Form 4.3-4*

5 On-site biotreatment with volume based biotreatment BMP (ft³): 0 *Copy Item 3 in Form 4.3-5*

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

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

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

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

- Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture:
*Checked yes for Form 4.3-5 Item 7, Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, $V_{alt} = (Item\ 1 - Item\ 2 - Item\ 3 - Item\ 4 - Item\ 5) * (100 - Form\ 2.4-1\ Item\ 2)\%$*
- An approved Watershed Action Plan (WAP) demonstrates that water quality and hydrologic impacts of urbanization are more effective when managed in at an off-site facility:
Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed

4.3.6 Hydromodification Control BMP

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

Form 4.3-10 Hydromodification Control BMPs (DA 1)	
<p>1 Volume reduction needed for HCOC performance criteria (ft³): <i>(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1</i></p>	<p>2 On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft³): <i>Sum of Form 4.3-9 Items 2, 3, and 4 Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving HCOC volume reduction</i></p>
<p>3 Remaining volume for HCOC volume capture (ft³): <i>Item 1 – Item 2</i></p>	<p>4 Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft³): <i>Existing downstream BMP may be used to demonstrate additional volume capture (if so, attach to this WQMP a hydrologic analysis showing how the additional volume would be retained during a 2-yr storm event for the regional watershed)</i></p>
<p>5 If Item 4 is less than Item 3, incorporate in-stream controls on downstream waterbody segment to prevent impacts due to hydromodification <input type="checkbox"/> <i>Attach in-stream control BMP selection and evaluation to this WQMP</i></p>	
<p>6 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes <input type="checkbox"/> No <input type="checkbox"/> <i>If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:</i></p> <ul style="list-style-type: none"> • Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP <input type="checkbox"/> <i>BMP upstream of a waterbody segment with a potential HCOC may be used to demonstrate increased time of concentration through hydrograph attenuation (if so, show that the hydraulic residence time provided in BMP for a 2-year storm event is equal or greater than the addition time of concentration requirement in Form 4.2-4 Item 15)</i> • Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities <input type="checkbox"/> • Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California <input type="checkbox"/> 	
<p>7 Form 4.2-2 Item 12 less than or equal to 5%: Yes <input type="checkbox"/> No <input type="checkbox"/> <i>If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:</i></p> <ul style="list-style-type: none"> • Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs <input type="checkbox"/> <i>BMPs upstream of a waterbody segment with a potential HCOC may be used to demonstrate additional peak runoff reduction through hydrograph attenuation (if so, attach to this WQMP, a hydrograph analysis showing how the peak runoff would be reduced during a 2-yr storm event)</i> • Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California <input type="checkbox"/> 	

4.4 Alternative Compliance Plan (if applicable)

(NOT IMPLEMENTED PROJECT ADDRESSES WATER QUALITY VOLUME THOURGH INFILTRATION)

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

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

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

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

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

Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)			
BMP	Responsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Catch Basin Inserts	Property Owner / HOA	Inspect catch basins and catch basin inserts to ensure trash and debris build up does not overload catch basin insert.	Minimum of twice annually, including after rain events
S1 Inlet Stencils	Property Owner / HOA	Check that signage is visible; remove/replace sign if illegible; remove graffiti; repair broken signs. The stenciling shall state "No Dumping -Drains to River" or per City of Colton specifications.	Minimum of twice annually, repair as needed
Trash Receptacles	Property Owner / HOA	Trash receptacles shall be closed or covered at all times; display signs of "No hazardous waste dumping" or equivalent; ensure regular waste pick-up and maintain solid roofs over enclosure. Trash receptacles shall be closed at all time and must remain onsite.	As needed, with minimum weekly inspections
Street/Parking Lot Sweeping	Property Owner / HOA	Street sweeping shall be implemented within streets and pavement areas at a minimum of bi-weekly	Minimum bi-weekly
Landscape Maintenance	Property Owner / HOA	Maintain landscape area vegetation, slope protection and 1" – 2" depressed grades, adjacent to hardscape and prevent discharges of landscape maintenance waste into storm drains	Weekly
N1 Education for Property Owners, Tenants, and Occupants	Property Owner / HOA	The current property owner/HOA shall be familiar with the contents of the WQMP and the County & City Ordinance and brochures and furnish copies of city and County BMP factsheets to all future property owners.	Education materials should be kept onsite for reference.
N2 Activity Restrictions	Property Owner / HOA	Property owners and their tenants or occupants shall not be allowed to discharge chemicals, chemical residues, wastewater or other prohibited discharges listed in the	The property owners / HOA shall control the discharge of

Water Quality Management Plan (WQMP)

		City stormwater Ordinance, to the outside, paved areas of the site; or store chemicals or other pollutant sources in a non-spill contained or covered facilities as stipulated in the CC&Rs. Dumpsters and/or trash receptacles shall remain closed.	stormwater pollutants from this site.
N3 Landscape Management	Property Owner / HOA	The HOA and their landscape maintenance contractor shall inspect the irrigation system plant health and erosion problems after each landscape procedure and shall report all repairs and problems to the HOA. All routine landscaping maintenance.	Inspection Weekly
N4 BMP Maintenance	Property Owner / HOA	The HOA shall inspect for standing water in the water retention/infiltration basins, 48 hours after storm events. BMP maintenance shall be performed per the schedule in Form 5-1, as needed to restore free drainage.	The HOA shall inspect 48 hours after storm events.
N6 Local Water Quality Ordinance	Property Owner / HOA	The HOA shall ensure that all maintenance activities at the site comply with the City of Ontario's Stormwater Ordinance, through the implementation of BMPs.	Ongoing
N10 Uniform Fire Code Implementation	Property Owner / HOA	The current owners or the future HOA shall require all fire code requirements to be implemented at this project site.	Property Owner / HOA
N11 Litter Control	Property Owner / HOA	The property owners, HOA and their contractor shall pick up litter and sweep and clean the existing trash enclosure weekly. The trash enclosure is designed to divert all flows around the dumpsters and shall be roofed. The HOA shall contract with a refuse company to have the dumpsters emptied on a weekly basis, at a minimum.	Trash pickup once per week. Trash enclosure should be kept clean from litter and be swept on a weekly basis.
N14 Catch Basin Inspection	Property Owner / HOA	The on-site catch basins shall be inspected monthly during the rainy season (October-May) and before and after each storm to ensure proper operation. The HOA shall contract with a qualified landscape contractor to inspect and clean out accumulation of trash, litter and sediment and check for evidence of illegal dumping of waste materials into on-site drains.	Quarterly inspections during the rainy season (October – May) and before and after each storm to ensure proper operation.
N15 Vacuum Sweeping of Private Streets and Parking Lots	Property Owner / HOA	The paved areas and common open areas of the project site shall be swept and cleaned weekly by the HOA's contractor.	Inspection weekly
S3 Design and construct outdoor material storage	Property Owner / HOA	Stormwater flows are diverted away from the trash enclosure. All dumpsters shall have working lids which shall be kept closed, at all times. Trash enclosure shall comply with CASQA SD-32 and shall have doors and a solid roof.	Construction Superintendent

Water Quality Management Plan (WQMP)

<p>areas to reduce pollution introduction</p>			
<p>S4 Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control</p>	<p>Property Owner / HOA</p>	<p>The irrigation system will include devices to prevent low head drainage, overspray and run off through the use of pressure regulating devices, check valves, rain shutoff valves, flow sensors, pressure drop sensors, proper spacing, low precipitation emission devices and ET or weather based controllers.</p> <p>Landscape and irrigation shall be consistent with the State Model Water Efficient landscape Ordinance and the City of Ontario landscape Development Standards. Plants installed will be arranged according to similar hydrozones and meet the required water budget for the site. Shade trees shall be used to intercept rainwater and reduce heat gain on paving.</p>	<p>Landscape & irrigation to be inspected weekly after each landscape procedure.</p>
<p>S5 Finish grade of landscaped areas</p>	<p>Property Owner / HOA</p>	<p>All landscaped areas shall comply with depressed grading requirements by finish grading to a minimum of 1" below pavement grades or top-of-curb.</p>	<p>Landscape & irrigation to be inspected weekly after each landscape procedure.</p>

Section 6 WQMP Attachments

6.1. Site Plan and Drainage Plan

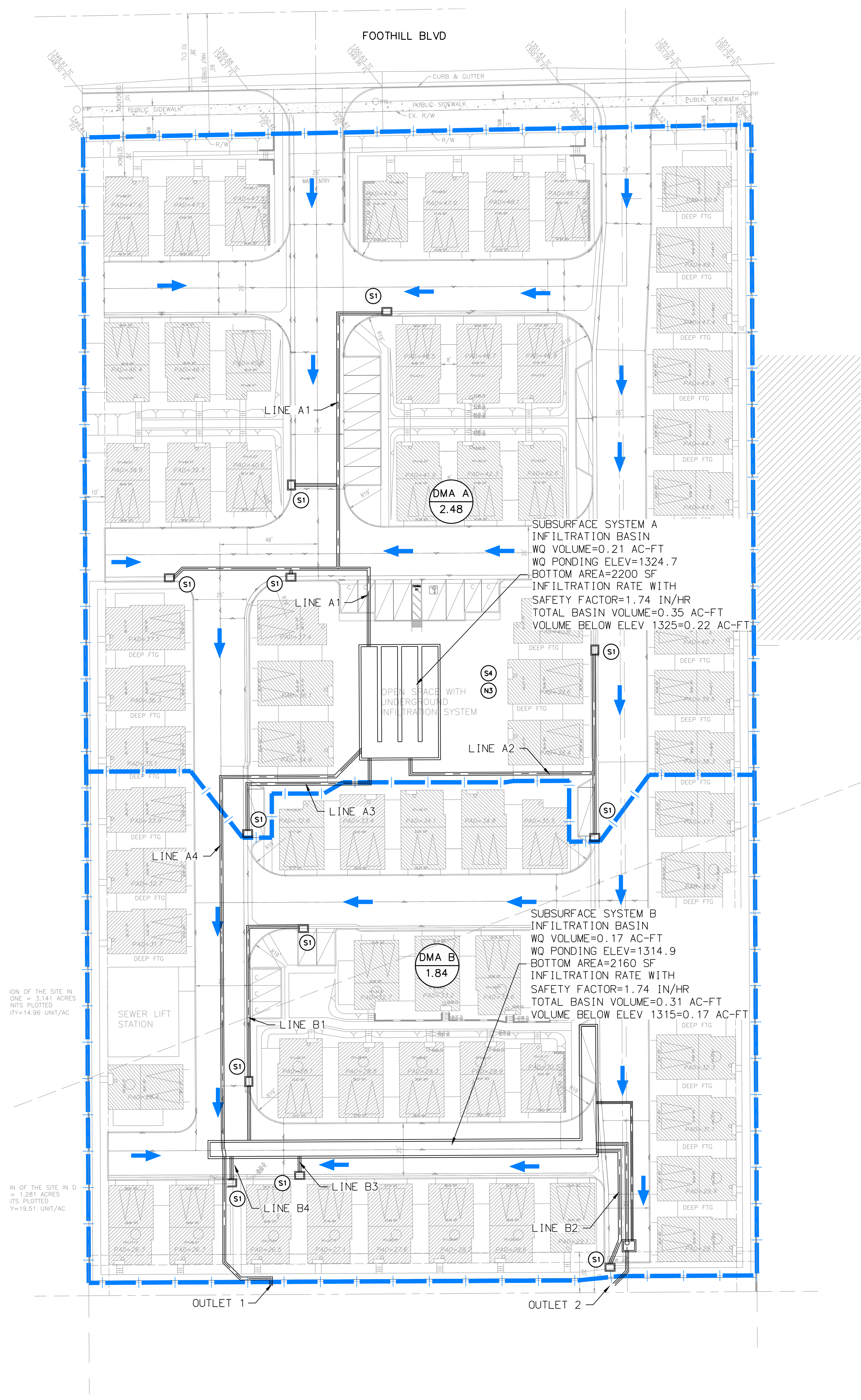
Include a site plan and drainage plan sheet set containing the following minimum information:

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

BUFFALO GROVE

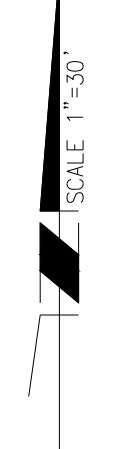
IN THE CITY OF UPLAND, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA

PRELIMINARY WQMP SITE PLAN



ION OF THE SITE IN ONE = 3.141 ACRES
 N15° PLOTTED
 1"=14.96' UNIT/AC

ION OF THE SITE IN ONE = 1.281 ACRES
 ITS PLOTTED
 1"=19.51' UNIT/AC



SOURCE CONTROL BMPs	
DESIGNATION	DESCRIPTION
(S1)	STORM DRAIN STENCILING AND SIGNAGE
(S4)	DROUGHT TOLERANT LANDSCAPING
(N3)	LANDSCAPE MANAGEMENT BMPs

SOURCE CONTROL NOTES:
 ALL INLETS WILL BE EQUIPPED WITH A KRISTAR CATCH BASIN INSERT AND A CATCH BASIN TRASH SCREEN PER UNITED STORMWATER

DRAINAGE AREA SUMMARY TABLE		
DRAINAGE AREA	A	B
AREA (ACRES)	2.48	1.84
IMPERVIOUS RATIO	0.75	0.80
WATER QUALITY VOLUME REQUIRED	8,963	7,330
DESIGN SUBSURFACE STORAGE VOLUME	9,000	7,400

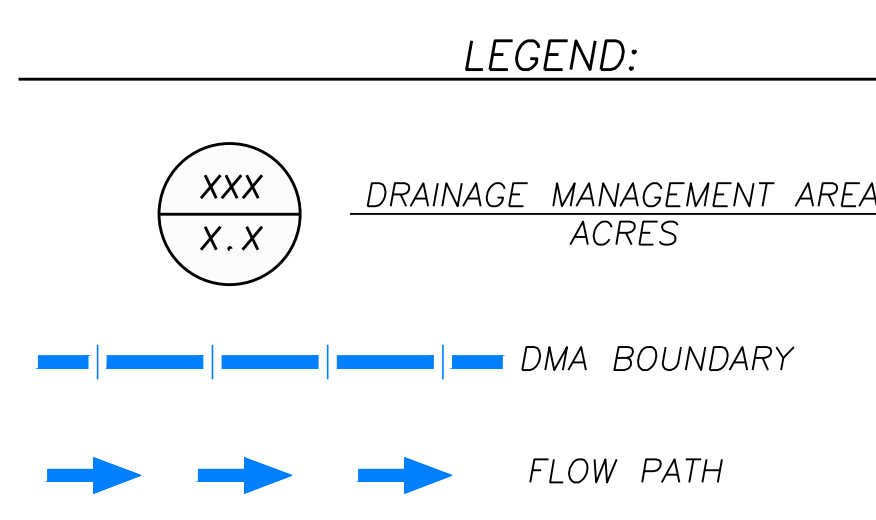


FIGURE 3
BUFFALO GROVE
PRELIMINARY WQMP SITE PLAN

JLC Engineering & Consulting, Inc.
 41660 IVY STREET, SUITE A
 MURRIETA, CA 92562
 PH. 951.304.9552 FAX 951.304.3568

Drawing Name: G:\320.05.25\Engineering\WQMP\6.1 - Site Plan\Figure_3_WQMP_SitePlan.dwg
 Last Opened: Apr 30, 2025 - 12:00pm by Sophie

6.2 Electronic Data Submittal

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

6.3 Post Construction

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

O&M Materials will be provided during Final Engineering.

6.4 Water Quality Documentaion

**Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume
BUFFALO GROVE - AREA A**

1 Project area DA 1 (ft ²): 108,029	2 Impervious area after applying preventative site design practices (Imp%): 0.75	3 Runoff Coefficient (Rc): <u>0.5437</u> $R_c = 0.858(\text{Imp}\%)^3 - 0.78(\text{Imp}\%)^2 + 0.774(\text{Imp}\%) + 0.04$
4 Determine 1-hour rainfall depth for a 2-year return period P _{2yr-1hr} (in):		0.63 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html
5 Compute P ₆ , Mean 6-hr Precipitation (inches)		0.9328 <i>P₆ = Item 4 * C₁, where C₁ is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)</i>
6 Drawdown Rate <i>Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.</i>		24-hrs <input type="checkbox"/> 48-hrs <input checked="" type="checkbox"/>
7 Compute design capture volume, DCV (ft ³)		8,963 <i>DCV = 1/12 * [Item 1 * Item 3 * Item 5 * C2], where C2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)</i> <i>Compute separate DCV for each outlet from the project site per schematic drawdown in Form 3-1 Item 2</i>

DRAWDOWN TIME CALCULATION	
3.48	MEASURED INFILTRATION RATE (IN/HR)
2.00	SAFETY FACTOR
1.74	DESIGN INFILTRATION RATE (IN/HR)
0.15	DESIGN INFILTRATION RATE (FT/HR)
2200	INFILTRATION SURFACE AREA (SF)
319.0	INFILTRATION RATE (CF/HR)
28.1	DRAWDOWN TIME (HR)

VII.4. Considerations for Infiltration Rate Factor of Safety

Given the known potential for infiltration BMPs to fail over time, an appropriate factor of safety applied to infiltration testing results must be mandatory. The infiltration rate will decline between maintenance cycles as the BMP surface becomes occluded and particulates accumulate in the infiltrative layer. Monitoring of actual facility performance has shown that the full-scale infiltration rate is far lower than the rate measured by small-scale testing. It is important that adequate conservatism is incorporated in the selection of design infiltration rates. The design infiltration rate discussed here is the infiltration rate of the underlying soil, below the elevation to which soil amendments would not be provided.

The factor of safety that should be applied to measured infiltration rates is a function of:

- Suitability of underlying soils for infiltration
- The infiltration system design.

These factors are discussed in the following sections.

The *measured infiltration rate* calculated for the purpose of infiltration infeasibility screening ([TGD Section 2.4.2.4](#)) shall be based on a factor of safety of 2.0 applied to the rates obtained from the infiltration test results. No adjustments from this value are permitted. The factor of safety used to compute the *design infiltration rate* shall not be less than 2.0, but may be higher at the discretion of the design engineer and acceptance of the plan reviewer, per the considerations described in the following sections.

It is recognized that there are competing objectives in the selection of a factor of safety. There is an initial economic incentive to select a lower factor of safety to yield smaller BMP designs. A low factor of safety also allows a broader range of systems to be considered “feasible” in marginal conditions. However, there are both economic and environmental incentives for the use of an appropriate factor of safety to prevent premature failure and substandard performance. The use of an artificially low factor of safety to demonstrate feasibility in the design process is shortsighted in that it does not consider the long term feasibility of the system.

The best way to balance these competing factors is through a commitment to thorough site investigation, use of effective pretreatment controls, good construction practices, the commitment to restore the infiltration rates of soils that are damaged by prior uses or construction practices, and the commitment to effective maintenance practices. However, these commitments do not mitigate the need to apply a factor of safety to account for uncertainty and long term deterioration that cannot be technically mitigated. Therefore, a factor of safety of no less than 2.0 shall be used to compute the design infiltration rate.

VII.4.1. Site Suitability Considerations

Suitability assessment related considerations include ([Table VII.3](#)):

- Soil assessment methods – the site assessment extent (e.g., number of borings, test pits, etc.) and the measurement method used to estimate the short-term infiltration rate.
- Predominant soil texture/percent fines – soil texture and the percent of fines can greatly influence the potential for clogging.
- Site soil variability – site with spatially heterogeneous soils (vertically or horizontally) as determined from site investigations are more difficult to estimate average properties for resulting in a higher level of uncertainty associated with initial estimates.
- Depth to seasonal high groundwater/impervious layer – groundwater mounding may become an issue during excessively wet conditions where shallow aquifers or shallow clay lenses are present.

Table VII.3: Suitability Assessment Related Considerations for Infiltration Facility Safety Factors

Consideration	High Concern	Medium Concern	Low Concern
Assessment methods (see explanation below)	Use of soil survey maps or simple texture analysis to estimate short-term infiltration rates	Direct measurement of ≥ 20 percent of infiltration area with localized infiltration measurement methods (e.g., infiltrometer)	Direct measurement of ≥ 50 percent of infiltration area with localized infiltration measurement methods or Use of extensive test pit infiltration measurement methods
Texture Class	Silty and clayey soils with significant fines	Loamy soils	Granular to slightly loamy soils
Site soil variability	Highly variable soils indicated from site assessment or limited soil borings collected during site assessment	Soil borings/test pits indicate moderately homogeneous soils	Multiple soil borings/test pits indicate relatively homogeneous soils
Depth to groundwater/ impervious layer	<5 ft below facility bottom	5-10 ft below facility bottom	>10 below facility bottom

Localized infiltration testing refers to methods such as the double ring infiltrometer test (ASTM D3385-88) which measure infiltration rates over an area less than 10 sq-ft, may include lateral

flow, and do not attempt to account for heterogeneity of soil. The amount of area each test represents should be estimated depending on the observed heterogeneity of the soil.

Extensive infiltration testing refers to methods that include excavating a significant portion of the proposed infiltration area, filling the excavation with water, and monitoring drawdown. The excavation should be to the depth of the proposed infiltration surface and ideally be at least 50 to 100 square feet.

In all cases, testing should be conducted in the area of the proposed BMP where, based on review of available geotechnical data, soils appear least likely to support infiltration.

VII.4.2. Design Related Considerations

Design related considerations include ([Table VII.4](#)):

- Size of area tributary to facility – all things being equal, risk factors related to infiltration facilities increase with an increase in the tributary area served. Therefore facilities serving larger tributary areas should use more restrictive adjustment factors.
- Level of pretreatment/expected influent sediment loads – credit should be given for good pretreatment by allowing less restrictive factors to account for the reduced probability of clogging from high sediment loading. Also, facilities designed to capture runoff from relatively clean surfaces such as rooftops are likely to see low sediment loads and therefore should be allowed to apply less restrictive safety factors.
- Redundancy – facilities that consist of multiple subsystems operating in parallel such that parts of the system remains functional when other parts fail and/or bypass should be rewarded for the built-in redundancy with less restrictive correction and safety factors. For example, if bypass flows would be at least partially treated in another BMP, the risk of discharging untreated runoff in the event of clogging the primary facility is reduced. A bioretention facility that overflows to a landscaped area is another example.
- Compaction during construction – proper construction oversight is needed during construction to ensure that the bottoms of infiltration facility are not overly compacted. Facilities that do not commit to proper construction practices and oversight should have to use more restrictive correction and safety factors.

Table VII.4: Design Related Considerations for Infiltration Facility Safety Factors

Consideration	High Concern	Medium Concern	Low Concern
Tributary area size	Greater than 10 acres.	Greater than 2 acres but less than 10 acres.	2 acres or less.
Level of pretreatment/ expected influent sediment loads	Pretreatment from gross solids removal devices only, such as hydrodynamic separators, racks and screens AND tributary area includes landscaped areas, steep slopes, high traffic areas, or any other areas expected to produce high sediment, trash, or debris loads.	Good pretreatment with BMPs that mitigate coarse sediments such as vegetated swales AND influent sediment loads from the tributary area are expected to be relatively low (e.g., low traffic, mild slopes, disconnected impervious areas, etc.).	Excellent pretreatment with BMPs that mitigate fine sediments such as bioretention or media filtration OR sedimentation or facility only treats runoff from relatively clean surfaces, such as rooftops.
Redundancy of treatment	No redundancy in BMP treatment train.	Medium redundancy, other BMPs available in treatment train to maintain at least 50% of function of facility in event of failure.	High redundancy, multiple components capable of operating independently and in parallel, maintaining at least 90% of facility functionality in event of failure.
Compaction during construction	Construction of facility on a compacted site or elevated probability of unintended/ indirect compaction.	Medium probability of unintended/ indirect compaction.	Heavy equipment actively prohibited from infiltration areas during construction and low probability of unintended/ indirect compaction.

VII.4.3. Determining Factor of Safety

A factor of safety shall be used. To assist in selecting the appropriate design infiltration rate, the measured short term infiltration rate should be adjusted using a weighted average of several safety factors using the worksheet shown in [Worksheet H](#) below. The design infiltration rate would be determined as follows:

1. For each consideration shown in [Table VII.3](#) and [Table VII.4](#) above, determine whether the consideration is a high, medium, or low concern.
2. For all high concerns, assign a factor value of 3, for medium concerns, assign a factor value of 2, and for low concerns assign a factor value of 1.
3. Multiply each of the factors by the corresponding weight to get a product.
4. Sum the products within each factor category to obtain a safety factor for each.
5. Multiply the two safety factors together to get the final combined safety factor. If the combined safety factor is less than 2, then 2 shall be used as the safety factor.
6. Divide the measured short term infiltration rate by the combined safety factor to obtain the adjusted design infiltration rate for use in sizing the infiltration facility.

The design infiltration rate shall be used to size BMPs and to evaluate their expected long term performance. This rate shall not be less than 2, but may be higher at the discretion of the design engineer.

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

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) $p = w \times v$
A	Suitability Assessment	Soil assessment methods	0.25	1	
		Predominant soil texture	0.25	1	
		Site soil variability	0.25	1	
		Depth to groundwater / impervious layer	0.25	1	
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			
B	Design	Tributary area size	0.25	2	
		Level of pretreatment/ expected sediment loads	0.25	2	
		Redundancy	0.25	2	
		Compaction during construction	0.25	2	
		Design Safety Factor, $S_B = \Sigma p$			
Combined Safety Factor, $S_{TOT} = S_A \times S_B$				2	
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)				3.48	
Design Infiltration Rate, in/hr, $K_{DESIGN} = S_{TOT} \times K_M$				$K_{DESIGN} = K_M / S_{TOT}$	1.74 in/hr
Supporting Data					
Briefly describe infiltration test and provide reference to test forms:					

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

BASIN A SUBSURFACE SYSTEM

320.05 Buffalo Grove

4 Barrel 96-Inch Subsurface Infiltration Basin Volume Calculations

LENGTH OF SUBSURFACE SYSTEM (FT) = 55

NUMBER OF CELLS

4

Elevation	Depth	Pipe Depth	Pipe Area Each (ft ²)	Pipe Area Total (ft ²)	Pipe Total Gross Volume at Elev. (ft ³)	Gross Cross Sectional Area of System (ft ²)	Net Gravel Area (ft ²)	Gravel Volume (ft ³)	Cumulative Subsurface System Volume (ft ³)	Cumulative Subsurface System Volume (ac-ft)	Incremental Increase in Subsurface System Volume (ac-ft)	Effective Storage (ac-ft)
1319	0	0	0.00	0.00	0.00	0	0.00	0.00	0.00	0.000	-	0.000
1319.5	0.5	0	0.00	0.00	0.00	20	20.00	440.00	440.00	0.010	0.010	0.010
1320	1	0	0.00	0.00	0.00	40	40.00	880.00	880.00	0.020	0.010	0.020
1320.5	1.5	0.5	1.31	5.23	287.77	60	54.77	1204.89	1492.66	0.034	0.014	0.034
1321	2	1	3.63	14.51	797.83	80	65.49	1440.87	2238.70	0.051	0.017	0.051
1321.5	2.5	1.5	6.52	26.10	1435.37	100	73.90	1625.85	3061.22	0.070	0.019	0.070
1322	3	2	9.83	39.31	2161.93	120	80.69	1775.23	3937.16	0.090	0.020	0.090
1322.5	3.5	2.5	13.42	53.68	2952.45	140	86.32	1899.02	4851.47	0.111	0.021	0.111
1323	4	3	17.22	68.87	3787.71	160	91.13	2004.92	5792.63	0.133	0.022	0.133
1323.5	4.5	3.5	21.14	84.57	4651.50	180	95.43	2099.40	6750.90	0.155	0.022	0.155
1324	5	4	25.13	100.53	5529.20	200	99.47	2188.32	7717.52	0.177	0.022	0.177
1324.5	5.5	4.5	29.12	116.49	6406.91	220	103.51	2277.24	8684.14	0.199	0.022	0.199
1325	6	5	33.05	132.19	7270.69	240	107.81	2371.72	9642.42	0.221	0.022	0.221
1325.5	6.5	5.5	36.85	147.38	8105.95	260	112.62	2477.62	10583.57	0.243	0.022	0.243
1326	7	6	40.44	161.75	8996.48	280	118.25	2601.41	11497.89	0.264	0.021	0.264
1326.5	7.5	6.5	43.74	174.96	9623.04	300	125.04	2750.78	12373.82	0.284	0.020	0.284
1327	8	7	46.64	186.56	10260.58	320	133.44	2935.77	13196.35	0.303	0.019	0.303
1327.5	8.5	7.5	48.96	195.83	10770.64	340	144.17	3171.75	13942.38	0.320	0.017	0.320
1328	9	8	50.27	201.06	11058.41	360	158.94	3496.64	14555.04	0.334	0.014	0.334
1328.5	9.5	8	50.27	201.06	11058.41	380	178.94	3936.64	14995.04	0.344	0.010	0.344
1329	10	8	50.27	201.06	11058.41	400	198.94	4376.64	15435.04	0.354	0.010	0.354

INPUT DATA

wq volume

SUBSURFACE SYSTEM NAME	A	-
DIAMETER OF SUBSURFACE SYSTEM	8	FT
NUMBER OF BARRELS	4	EA
LENGTH OF SUBSURFACE SYSTEM	55	FT
BOTTOM INVERT OF GRAVEL BED	1319	FT
EFFECTIVE STORAGE ELEVATION	1319	FT
PIPE SPACING	2	FT
EDGE THICKNESS	1	FT
TOP CLEARANCE, THICKNESS	1	FT
BOTTOM CLEARANCE, THICKNESS	1	FT
GRAVEL POROSITY, N	0.4	-
FT2 -> AC	43560	FT ² /AC

OPTIONAL INPUT DATA

WATER QUALITY VOLUME TO RETAIN	9000	FT ³
	0.21	AC-FT

BASIN B SUBSURFACE SYSTEM
1 Barrel 84-Inch Subsurface Infiltration Basin Volume Calculations

320.05 - Buffalo Grove

LENGTH OF SUBSURFACE SYSTEM (FT) = 240

NUMBER OF CELLS

1

Elevation	Depth	Pipe Depth	Pipe Area Each (ft ²)	Pipe Area Total (ft ²)	Pipe Total Gross Volume at Elev. (ft ³)	Gross Cross Sectional Area of System (ft ²)	Net Gravel Area (ft ²)	Gravel Volume (ft ³)	Cumulative Subsurface System Volume (ft ³)	Cumulative Subsurface System Volume (ac-ft)	Incremental Increase in Subsurface System Volume (ac-ft)	Effective Storage (ac-ft)*
1310	0	0	0.00	0.00	0.00	0	0.00	0.00	0.00	0.000	-	0.000
1310.5	0.5	0	0.00	0.00	0.00	4.5	4.50	432.00	432.00	0.010	0.010	0.010
1311	1	0	0.00	0.00	0.00	9	9.00	864.00	864.00	0.020	0.010	0.020
1311.5	1.5	0.5	1.22	1.22	292.83	13.5	12.28	1178.87	1471.70	0.034	0.014	0.034
1312	2	1	3.37	3.37	809.37	18	14.63	1404.25	2213.62	0.051	0.017	0.051
1312.5	2.5	1.5	6.05	6.05	1451.20	22.5	16.45	1579.52	3030.72	0.070	0.019	0.070
1313	3	2	9.07	9.07	2177.56	27	17.93	1720.97	3898.54	0.089	0.020	0.089
1313.5	3.5	2.5	12.34	12.34	2961.29	31.5	19.16	1839.49	4800.77	0.110	0.021	0.110
1314	4	3	15.75	15.75	3781.01	36	20.25	1943.60	5724.60	0.131	0.021	0.131
1314.5	4.5	3.5	19.24	19.24	4618.14	40.5	21.26	2040.74	6658.88	0.153	0.021	0.153
1315	5	4	22.73	22.73	5455.28	45	22.27	2137.89	7593.17	0.174	0.021	0.174
1315.5	5.5	4.5	26.15	26.15	6275.00	49.5	23.35	2242.00	8517.00	0.196	0.021	0.196
1316	6	5	29.41	29.41	7058.72	54	24.59	2360.51	9419.23	0.216	0.021	0.216
1316.5	6.5	5.5	32.44	32.44	7785.08	58.5	26.06	2501.97	10287.05	0.236	0.020	0.236
1317	7	6	35.11	35.11	8426.91	63	27.89	2677.24	11104.14	0.255	0.019	0.255
1317.5	7.5	6.5	37.26	37.26	8943.45	67.5	30.24	2902.62	11846.07	0.272	0.017	0.272
1318	8	7	38.48	38.48	9236.28	72	33.52	3217.49	12453.77	0.286	0.014	0.286
1318.5	8.5	7	38.48	38.48	9236.28	76.5	38.02	3649.49	12885.77	0.296	0.010	0.296
1319	9	7	38.48	38.48	9236.28	81	42.52	4081.49	13317.77	0.306	0.010	0.306

INPUT DATA

SUBSURFACE SYSTEM NAME	B	-
DIAMETER OF SUBSURFACE SYSTEM	7	FT
NUMBER OF BARRELS	1	EA
LENGTH OF SUBSURFACE SYSTEM	240	FT
BOTTOM INVERT OF GRAVEL BED	1310	FT
EFFECTIVE STORAGE ELEVATION	1310	FT
PIPE SPACING	0	FT
EDGE THICKNESS	1	FT
TOP CLEARANCE, THICKNESS	1	FT
BOTTOM CLEARANCE, THICKNESS	1	FT
GRAVEL POROSITY, N	0.4	-
FT2 -> AC	43560	FT ² /AC

wq volume

OPTIONAL INPUT DATA

WATER QUALITY VOLUME TO RETAIN	7330	FT ³
	0.17	AC-FT

6.5 Precipitation



NOAA Atlas 14, Volume 6, Version 2
Location name: Upland, California, USA*
Latitude: 34.1064°, Longitude: -117.6883°
Elevation: 1346 ft**



* source: ESRI Maps
 ** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerials](#)

PF tabular

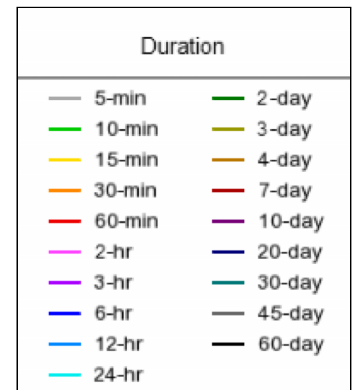
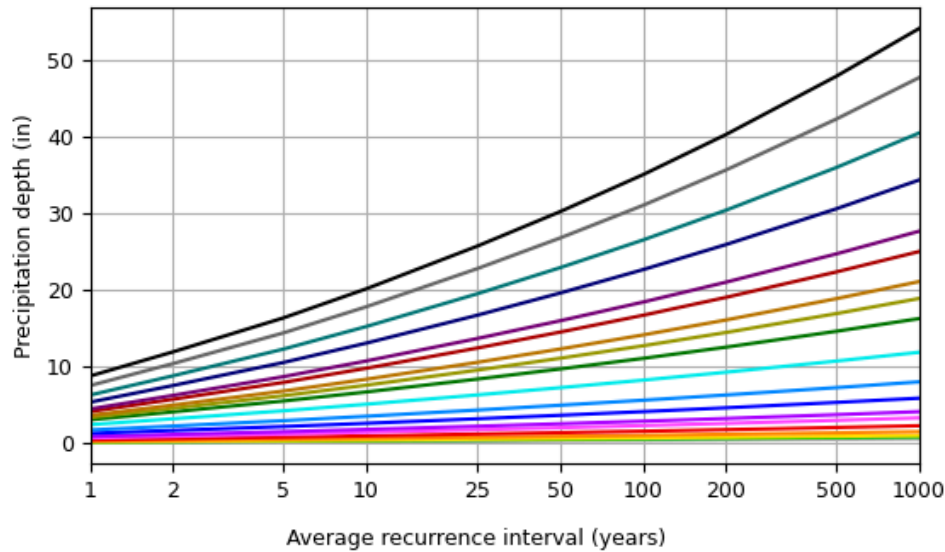
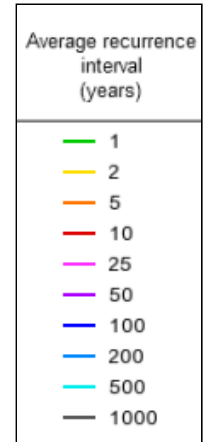
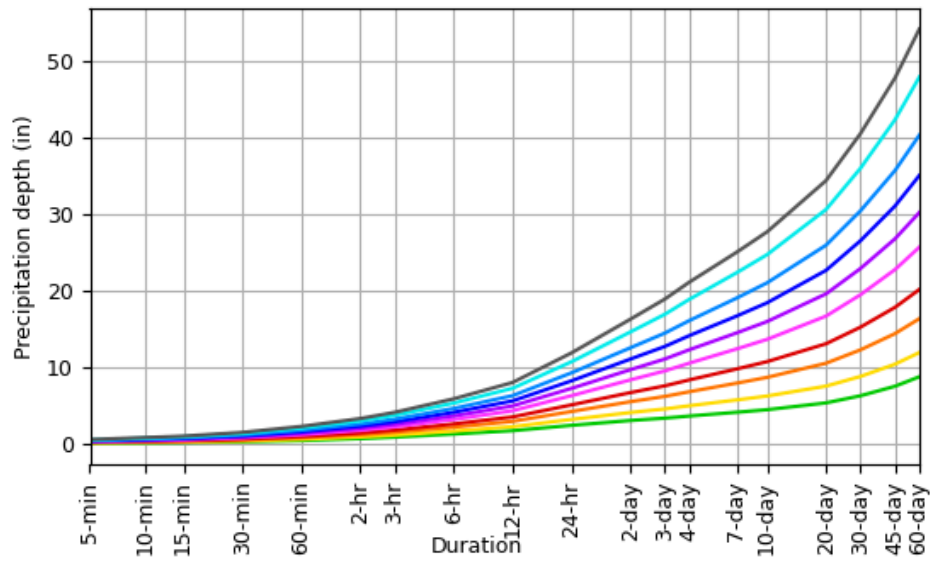
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.124 (0.104-0.151)	0.164 (0.137-0.199)	0.217 (0.180-0.264)	0.261 (0.215-0.320)	0.323 (0.256-0.410)	0.371 (0.289-0.482)	0.422 (0.320-0.561)	0.475 (0.350-0.651)	0.549 (0.387-0.786)	0.609 (0.414-0.903)
10-min	0.178 (0.149-0.216)	0.235 (0.196-0.285)	0.311 (0.258-0.378)	0.374 (0.308-0.459)	0.462 (0.368-0.587)	0.532 (0.414-0.691)	0.604 (0.458-0.805)	0.681 (0.501-0.933)	0.787 (0.555-1.13)	0.872 (0.594-1.30)
15-min	0.216 (0.180-0.261)	0.284 (0.237-0.345)	0.376 (0.312-0.458)	0.453 (0.373-0.555)	0.559 (0.445-0.710)	0.643 (0.500-0.835)	0.731 (0.554-0.973)	0.823 (0.606-1.13)	0.952 (0.672-1.36)	1.06 (0.718-1.57)
30-min	0.315 (0.263-0.382)	0.416 (0.346-0.504)	0.550 (0.457-0.669)	0.662 (0.545-0.812)	0.817 (0.650-1.04)	0.940 (0.732-1.22)	1.07 (0.810-1.42)	1.20 (0.886-1.65)	1.39 (0.982-1.99)	1.54 (1.05-2.29)
60-min	0.474 (0.395-0.574)	0.625 (0.521-0.758)	0.827 (0.687-1.01)	0.995 (0.819-1.22)	1.23 (0.977-1.56)	1.41 (1.10-1.84)	1.61 (1.22-2.14)	1.81 (1.33-2.48)	2.09 (1.48-3.00)	2.32 (1.58-3.44)
2-hr	0.721 (0.601-0.874)	0.938 (0.781-1.14)	1.23 (1.02-1.49)	1.47 (1.21-1.80)	1.80 (1.43-2.29)	2.06 (1.61-2.68)	2.34 (1.77-3.11)	2.62 (1.93-3.60)	3.03 (2.14-4.33)	3.35 (2.28-4.96)
3-hr	0.916 (0.764-1.11)	1.18 (0.987-1.44)	1.54 (1.28-1.88)	1.84 (1.52-2.26)	2.25 (1.79-2.86)	2.58 (2.00-3.35)	2.91 (2.21-3.88)	3.27 (2.41-4.48)	3.76 (2.65-5.38)	4.16 (2.83-6.17)
6-hr	1.32 (1.10-1.60)	1.71 (1.42-2.07)	2.22 (1.84-2.70)	2.64 (2.17-3.24)	3.22 (2.56-4.09)	3.68 (2.86-4.78)	4.16 (3.15-5.54)	4.66 (3.43-6.39)	5.36 (3.78-7.67)	5.91 (4.03-8.78)
12-hr	1.76 (1.47-2.13)	2.28 (1.90-2.77)	2.98 (2.47-3.62)	3.56 (2.93-4.36)	4.36 (3.47-5.54)	4.99 (3.88-6.48)	5.64 (4.28-7.52)	6.33 (4.66-8.68)	7.29 (5.14-10.4)	8.05 (5.48-11.9)
24-hr	2.46 (2.18-2.83)	3.23 (2.86-3.73)	4.26 (3.76-4.93)	5.13 (4.48-5.98)	6.33 (5.36-7.63)	7.28 (6.04-8.95)	8.26 (6.69-10.4)	9.30 (7.33-12.0)	10.7 (8.13-14.5)	11.9 (8.70-16.6)
2-day	3.09 (2.74-3.56)	4.13 (3.65-4.77)	5.54 (4.89-6.41)	6.72 (5.88-7.84)	8.39 (7.10-10.1)	9.71 (8.06-12.0)	11.1 (8.99-14.0)	12.6 (9.90-16.3)	14.6 (11.1-19.7)	16.3 (11.9-22.7)
3-day	3.40 (3.01-3.92)	4.60 (4.06-5.30)	6.23 (5.49-7.21)	7.61 (6.66-8.88)	9.55 (8.09-11.5)	11.1 (9.21-13.7)	12.7 (10.3-16.1)	14.5 (11.4-18.8)	16.9 (12.8-22.9)	18.9 (13.8-26.4)
4-day	3.67 (3.25-4.23)	5.01 (4.43-5.78)	6.84 (6.03-7.92)	8.38 (7.34-9.78)	10.6 (8.95-12.7)	12.3 (10.2-15.2)	14.2 (11.5-17.8)	16.1 (12.7-20.9)	18.9 (14.3-25.5)	21.1 (15.4-29.5)
7-day	4.16 (3.69-4.80)	5.77 (5.10-6.66)	7.96 (7.02-9.22)	9.81 (8.58-11.4)	12.4 (10.5-15.0)	14.5 (12.0-17.9)	16.7 (13.5-21.1)	19.1 (15.0-24.7)	22.4 (16.9-30.2)	25.0 (18.3-35.0)
10-day	4.50 (3.98-5.18)	6.28 (5.56-7.25)	8.71 (7.68-10.1)	10.8 (9.42-12.6)	13.7 (11.6-16.5)	16.0 (13.3-19.7)	18.4 (14.9-23.2)	21.0 (16.6-27.3)	24.7 (18.7-33.4)	27.7 (20.2-38.7)
20-day	5.39 (4.77-6.21)	7.57 (6.69-8.73)	10.6 (9.31-12.2)	13.1 (11.5-15.3)	16.7 (14.1-20.1)	19.6 (16.3-24.1)	22.7 (18.4-28.6)	26.0 (20.4-33.6)	30.6 (23.1-41.3)	34.4 (25.1-48.0)
30-day	6.32 (5.59-7.28)	8.83 (7.81-10.2)	12.3 (10.8-14.2)	15.3 (13.4-17.8)	19.5 (16.5-23.5)	22.9 (19.0-28.2)	26.5 (21.5-33.4)	30.4 (24.0-39.4)	36.0 (27.2-48.5)	40.5 (29.6-56.5)
45-day	7.55 (6.68-8.70)	10.4 (9.22-12.0)	14.4 (12.7-16.7)	17.8 (15.6-20.8)	22.8 (19.3-27.4)	26.8 (22.2-32.9)	31.1 (25.1-39.1)	35.7 (28.1-46.2)	42.3 (32.0-57.1)	47.7 (34.9-66.6)
60-day	8.79 (7.78-10.1)	12.0 (10.6-13.8)	16.4 (14.4-18.9)	20.2 (17.7-23.5)	25.7 (21.8-31.0)	30.2 (25.1-37.2)	35.1 (28.4-44.2)	40.3 (31.8-52.2)	47.9 (36.2-64.6)	54.1 (39.6-75.6)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

[Back to Top](#)

PF graphical

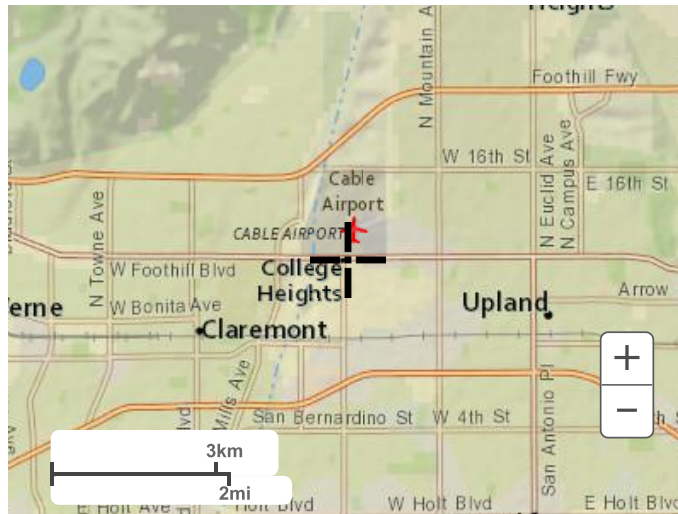
PDS-based depth-duration-frequency (DDF) curves
 Latitude: 34.1064°, Longitude: -117.6883°



[Back to Top](#)

Maps & aeriels

Small scale terrain



Large scale terrain



Large scale map



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1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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6.6 Infiltration Testing

**GEOTECHNICAL AND INFILTRATION EVALUATION
PROPOSED SINGLE-FAMILY RESIDENTIAL DEVELOPMENT
ASSESSOR'S PARCEL NUMBERS (APNs) 1007-061-08-0000 AND 1007-061-23-0000
1812 AND 1816 WEST FOOTHILL BOULEVARD
UPLAND, SAN BERNARDINO COUNTY, CALIFORNIA**

PREPARED FOR

**CENTURY COMMUNITIES
4395 MACARTHUR COURT, SUITE 300
NEWPORT BEACH, CALIFORNIA 92660**

PREPARED BY

**GEOtek, INC.
1548 NORTH MAPLE STREET
CORONA, CALIFORNIA 92878**



GeoTek, Inc.

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

February 5, 2025
Project No. 4056-CR

Century Communities

4395 MacArthur Court, Suite 300
Newport Beach, California 92660

Attention: Mr. Brian Taylor

Subject: **Geotechnical and Infiltration Evaluation**
Proposed Single-Family Residential Development
Assessor's Parcel Numbers (APNs) 1007-061-08-0000 and 1007-061-23-0000
1812 and 1816 West Foothill Boulevard
Upland, San Bernardino County, California

Dear Mr. Taylor:

GeoTek, Inc. (GeoTek) is pleased to provide the results of this Geotechnical and Infiltration Evaluation for a proposed single-family residential development that will be constructed at 1812 and 1816 West Foothill Boulevard, in the City of Upland, San Bernardino County, California. This report presents a discussion of GeoTek's evaluation and provides preliminary geotechnical recommendations for site preparation, foundation design, preliminary infiltration rates and construction of the proposed site improvements.

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

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

Respectfully submitted,
GeoTek, Inc.



Bruce A. Hick
GE 2284, Exp. 12/31/26
Geotechnical Engineer

Edward H. LaMont
CEG 1892, Exp. 07/31/26
Principal Geologist

Anna M. Scott
Project Geologist

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

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TABLE OF CONTENTS

1. PURPOSE AND SCOPE OF SERVICES	1
2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT	1
2.1 SITE DESCRIPTION	1
2.2 PROPOSED DEVELOPMENT	2
3. FIELD EXPLORATION AND LABORATORY TESTING	3
3.1 FIELD EXPLORATION	3
3.2 LABORATORY TESTING	5
4. GEOLOGIC AND SOILS CONDITIONS	5
4.1 REGIONAL SETTING	5
4.2 GENERAL SOIL/GEOLOGIC CONDITIONS	6
4.2.1 Undocumented Fill	6
4.2.2 Alluvium	6
4.3 SURFACE AND GROUNDWATER	7
4.3.1 Surface Water	7
4.3.2 Groundwater	7
4.4 FAULTING AND SEISMICITY	7
4.4.1 Seismic Design Parameters	7
4.5 LIQUEFACTION	8
4.6 OTHER SEISMIC HAZARDS	9
5. CONCLUSIONS AND RECOMMENDATIONS	9
5.1 GENERAL	9
5.2 EARTHWORK CONSIDERATIONS	10
5.2.1 Site Clearing and Demolition	10
5.2.2 Site Preparation	11
5.2.3 Pavement Areas	11
5.2.4 Hardscape Areas	11
5.2.5 Preparation of Excavation Bottoms	12
5.2.6 Engineered Fill	12
5.2.7 Excavation Characteristics	12
5.2.8 Trench Excavations and Backfill	13
5.2.9 Slot-Cut Excavations	13
5.2.10 Shrinkage and Subsidence	14
5.2.11 Import Soils	14
5.3 DESIGN RECOMMENDATIONS	14
5.3.1 Foundation Design	14
5.3.2 Moisture Vapor and Retarding System	16
5.3.3 Miscellaneous Foundation Recommendations	17
5.3.4 Foundation Setbacks	17
5.3.5 Soil Corrosivity	18
5.3.6 Soil Sulfate Content	18
5.4 RETAINING AND SCREEN WALL DESIGN AND CONSTRUCTION	18
5.4.1 General Design Criteria	18

TABLE OF CONTENTS

5.4.2 Cantilevered Walls.....	19
5.4.3 Retaining Wall Backfill and Drainage.....	20
5.4.4 Restrained Retaining Walls.....	21
5.4.5 Additional Retaining Wall Design Considerations	21
5.5 CONCRETE FLATWORK.....	22
5.5.1 Exterior Concrete Slabs, Sidewalks and Driveways	22
5.5.2 Concrete Performance.....	22
5.6 PRELIMINARY PAVEMENT DESIGN	23
5.6.1 Asphaltic Concrete Pavement	23
5.6.2 Permeable Interlocking Concrete Pavers.....	23
5.6.3 Portland Cement Concrete (PCC) Pavement.....	24
5.6.4 Pavement Construction	25
5.7 POST CONSTRUCTION CONSIDERATIONS	25
5.7.1 Landscape Maintenance and Planting.....	25
5.7.2 Drainage	26
5.8 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS	26
6. INTENT	27
7. LIMITATIONS	27
8. SELECTED REFERENCES	28

ENCLOSURES

Figure 1 – Site Location and Topography Map

Figure 2 – Exploration Location Map

Appendix A – Logs of Exploratory Borings

Appendix B – Laboratory Test Results

Appendix C – Infiltration Test Data and Porchet Calculations

Appendix D – General Earthwork Grading Guidelines

I. PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to evaluate the site geotechnical conditions for a proposed single-family residential development to be constructed at 1812 and 1816 West Foothill Boulevard, in the City of Upland, San Bernardino County, California, as outlined in GeoTek's proposal P-0801724-CR dated August 1, 2024. Services provided for this study included the following:

- Research and review of available geologic and geotechnical data and general information pertinent to the site,
- A site reconnaissance,
- Excavation of five (5) exploratory borings for the geotechnical portion of the evaluation to depths ranging between about eight (8) to 25.5 feet below existing grades,
- Infiltration testing of two (2) additional test borings at a depth of about five (5) feet deep in anticipated stormwater management areas,
- Collection of soil samples in the test borings,
- Laboratory testing of selected soil samples,
- Review and evaluation of site seismicity, and
- Compilation of this geotechnical report which presents preliminary recommendations for site development.

The intent of this report is to aid in the evaluation of the site for future proposed development from a geotechnical perspective. The professional opinions and geotechnical information contained in this report may need to be updated based upon review of the final site development plans. These plans should be provided to GeoTek Inc. for review when available.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

2.1 SITE DESCRIPTION

The rectangular-shaped project site is comprised of two (2) parcels of land totaling approximately 4.42-acres in size, located at 1812 and 1816 West Foothill Boulevard, in the City



of Upland, San Bernardino County, California (see Figure 1). Access to the site is generally available from West Foothill Boulevard, a paved, improved street located adjacent to the northern boundary of the site. The parcels are identified as San Bernardino County Assessor's Parcel Numbers (APNs) 1007-061-08-0000 and 1007-061-23-0000.

The site can be considered as having a relatively flat topography (see Figure 1). The elevation of the site ranges from approximately 1,330 to 1,350 feet above mean sea level (amsl). Site drainage is generally directed in a southerly direction by sheetflow.

The site is currently occupied by abandoned structures and a parking lot in the northern portion of the site. It is anticipated that foundations, slabs, underground utilities and possible septic tank/seepage pits are present on the site.

2.2 PROPOSED DEVELOPMENT

Based on review of a *Concept Design Site Plan*, prepared by KTG Y and dated December 20, 2024, the proposed residential development will consist of 70, one- to two-story single-family homes, as well as stormwater disposal facilities, open space, perimeter/retaining walls, associated interior streets/driveways, underground utilities and other typical development improvements (see Figure 2).

It is anticipated that the residential structures will be of wood frame construction, supported by shallow spread foundations (continuous and pad), and most likely will include conventional slab-on-grade floors. Although structural loading information was not provided, GeoTek has assumed the structures will exert relatively light to moderate foundation loads. Maximum column and wall loads on the order of 50 kips and 2.5 kips per lineal foot, respectively, are estimated for the proposed structures. Once actual loads are known, that information should be provided to GeoTek to determine if modifications to the recommendations presented in this report are warranted.

On-site stormwater disposal facilities are proposed for the project; however, the type and specific locations of the facilities are unknown at this time.

Cut and fills of less than approximately 5 feet in height, not including any recommended remedial grading are anticipated for site development. Retaining and perimeter walls are anticipated. Sewage disposal is anticipated to be provided by a public sewer system. If site development differs from the assumptions made herein, the recommendations included in this report should be subject to further review and evaluation.

3. FIELD EXPLORATION AND LABORATORY TESTING

3.1 FIELD EXPLORATION

The field exploration for this evaluation was conducted on January 30, 2025. For the geotechnical portion of the investigation, five (5) exploratory borings (Borings B-1 through B-5) were excavated with a hollow-stem auger drill rig to depths ranging from about eight (8) to 25.5 feet below the existing ground surface at the boring locations. All of the test borings were terminated at a depth shallower than planned due to auger refusal on cobbles and boulders.

For the infiltration part of the study, two (2) test borings were excavated to depths of approximately five (5) feet, below the existing ground location in the southern portion of the site, as requested by the project civil engineer.

A hollow-stem auger with an outside diameter of approximately 8.0 inches was utilized to conduct the borings. The inside diameter of the auger was approximately 4.5 inches. A geologist from GeoTek, Inc. logged the exploratory borings and obtained soil samples from within the borings. The boring locations are presented on Figure 2, Exploration Location Map. The logs of the exploratory borings are included in Appendix A.

The exploration logs in Appendix A show subsurface conditions at the dates and locations indicated and may not be representative of other locations and times. The stratification lines presented on the logs represent the approximate boundaries between soil types, and the transitions may be gradual.

In the geotechnical borings, relatively undisturbed soil samples were recovered at various intervals with a California sampler. The California sampler is a 2.9-inch outside diameter, 2.5-inch inside diameter, split barrel sampler lined with brass rings. The sampler is approximately 18 inches in length. The sampler conformed to the requirements of ASTM D 3550. A 140-pound automatic trip hammer was utilized, dropping approximately 30 inches for each blow. The relatively undisturbed samples, together with bulk samples of representative soil types, were returned to the laboratory for testing and evaluation.

Infiltration Testing

Two (2) borings (Borings I-1 and I-2) were excavated on the project site to evaluate preliminary infiltration rates for the proposed stormwater management facilities. Infiltration testing was conducted in these borings in general accordance County of San Bernardino guidelines.

The infiltration tests consisted of drilling eight-inch diameter test holes to the desired depth and installing approximately two (2) inches of gravel in the bottom of the holes. A three-inch diameter perforated PVC pipe, wrapped in a filter sock, was placed in the excavations and the annular space was filled with gravel to prevent caving within the borings. Water was then placed in the borings to presoak the holes and percolation testing was performed following the pre-soak period. Following presoaking, the percolation tests were performed which consisted of adding water to each test hole and measuring the water drop over a 10-minute period. The water drop was recorded and six (6) 10-minute test intervals were completed. Water was added to the test holes after each test interval. The field percolation rates were then converted to an infiltration rate using the Porchet Method. The infiltration rates calculated using the Porchet Method are presented in the following table:

SUMMARY OF PRELIMINARY INFILTRATION RATES		
Boring	Depth of Test (Feet)	Preliminary Infiltration Rate* (Inches per hour)
I-1	5.0	3.48
I-2	5.0	4.61

*Porchet Method converted infiltration rate from field measured rate.

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

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

Representatives of GeoTek should observe the soils exposed at the bottom of the stormwater management facilities during construction/earthwork operations to confirm suitability and that the conditions exposed are as anticipated for the proposed stormwater disposal basin.

3.2 LABORATORY TESTING

Laboratory testing was performed on selected soil samples obtained during the field exploration. The purpose of the laboratory testing was to confirm the field classification of the soils encountered and to evaluate the physical properties of the soils for use in engineering design and analysis.

Included in the laboratory testing were moisture-density determinations on relatively undisturbed samples. The optimum moisture content-maximum dry density relationships were established for typical soil types so that the relative compaction of the subsoils could be determined. Expansion index testing was performed on selected samples to evaluate the expansion potential of the on-site soils. Direct shear testing was conducted to determine the shear strength parameters of the site soils. Chemical testing comprised of pH, soluble sulfate, chloride and resistivity testing was conducted on selected samples. The moisture-density test data are presented on the exploration boring logs in Appendix A. The maximum density, expansion index, direct shear and chemical test data are presented in Appendix B.

4. GEOLOGIC AND SOILS CONDITIONS

4.1 REGIONAL SETTING

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

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



More specific to the subject property, the site is located in an area geologically mapped to be underlain by alluvium (Dibblee, T.W. and Minch, J.A., 2002).

4.2 GENERAL SOIL/GEOLOGIC CONDITIONS

A brief description of the lithologic units encountered on the site is presented in the following sections. Based on the field exploration and observations, the area investigated is locally underlain by undocumented fill materials or disturbed topsoil, overlying alluvial materials.

4.2.1 Undocumented Fill

Asphalt concrete pavement (asphalt concrete) was encountered at the surface of Boring B-1.

Undocumented fill materials were encountered in Borings B-1 and B-5 to depths of up to approximately 2.5 feet below the ground surface. These materials were found to generally consist of gravel and gravelly sand (GP and SP soil types based upon the Unified Soil Classification System). These fill soils were most likely placed during the grading for the existing site improvements.

Based on the laboratory test results, the near surface soils exhibit a “Very Low” ($0 \leq EI \leq 20$) Expansion Index when tested in accordance with ASTM D 4829. Based on the laboratory test results, the near surface soils have a soluble sulfate content of less than 0.1 percent (ASTM D 4327). The laboratory test results are provided in Appendix B.

4.2.2 Alluvium

Alluvial materials were encountered in all of the borings performed beneath the undocumented fill soils. The alluvial materials were found to generally consist of interbedded dense sand and gravel with varying amounts of cobbles (SP and GP soil types). Although boulders were not observed during the drilling, it is anticipated that various amounts of boulders are also present in the alluvial materials. The gravel and cobbles most likely affected the sampler blow counts obtained. Alluvial materials were encountered to the maximum depths explored of approximately 25.5 feet in Boring B-5. As previously discussed, all borings were terminated due to refusal on cobbles and boulders.

4.3 SURFACE AND GROUNDWATER

4.3.1 Surface Water

Surface water was not observed during the site exploration. If encountered during earthwork construction, surface water on this site is the result of precipitation or possibly some minor surface run-off from surrounding areas. Overall site drainage is generally in a southerly direction, as directed by site topography. Provisions for surface drainage will need to be accounted for by the project civil engineer.

4.3.2 Groundwater

Groundwater was not encountered to a maximum depth of about 25.5 feet within Boring B-5 at the time of drilling. Based on review of the California's Groundwater Live: Groundwater Levels website ([California's Groundwater Live: Groundwater Levels](#)), the depth to groundwater in the proximity of the site is approximately 128 feet below existing grades for a reading from October 1, 2024.

Based on the above, groundwater is not anticipated to be a factor during the site grading. However, seasonal perched groundwater may be encountered during grading within portions of the site.

4.4 FAULTING AND SEISMICITY

The geologic structure of the entire southern California area is dominated mainly by northwest-trending faults associated with the San Andreas system. The site is in a seismically active region.

The site is not situated within an "Alquist-Priolo" Earthquake Fault Zone. The subject property is not located within a State of California Seismic Hazard Zone for earthquake induced liquefaction nor within an area designated for earthquake induced landslides.

4.4.1 Seismic Design Parameters

The site is located at approximately 34.1058 Latitude and -117.6880 West Longitude. Based on the relatively dense soil conditions encountered across the site, a Site Class "D" is considered appropriate for this project. Site spectral accelerations (S_a and S_1), for 0.2 and 1.0 second periods for a Class "D" site, was determined from the SEAOC/OSHPD web interface that utilizes the USGS web services and retrieves the seismic design data and presents that information in a report format.

The following seismic design parameters, based on the 2015 National Earthquake Hazards Reduction Program (NEHRP)/ASCE 7-16/2022 CBC, are presented below:

SITE SEISMIC PARAMETERS	
Mapped 0.2 sec Period Spectral Acceleration, S_s	1.695g
Mapped 1.0 sec Period Spectral Acceleration, S_1	0.638g
Site Coefficient for Site Class "D", F_a	1.0
Site Coefficient for Site Class "D", F_v	1.7**
Maximum Considered Earthquake Spectral Response Acceleration for 0.2 Second, S_{MS}	1.695g
Maximum Considered Earthquake Spectral Response Acceleration for 1.0 Second, S_{M1}	1.626g*
5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, S_{DS}	1.13g
5% Damped Design Spectral Response Acceleration Parameter at 1 second, S_{D1}	1.085g*
Site Modified Peak Ground Acceleration, PGA_M	0.792g
Seismic Design Category	D

*ASCE 7-16 Supplement 3 Section 11.4.8 requires a ground motion hazard analysis for structures on Site Class "D" for values of S_1 greater than or equal to 0.2g. However, a ground motion hazard analysis is not required where the values of S_{M1} and S_{D1} are increased by 50%. The S_{M1} and S_{D1} values shown above already include the 50% increase, so that exception can be obtained.

**ASCE 7-16 Supplement 3 Section 11.4.8 indicates that the value of F_v should only be used for calculation of T_s , determination of Seismic Design Category, linear interpolation for intermediate values of S_1 , and when taking the exceptions under Items 1 and 2 of Section 11.4.8 for the calculation of S_{D1} .

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

4.5 LIQUEFACTION

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

The factors known to influence liquefaction potential include soil type and grain size, relative density, groundwater level, confining pressures, and both intensity and duration of ground

shaking. In general, materials that are susceptible to liquefaction are loose, saturated granular soils having low fines content under low confining pressures.

The project site is not located within an area mapped by the State of California for liquefaction potential.

Based on the relatively dense nature of the subsurface soils encountered, along with the relatively deep groundwater depth, the liquefaction potential at the subject site is considered to be very low.

4.6 OTHER SEISMIC HAZARDS

Due to the relatively dense nature of the subsurface alluvial soils and proposed remedial grading, the “dry sand” (unsaturated) settlements at the site are estimated to be negligible.

Evidence of ancient landslides or slope instability at this site was not observed during the field investigation. Due to the relatively flat site topography, the potential for seismic-induced lateral displacements (i.e., “lateral spread”) and slope instability hazards are considered negligible.

The potential for secondary seismic hazards such as a seiche and tsunami is considered negligible due to site elevation and distance from an open body of water.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

The anticipated site development appears feasible from a geotechnical viewpoint provided that the following recommendations, and those provided by this firm at a later date are incorporated into the design and construction phases of development. Site development, grading and foundation plans should be reviewed by GeoTek, Inc. when they become available so the recommendations contained in this report can be confirmed.

The near-surface upper site soils were found to consist of undocumented fill soils. In addition, the upper site soils are anticipated to be further disturbed from the demolition of the existing site structures and utility lines. Therefore, the upper site soils are not considered suitable for foundation loading in their current condition. Remedial grading, consisting of overexcavation and

recompaction of the upper site soils, is recommended to provide a uniform bearing for any proposed structures.

5.2 EARTHWORK CONSIDERATIONS

Earthwork and grading should be performed in accordance with the applicable grading ordinances of the City of Upland, the 2022 California Building Code (CBC) and recommendations contained in this report. The Grading Guidelines included in Appendix D outline general procedures and do not anticipate all site-specific situations. In the event of conflict, the recommendations presented in the text of this report should supersede those contained in Appendix D.

5.2.1 Site Clearing and Demolition

Initial site preparation should commence with removal of debris, existing structures, pavements, underground utilities, foundations, slabs-on-grade, deleterious materials and vegetation within the limits of the planned improvements. Demolition of the existing buildings/structures should include removal of all shallow foundations, floor slabs, on-site wastewater disposal systems and any below-grade construction.

In areas of planned grading and improvements, the locations of existing utilities should be determined. Existing utilities should be relocated or abandoned. Debris should be properly disposed of off-site. Voids resulting from site clearing should be backfilled with engineered fill.

Portland Cement Concrete (PCC) generated from the demolition of existing site improvements may be incorporated into site fills provided the following guidelines are implemented: 1) concrete should be free of rebar or other deleterious materials and should be broken down to a maximum dimension of six (6) inches; 2) concrete should not be placed within three (3) feet of finish grade in the building pad areas or within one (1) foot of subgrade elevations in the street/drive areas; 3) concrete should be distributed in the fill and should not be “nested” or placed in concentrated pockets.

Asphalt concrete (AC) should not be used in fill for building pads or landscape areas. This material may be used in pavement areas of the project or should be removed from the site.

Alternatively, existing PCC concrete, AC and aggregate base may be pulverized and reused as Crushed Miscellaneous Base (CMB) in new pavement sections. These pulverized materials should not contain any detrimental or deleterious materials (reinforcing steel, nails, metal, glass, plastic rubber, wood, organic matter, friable materials, elongated or laminated pieces, etc.). Any

materials to be used as CMB should be tested to confirm conformance with appropriate Standard Specifications for Public Works Construction (“Greenbook”) specifications (Section 200-2.4).

5.2.2 Site Preparation

Due to the presence of undocumented fill and anticipated disturbance of the upper site soils due to site demolition operations, it is recommended that the soils be removed beneath the planned building footprints to a depth of at least four (4) feet below existing grades, or two (2) feet below the base of the proposed foundations, whichever is greater. All disturbed soils and any undocumented fill soils shall be removed as part of remedial grading. The lateral extent of this recommended over-excavation should extend at least five (5) feet beyond the building limits, where obtainable. Removal bottoms should be relatively uniform in soil type and not adversely porous and having an in-place density of at least 85 percent of the soil’s maximum dry density as determined by ASTM D 1557 test procedures. Deeper removals may be required and should be determined during site grading by a GeoTek representative.

Following site clearing operations, over-excavation and lowering of site grades, where necessary, it is recommended that the exposed subgrade soils beneath all surface improvements be proof rolled with a heavy rubber-tired piece of construction equipment approved by and in the presence of the geotechnical engineering representative. All soil that ruts or excessively deflects during proof rolling should be removed as recommended by the GeoTek representative.

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

5.2.3 Pavement Areas

Undocumented fill should be removed below proposed pavement areas. If no undocumented fill is encountered or is relatively shallow, the natural soils should be overexcavated to a depth of 12 inches below existing grade or 12 inches below proposed finished grade, whichever is deeper. Finished grade is defined as the top of the subgrade. The exposed soils in these areas and in cut areas should be scarified to a depth of approximately eight inches, moistened to at least the optimum moisture content and compacted to a minimum relative compaction of at least 95 percent of maximum dry density as determined by ASTM D 1557 test procedures.

5.2.4 Hardscape Areas

Undocumented fill should be removed below hardscape areas. The exposed soils in these areas and in cut areas should be scarified to a depth of approximately eight inches, moistened to at

least the optimum moisture content and compacted to a minimum relative compaction of at least 90 percent of maximum dry density as determined by ASTM D 1557 test procedures.

5.2.5 Preparation of Excavation Bottoms

A representative of this firm should observe the bottom of all excavations. Upon approval, the exposed soils should be scarified to a depth of approximately eight inches, moistened to at least the optimum moisture content and compacted to a minimum relative compaction of at least 95 percent of maximum dry density as determined by ASTM D 1557 test procedures.

5.2.6 Engineered Fill

The on-site soils are generally considered suitable for reuse as engineered fill provided they are free from vegetation, oversize materials, debris and other deleterious material. Engineered fill should be placed in loose lifts with a thickness of eight inches or less and moisture conditioned to at least the optimum moisture content.

The alluvial materials are anticipated to contain significant quantities of oversize materials (i.e., particles greater than six inches maximum size). Special excavation and grading techniques will be required to perform site excavations (including utility lines) and grading. The project budget should include contingencies for possible crushing or removal of the oversized materials.

Below and within the proposed building area, engineered fill should be moisture conditioned to at least optimum moisture content and be compacted to at least 90 percent of maximum dry density as determined by ASTM D 1557 test procedures if a shallow foundation system is used. Below other structural elements, such as hardscape areas and walls independent of the building, engineered fill should be moisture conditioned to at least optimum moisture content and be compacted to at least 90 percent of maximum dry density as determined by ASTM D 1557 test procedures.

5.2.7 Excavation Characteristics

Excavation of the on-site soils is expected to be feasible utilizing heavy-duty grading equipment in good operating condition. Some excavation difficulties should be anticipated due to the presence of cobbles and/or boulders. Oversized rocks (>6 inches) should be anticipated on this site. The alluvial materials are anticipated to contain significant quantities of oversize (i.e., greater than six inches maximum size). Special excavation techniques and/or equipment (screens) may be required to create acceptable fill.

All temporary excavations for grading purposes and installation of underground utilities should be constructed in accordance with local and Cal-OSHA guidelines. Temporary excavations

within the on-site materials should be stable at 1.5:1 (horizontal: vertical) inclinations for cuts less than five feet in height.

5.2.8 Trench Excavations and Backfill

Temporary trench excavations within the on-site materials should be stable at 1.5:1 inclinations for short durations during construction and where cuts do not exceed 8 feet in height. It is anticipated that temporary cuts to a maximum height of four (4) feet can be excavated vertically, but local sloughing and/or failure could occur due to the granular nature of the soils at this site. Increased caution should be applied when working near or within any excavations at this site. "Popouts" and/or sloughing of oversize cobbles and boulders should be anticipated during utility trench operations.

The alluvial materials are anticipated to contain significant quantities of oversize (i.e., greater than six inches maximum size). Special excavation techniques and/or equipment (screens) may be required to create acceptable fill.

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

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

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

5.2.9 Slot-Cut Excavations

Assuming that any existing block walls along existing site boundaries are screen walls (imparting minimal loads), GeoTek evaluated the use of slot-cut excavations adjacent to these improvements in order to facilitate the required remedial grading for construction of proposed site walls and other improvements. Preliminary analyses by GeoTek using a soil cohesion of zero psf along a friction angle of approximately 34 degrees, an assumed slot-cut height of about five feet, and an assumed footing surcharge of approximately 1,000 psf yielded an approximate slot-

cut width of five feet. Wider slot cuts may be feasible if favorable conditions (i.e. denser soils with significant cohesion) are exposed in the site excavations.

Slot-cut excavations should follow an A-B-C sequence. Each “A” section should be excavated to the required depth and then backfilled with compacted soil (or wall section constructed). Following completion of the “A” sections, the “B” sections are then excavated and backfilled/constructed and then all “C” sections are completed in a similar manner. A GeoTek representative should observe that the slot-cuts are being performed in conformance with these recommendations.

5.2.10 Shrinkage and Subsidence

Several factors will impact earthwork balancing on the site, including shrinkage, subsidence, removal of oversize material, trench spoil from utilities and footing excavations, as well as the accuracy of topography. Shrinkage and subsidence are primarily dependent upon the degree of compactive effort achieved during construction. For planning purposes, a shrinkage factor of 10 to 15 percent may be considered for the materials requiring removal and/or recompaction. Site balance areas should be available in order to adjust project grades, depending on actual field conditions at the conclusion of earthwork. Subsidence on the order of up to 0.2 foot may be anticipated for the underlying soils. Additional loss should be anticipated for removal and offsite disposal of oversized materials.

5.2.11 Import Soils

Import soils should have a “Very Low” (0-20) Expansion Index. GeoTek, Inc. also recommends that the proposed import soils be tested for expansion and corrosivity potential. GeoTek, Inc. should be notified a minimum of 72 hours prior to importing so that appropriate sampling and laboratory testing can be performed.

5.3 DESIGN RECOMMENDATIONS

5.3.1 Foundation Design

The tested surficial site soils generally exhibit a “Very Low” ($0 \leq EI \leq 20$) Expansion Index (EI) when tested in accordance with ASTM D 4829. Additionally, the site soils tested generally have soil soluble sulfate contents of less than 0.1 percent. Laboratory testing should be performed at the completion of site grading to verify the Expansion Index (EI) and soluble sulfate content of the near-surface soils.

Foundation design criteria, in general conformance with the 2022 CBC, are presented below. The recommendations provided are minimal and are not intended to supersede the design by the project structural engineer. It should be noted that the criteria provided are based on soil support characteristics only. The structural engineer should design the slab and beam reinforcement based on actual loading conditions.

The foundation elements for the proposed structures should bear entirely in engineered fill soils as recommended in this report. Foundations should be designed in accordance with the 2022 California Building Code (CBC) and City of Upland requirements. A summary of the foundation design recommendations is presented in the following table:

MINIMUM DESIGN REQUIREMENTS FOR CONVENTIONALLY REINFORCED FOUNDATIONS	
Design Parameter	“Very Low” Expansion Index ($0 \leq EI \leq 20$)
Foundation Depth or Minimum Perimeter Beam Depth (inches below lowest adjacent grade)	One- and two-story – 12
Minimum Foundation Width (Inches)*	One-story – 12 Two-story – 12
Minimum Slab Thickness (Inches)	4 – Actual
Minimum Slab Reinforcing	6” x 6” – W1.4 x W1.4 welded wire fabric or No. 3 reinforcing bars placed at 18 on center each way placed in middle of slab
Minimum Reinforcement for Continuous Footings, Grade Beams, and Retaining Wall Footings	Two No. 4 reinforcing bars, one placed near the top and one near the bottom
Presaturation of Subgrade Soil (Percent of Optimum/Depth in Inches)	Minimum 100% of the optimum moisture content to a depth of at least 12 inches prior to placing concrete

*Code minimums per Table 1809.7 of the 2022 CBC should be complied with.

The following criteria for design of foundations are preliminary and should be re-evaluated based on the results of additional laboratory testing of samples obtained near finish pad grade. An allowable bearing capacity of 2,000 pounds per square foot (psf) may be used for design of continuous and perimeter footings 12 inches deep and 12 inches wide, and pad footings 24 inches square and 12 inches deep. This allowable soil bearing capacity may be increased by 400 psf for each additional foot of footing depth and 250 psf for each additional foot of footing width to a maximum value of 3,500 psf. An increase of one-third may be applied when considering short-term live loads (e.g., seismic and wind loads). These bearing values contain a minimum factor of safety of three (3).

The recommended allowable bearing capacity is based on an estimated maximum post-construction settlement of 1-inch. Differential settlement of about one-half of the total settlement over a horizontal distance of 40 feet could result. The project structural engineer, foundation engineer, and earth retention structure designer should incorporate these settlement estimates into the design, as appropriate.

The passive earth pressure may be computed as an equivalent fluid having a density of 400 psf per foot of depth, to a maximum earth pressure of 4,000 psf for footings founded on engineered fill or competent native soil. The allowable passive earth pressure contains a factor of safety of 1.5. A coefficient of friction between soil and concrete of 0.35 may be used with dead load forces. Passive pressure and frictional resistance may be combined without reduction. The upper one foot of soil should be ignored in the passive pressure calculations unless the surface is covered with pavements or slabs.

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

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

5.3.2 Moisture Vapor and Retarding System

A moisture and vapor retarding system should be placed below slabs-on-grade where moisture migration through the slab is undesirable. Guidelines for these are provided in the 2022 California Green Building Standards Code (CALGreen) Section 4.505.2, the 2022 CBC Section 1907.1 and ACI 360R-10. The vapor retarder design and construction should also meet the requirements of ASTM E 1643. A portion of the vapor retarder design should be the implementation of a moisture vapor retardant membrane.

The effectiveness of the vapor retarding membrane can be adversely impacted as a result of construction related punctures. These occurrences should be limited as much as possible during construction. Thicker membranes are generally more resistant to accidental puncture than thinner ones. Products specifically designed for use as moisture/vapor retarders may also be more puncture resistant. Although the CBC specifies a 6-mil vapor retarder membrane, a minimum 10 mil thick membrane with joints properly overlapped and sealed should be considered, unless otherwise specified by the slab design professional. The membrane should consist of Stego wrap or the equivalent.

Moisture and vapor retarding systems are intended to provide a certain level of resistance to vapor and moisture transmission through the concrete, but do not eliminate it. The acceptable level of moisture transmission through the slab is to a large extent based on the type of flooring used and environmental conditions. Ultimately, the vapor retarding system should be comprised of suitable elements to limit migration of water and reduce transmission of water vapor through the slab to acceptable levels. The selected elements should have suitable properties such as thickness, composition, strength, and permeability to achieve the desired performance level. Moisture retarders can reduce, but not eliminate, moisture vapor rise from the underlying soils up through the slab. Moisture retarder systems should be designed and constructed in accordance with applicable American Concrete Institute, Portland Cement Association, Post-Tensioning Concrete Institute, ASTM and California Building Code requirements and guidelines.

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

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

5.3.3 Miscellaneous Foundation Recommendations

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

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

5.3.4 Foundation Setbacks

Minimum setbacks for all foundations should comply with the 2022 CBC or City of Upland requirements, whichever is more stringent. Improvements not conforming to these setbacks are

subject to the increased likelihood of excessive lateral movement and/or differential settlement. If large enough, these movements can compromise the integrity of the improvements.

- The outside top edge of all footings should be set back a minimum of $H/3$, where H is the slope height, from the face of any descending slope. The setback should be at least five feet and need not exceed 40 feet.
- The bottom of any proposed foundations should be deepened so as to extend below a 1:1 upward projection from the bottom edge of the nearest excavation and the bottom edge of the closest footing.

5.3.5 Soil Corrosivity

Based on the chemical test results presented in Appendix B, the corrosivity test results indicate that the on-site soils are “mildly corrosive” to “moderately corrosive” (8,040 to 13,400 ohm-cm) to buried ferrous metal. This corrosion classification is obtained from “Corrosion Basics: An Introduction,” by Pierre R. Roberge, 2nd Edition, 2005. Recommendations for protection of buried ferrous metal should be provided by a corrosion engineer. Laboratory testing should be performed at the completion of site grading to verify the soil corrosivity of the near-surface soils.

5.3.6 Soil Sulfate Content

Based on the chemical test results presented in Appendix B, the sulfate test results on samples obtained from the project site indicate a soluble sulfate content of less than 0.1% by weight. Soluble sulfate contents of this level would be in the range of “negligible” (i.e., “S0” exposure classification) in accordance with ACI 318-19. Based on the test results and Table 19.3.1.1 of ACI 318-19, no special recommendations for concrete are required for this project due to soil sulfate exposure. Laboratory testing should be performed at the completion of site grading to verify the soil sulfate content of the near-surface soils

5.4 RETAINING AND SCREEN WALL DESIGN AND CONSTRUCTION

5.4.1 General Design Criteria

Retaining wall foundations independent of the building should be embedded a minimum of 18 inches into engineered fill. Retaining wall foundations should be designed in accordance with Section 5.3.1 of this report. Structural requirements may govern and should be evaluated by the project structural engineer. All earth retention structure plans should be reviewed by this office prior to finalization.

Site clearing and remedial earthwork for all earth retention structures should meet the requirements of this report, unless specifically provided otherwise, or more stringent requirements or recommendations are made by the wall designer. The soil used as backfill behind retaining walls should have a “Very Low” (0-20) Expansion Index and should be compacted to at least 90 percent relative compaction (ASTM D 1557).

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

In addition to the design lateral forces due to retained earth, surcharges due to improvements, such as an adjacent structure, should be considered in the design of the retaining walls. Loads applied within a 1:1 (h:v) projection from the surcharging structure on the stem of the retaining wall should be considered in the design.

Final selection of the appropriate design parameters should be made by the retaining wall designer based upon the local practices and ordinances, expected structure response, and desired level of conservatism.

5.4.2 Cantilevered Walls

The recommendations presented below are for cantilevered retaining walls up to six (6) feet high. Active earth pressure may be used for retaining wall design, provided the top of the wall is not restrained from minor deflections. Appropriate fluid unit weights are given below for specific slope gradients of the retained material. These do not include other superimposed loading conditions such as traffic, structures, seismic events, or adverse geologic conditions.

ACTIVE EARTH PRESSURES	
Surface Slope of Retained Materials (h:v)	Equivalent Fluid Pressure* (pcf)
Level	38
2:1	54

*The design pressures assume the backfill materials have an expansion index less than or equal to 20. Backfill zone includes the area between the back of the wall to a plane (1:1, h:v) up from the bottom of the wall foundation to the adjacent ground surface.

For walls with a retained height greater than six (6) feet, an incremental seismic pressure should be included into the wall design. Where needed, it is recommended that an incremental seismic

load for unrestrained walls with level backfill of $14H^2$ [Units: pounds per lineal foot of wall] should be included into the wall design to account for seismic loading conditions, where H is the retained height of the wall. For unrestrained walls with a retained height greater than six (6) feet with backfill of a 2:1 [horizontal: vertical] gradient, a dynamic load increment of $20H^2$ should be included in the wall design. These incremental seismic loads may be assumed to be applied at a point $1/3H$ above the base of the wall.

5.4.3 Retaining Wall Backfill and Drainage

Wall backfill should include a minimum one foot wide section of $3/4$ - to one-inch clean crushed rock or approved equivalent. The rock should be placed immediately adjacent to the back of the wall and extend up from a backdrain to within approximately 12 inches of finish grade. The portion of the rock opposite the back of the wall adjacent to the soil backfill should be covered with a layer of filter fabric comprised of Mirafi 140N or the equivalent. The upper 12 inches of backfill should consist of compacted on-site soil. Backfill placed within the active zone as defined by a 1:1 (H:V) projection from the back of the retaining wall footing up to the retained surface behind the wall should consist of very low expansive soil. The presence of other soils placed within the 1:1 projection will necessitate revision to the parameters provided and modification of wall designs.

The backfill soil should be placed in lifts no greater than eight inches in thickness, moisture conditioned to at least optimum moisture content and compacted to at least 90 percent of maximum dry density as determined by ASTM D 1557 test procedures. Proper surface drainage needs to be provided and maintained. Water should not be allowed to pond behind retaining walls. Waterproofing of site walls should be performed where moisture migration through the walls is undesirable.

Retaining walls should be provided with an adequate pipe and gravel back drain system to reduce the potential for hydrostatic pressures to develop. A 4-inch diameter perforated collector pipe (Schedule 40 PVC or approved equivalent) in a minimum of one cubic foot per linear foot of $3/4$ - inch or one inch clean crushed rock or equivalent, wrapped in filter fabric should be placed near the bottom of the backfill and the water should be directed to an appropriate disposal area.

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

Walls less than two (2) feet in height do not require backdrains. Walls from two to four feet in height may be drained using localized gravel packs (e.g., approximately 1.5 cubic feet of gravel in a woven plastic bag) behind weep holes at 10 feet maximum spacing. Weep holes should be provided or the head joints omitted in the first course of block extended above the ground surface. However, nuisance water may still collect in front of the wall.

Drain outlets should be maintained over the life of the project and should not be obstructed or plugged by adjacent improvements.

5.4.4 Restrained Retaining Walls

Retaining walls that will be restrained prior to placing and compacting backfill material or that have reentrant or male corners, should be designed for an at-rest equivalent fluid pressure of 64 pcf, plus any applicable surcharge loading. For areas of male or reentrant corners, the restrained wall design should extend a minimum distance of twice the height of the wall laterally from the corner, or a distance otherwise determined by the project structural engineer.

5.4.5 Additional Retaining Wall Design Considerations

- Retaining and screen wall foundation elements should be designed in accordance with building code setback requirements. A minimum horizontal setback distance of five feet as measured from the top outside edge of the footing to an adjacent slope face is recommended.
- Wall design should consider the additional surcharge loads from superjacent slopes and/or footings, where appropriate.
- No backfill should be placed against concrete until minimum design strengths are evident by compression tests of cylinders.
- The retaining wall footing excavations, backcuts, and backfill materials should be approved by the project geotechnical engineer or their authorized representative.
- Positive separations should be provided in screen walls at horizontal distances not exceeding 20 feet.

5.5 CONCRETE FLATWORK

5.5.1 Exterior Concrete Slabs, Sidewalks and Driveways

Exterior concrete slabs, sidewalks and driveways should be designed using a four-inch minimum thickness. Some shrinkage and cracking of the concrete should be anticipated as a result of typical mix designs and curing practices utilized in construction.

Sidewalks may be under the jurisdiction of the governing agency. If so, jurisdictional design and construction criteria will apply, if more restrictive than the recommendations presented in this report.

Subgrade soils should be pre-moistened prior to placing concrete. The subgrade soils below exterior slabs and sidewalks should be pre-saturated to a minimum of 100 percent of the optimum moisture content to a depth of 12 inches.

All concrete installation, including preparation and compaction of subgrade, should be done in accordance with the City of Upland specifications, and under the observation and testing of GeoTek, Inc. and a City inspector, if necessary.

5.5.2 Concrete Performance

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

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

5.6 PRELIMINARY PAVEMENT DESIGN

5.6.1 Asphaltic Concrete Pavement

Although planned final grades beneath the proposed streets and drive aisles within the site are not yet known, the following preliminary pavement design recommendations are based on an assumed Traffic Index of 5.5.

Preliminary pavement thickness design is based on the Caltrans Highway Design Manual (2018). An R-value of 50 was assumed for the determination of preliminary pavement sections for this report. Once the traffic loading information becomes more defined, revision to the pavement design recommendations may be warranted. It is recommended that the final pavement design be based on R-value testing of the as-graded subgrade soils within the pavement areas.

Based on the assumptions noted above, the following preliminary pavement section recommendations are provided for the site:

PRELIMINARY MINIMUM PAVEMENT SECTION		
Traffic Index	Thickness of Asphalt Concrete (inches)	Thickness of Aggregate Base (inches)
5.5 (Interior Streets and Drive Aisles)	3.0	4.0

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

All base material and the upper 12 inches of subgrade should be compacted to at least 95 percent of the material's maximum dry density as determined by ASTM D1557 test procedures. All materials and methods of construction should conform to the requirements of the City of Upland.

5.6.2 Permeable Interlocking Concrete Pavers

Interlocking concrete pavers can be used for this project. The pavers are assumed to be approximately 3.2 inches (80 millimeters) in thickness. Concrete pavers should be underlain by 1.0 inch to 1.5 inches of bedding sand overlying four inches of aggregate base founded on

compacted subgrade soils. The aggregate base should be compacted to at least 95 percent of maximum dry density as determined by ASTM D 1557 test procedures.

Where possible, the aggregate base should extend beyond the perimeter of the pavers a minimum distance of four inches.

The bedding sand should be placed and lightly moistened and compacted. Since this compaction cannot be tested it should be observed by a representative of this firm.

Historically, paver systems have experienced failures in areas where water has degraded the support characteristics of the underlying base and/or subgrade soils. Since paver systems are permeable and allow transmission of water into the underlying materials, it may be prudent to discuss with the paver designer/manufacturer what methods may be employed to address the issue of potential water introduction into the underlying materials. Underdrain systems, local subgrade reinforcement, tilting the pavement subgrade to drain away from paver areas and not pond, or additional structural elements such as geotextiles can be considered, particularly in high traffic areas and/or low areas where water will tend to collect. The recommendations of the designer/manufacturer should then be implemented in the design and construction of the paver system.

5.6.3 Portland Cement Concrete (PCC) Pavement

For the proposed vehicle parking areas, it is recommended that a minimum of five (5.0) inches of PCC pavement over 12 inches subgrade compacted to at least 95 percent of maximum dry density as determined by ASTM D 1557 test procedures be utilized. For vehicle service and access lanes, it is recommended that a minimum of six (6.0) inches of PCC pavement over 12 inches subgrade compacted to at least 95 percent of maximum dry density be utilized. This section should also be used in heavy truck traffic areas such as fire lanes, trash dumpster pads and approaches.

Requirements of Section 90 of Caltrans Standard Specifications, and various ACI and ASTM standards regarding mixing and placing concrete should be followed. The PCC pavement should have a minimum modulus of rupture of 500 pounds per square inch, and a minimum 28-day compressive strength of 4,000 pounds per square inch. Concrete should incorporate 1-inch maximum size aggregate and should be proportioned to achieve a maximum slump of four inches. Instead of increasing the water content, a plasticizing admixture may be utilized to increase the workability of the concrete. The concrete should be properly cured after placement. Concrete should not be placed during hot and windy weather.

Crack control joints should be provided in the transverse direction spaced at horizontal intervals ranging from 24 to 36 times the thickness of the concrete.

5.6.4 Pavement Construction

All pavement installation, including preparation and compaction of subgrade and base material, placement and rolling of asphaltic concrete and placement of concrete pavement, should be done in accordance with the City of Upland guidelines, and under the observation and testing of GeoTek and a City inspector, where required.

Any aggregate base used should consist of crushed rock with an R-Value and gradation in accordance with Crushed Aggregate Base (Section 400-2.4 of the “Greenbook” Regional Supplement Amendments). Any Crushed Miscellaneous Base used shall conform to Section 200-2.4 of the Green Book.

Minimum compaction requirements for aggregate base should be 95 percent of maximum dry density as determined by ASTM D 1557 test procedures for both soil subgrade and aggregate base. Jurisdictional minimum compaction requirements in excess of the aforementioned minimums may govern. The upper 12 inches of subgrade should be moisture-conditioned to at least optimum moisture. The top of the subgrade and aggregate base should be graded to drain to the perimeter of the pavement.

5.7 POST CONSTRUCTION CONSIDERATIONS

5.7.1 Landscape Maintenance and Planting

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

Overwatering should be avoided. An abatement program to control ground-burrowing rodents should be implemented and maintained. Burrowing rodents can decrease the long-term performance of slopes.

It is common for planting to be placed adjacent to structures in planter or lawn areas. This will result in the introduction of water into the ground adjacent to the foundations. This type of landscaping should be avoided.

5.7.2 Drainage

Positive site drainage should be maintained at all times. Drainage should not flow uncontrolled down any descending slope. Water should be directed away from foundations and not allowed to pond or seep into the ground adjacent to the footings and floor-slabs. Pad drainage should be directed toward approved areas and not be blocked by other improvements. Roof gutters should be installed that will direct the collected water at least 20 feet from the buildings.

5.8 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

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

- Observe site clearing and grubbing operations for proper removal of unsuitable materials.
- Observe and test bottom of removals prior to fill placement.
- Evaluate the suitability of on-site and import materials for fill placement and collect soil samples for laboratory testing where necessary.
- Observe the fill for uniformity during placement, including utility trench backfill. Perform field density testing of the fill materials.
- Observe and probe foundation excavations to confirm suitability of bearing materials with respect to density.

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

6. INTENT

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

The scope of this evaluation is limited to the boundaries of the subject property. This review does not and should in no way be construed to encompass any areas beyond the specific area of the proposed construction as indicated to us by the client. Further, no evaluation of any existing site improvements is included. The scope of this evaluation is based on GeoTek's understanding of the project and geotechnical engineering standards normally used on similar projects in this locality.

7. LIMITATIONS

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

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

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

8. SELECTED REFERENCES

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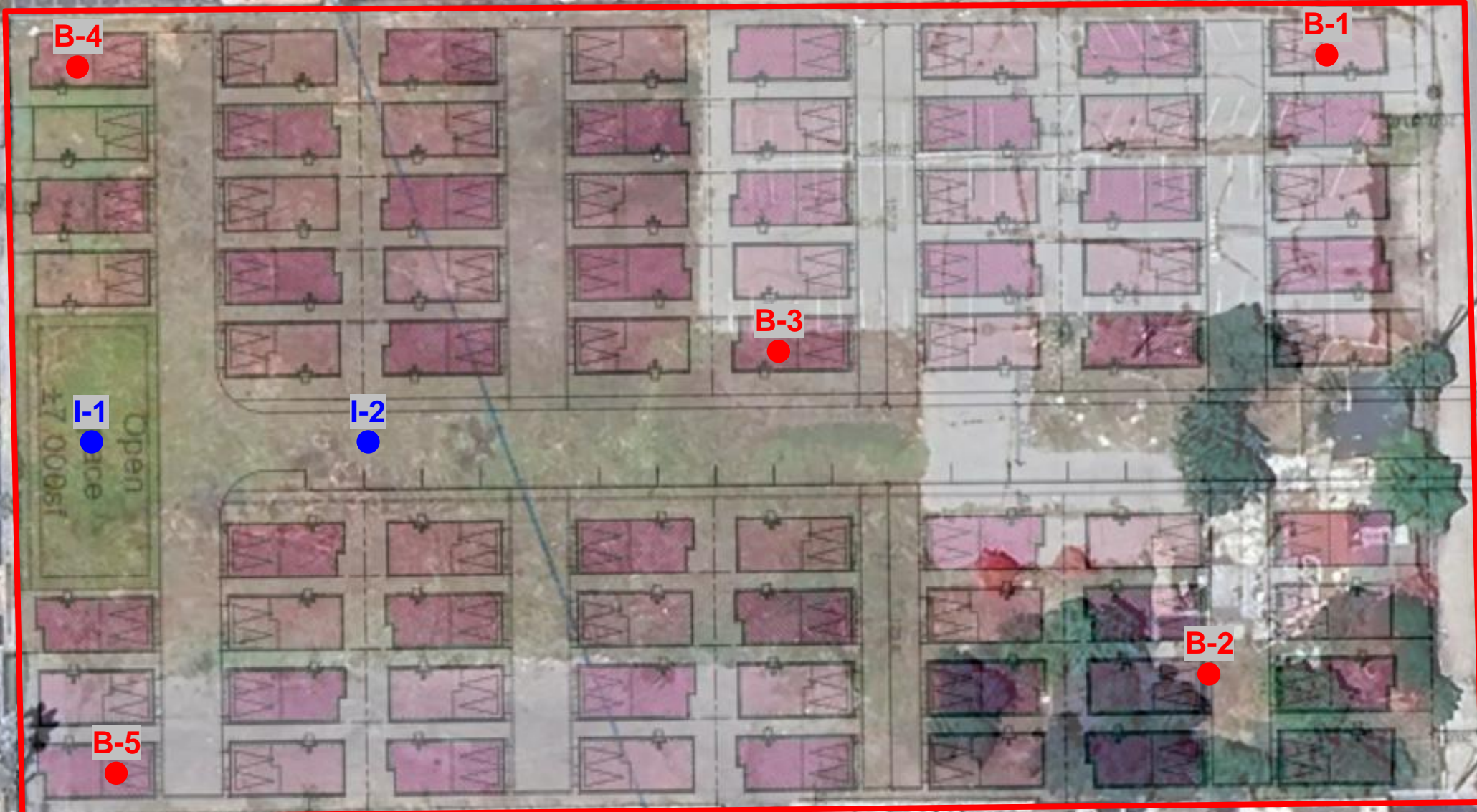
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ROUTE 66 / FOOTHILL BLVD

LEGEND
(Locations are Approximate)

 Site Boundary

 **B-5** Geotechnical Boring

 **I-2** Infiltration Test

Century Communities
APNs 1007-061-08-0000 and 107-061-23-0000
1812 and 1816 West Foothill Boulevard
Upland, San Bernardino County, California
Project No. 4056-CR



Figure 2
Exploration Location Map

APPENDIX A

LOGS OF EXPLORATORY BORINGS

**Geotechnical and Infiltration Evaluation
Proposed Single-Family Residential Development
APNs 1007-061-08-0000 and 1007-061-23-0000
1812 and 1816 West Foothill Boulevard
Upland, San Bernardino County, California
Project No. 4056-CR**



A - FIELD TESTING AND SAMPLING PROCEDURES

The Modified Split-Barrel Sampler (Ring)

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

The Standard Penetration Test (SPT) Sampler

Standard penetration tests (SPT) were performed with a 2.0-inch outside diameter, 1.5-inch inside diameter, split-barrel sampler. The sampler was 18 inches long. The inside diameter of the sampler shoe was 1.4 inches. The sampler was unlined. The sampler conformed to the requirements of ASTM D 1586. A 140-pound automatic trip hammer was utilized, dropping 30 inches for each blow. Blow counts are recorded for every 6 inches of penetration as indicated on the log of boring. Disturbed samples are removed from the sample barrel, sealed in a plastic bag, and transported to the laboratory for testing.

Bulk Samples (Large)

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

Bulk Samples (Small)

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

B – BORING/TRENCH LOG LEGEND

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

SOILS

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

GEOLOGIC

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

(Additional denotations and symbols are provided on the log of borings/trenches)

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Century Communities SoCal
PROJECT NAME: 1812 and 1816 W Foothill Blvd
PROJECT NO.: 4056-CR
LOCATION: See Boring Location Map

DRILLER: 2R Drilling Inc.
DRILL METHOD: Hollow Stem Auger
HAMMER: 140lbs/30in.

LOGGED BY: JR
OPERATOR: Miguel
RIG TYPE: CME-75
DATE: 1/30/2025

Depth (ft)	SAMPLES			USCS Symbol	BORING NO.: B-1	Laboratory Testing			
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others	
MATERIAL DESCRIPTION AND COMMENTS									
5	50/6"	R1	GP	3" Asphalt concrete/No base: Undocumented Fill: Cobble and gravel in sampler			0.6		EI, SH, SR, MD EI=5
5	26 40 50/4"	R2	GP	Alluvium: F-c sandy GRAVEL, brown, slightly moist, very dense, trace cobble			1.0		
5	35 50/5"	R3					0.7		
5	50/3"	R4							
10	BORING TERMINATED AT 8 FEET DUE TO PRACTICAL REFUSAL No groundwater encountered Boring backfilled with soil cuttings								
15									
20									
25									
30									

LEGEND	Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table							
	Lab testing: AL = Atterberg Limits SR = Sulfate/Resistivity Test		EI = Expansion Index SH = Shear Test		SA = Sieve Analysis HC = Consolidation		RV = R-Value Test MD = Maximum Density	

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Century Communities SoCal
PROJECT NAME: 1812 and 1816 W Foothill Blvd
PROJECT NO.: 4056-CR
LOCATION: See Boring Location Map

DRILLER: 2R Drilling Inc.
DRILL METHOD: Hollow Stem Auger
HAMMER: 140lbs/30in.

LOGGED BY: JR
OPERATOR: Miguel
RIG TYPE: CME-75
DATE: 1/30/2025

Depth (ft)	SAMPLES			USCS Symbol	BORING NO.: B-2	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
MATERIAL DESCRIPTION AND COMMENTS								
					Vegetation/Disturbed Topsoil:			
					Alluvium:			
		20 24 30	R1	SP	Gravelly f-c SAND, gray brown, slightly moist, dense	1.3		
		30 31 33	R2	SP/GP	Gravelly f-c SAND to f-c sandy GRAVEL, gray brown, slightly moist, dense	0.9		
5		50/4"	R3	GP	F-c sandy GRAVEL, gray brown, slightly moist, very dense, trace cobble			
		37 50/6"	R4		Cobble in sampler	0.6		
10								
		50/6"	R5	SP	Gravelly f-c SAND, brown, slightly moist, very dense, trace cobble	0.9		
15								
		50/4"	R6					
20					BORING TERMINATED AT 16.5 FEET DUE TO PRACTICAL REFUSAL			
					No groundwater encountered Boring backfilled with soil cuttings			
25								
30								

LEGEND	Sample type:	---Ring	---SPT	---Small Bulk	---Large Bulk	---No Recovery	---Water Table	
	Lab testing:	AL = Atterberg Limits	SR = Sulfate/Resistivity Test	EI = Expansion Index	SH = Shear Test	SA = Sieve Analysis	HC = Consolidation	RV = R-Value Test

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Century Communities SoCal
PROJECT NAME: 1812 and 1816 W Foothill Blvd
PROJECT NO.: 4056-CR
LOCATION: See Boring Location Map

DRILLER: 2R Drilling Inc.
DRILL METHOD: Hollow Stem Auger
HAMMER: 140lbs/30in.

LOGGED BY: JR
OPERATOR: Miguel
RIG TYPE: CME-75
DATE: 1/30/2025

Depth (ft)	SAMPLES			USCS Symbol	BORING NO.: B-3	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			MATERIAL DESCRIPTION AND COMMENTS	Water Content (%)	Dry Density (pcf)
5					Vegetation/Disturbed Topsoil:			SR
22 26 29		R1	SP/GP	F-c SAND to f-c sandy GRAVEL, brown to gray brown, slightly moist, dense	0.8			
26 27 50		R2	GP	Alluvium: F-c sandy GRAVEL, gray brown, slightly moist, very dense	0.7			
25 50/6"		R3			0.8			
40 50/3"		R4	SP	Gravelly f-c SAND, gray brown, slightly moist, very dense	1.2	123.9		
50/6"		R5	GP	(Cobble in sampler) F-c sandy GRAVEL, gray brown, slightly moist, very dense, trace cobble	0.7			
15	BORING TERMINATED AT 11 FEET DUE TO PRACTICAL REFUSAL No groundwater encountered Boring backfilled with soil cuttings							
20								
25								
30								
LEGEND	Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table							
	Lab testing: AL = Atterberg Limits EI = Expansion Index SA = Sieve Analysis RV = R-Value Test SR = Sulfate/Resistivity Test SH = Shear Test HC = Consolidation MD = Maximum Density							

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Century Communities SoCal
PROJECT NAME: 1812 and 1816 W Foothill Blvd
PROJECT NO.: 4056-CR
LOCATION: See Boring Location Map

DRILLER: 2R Drilling Inc.
DRILL METHOD: Hollow Stem Auger
HAMMER: 140lbs/30in.

LOGGED BY: JR
OPERATOR: Miguel
RIG TYPE: CME-75
DATE: 1/30/2025

Depth (ft)	SAMPLES			USCS Symbol	BORING NO.: B-5 MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
22 13 20		22 13 20	R1	SP	<u>Undocumented Fill:</u> Gravelly f-c SAND (Coarse Aggregate Base) to f SAND, black to brown, slightly moist, medium dense	1.4	110.3	EI, SH, MD EI=0
13 26 26		13 26 26	R2	GP	<u>Alluvium:</u> F sandy GRAVEL, brown, slightly moist, dense	0.9		
23 33 50/6"		23 33 50/6"	R3		F-c sandy GRAVEL, brown, slightly moist, very dense	1.0	128.9	
37 41 50/3"		37 41 50/3"	R4			1.3		
40 50/5"		40 50/5"	R5		F-c sandy GRAVEL, brown, slightly moist, very dense, trace cobble	2.1	108.8	
41 50/5"		41 50/5"	R6	SP	F-c SAND, brown, slightly moist, very dense, few gravel, trace cobble	4.9	119.6	
50/2"		50/2"	R7	GP				
50/1"		50/1"	SI					
BORING TERMINATED AT 25.5 FEET DUE TO PRACTICAL REFUSAL								
No groundwater encountered Boring backfilled with soil cuttings								

LEGEND	Sample type:	---SPT	---Small Bulk	---Large Bulk	---No Recovery	---Water Table		
	Lab testing:	AL = Atterberg Limits	EI = Expansion Index	SA = Sieve Analysis	RV = R-Value Test	SR = Sulfate/Resistivity Test	SH = Shear Test	HC = Consolidation

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Century Communities SoCal
PROJECT NAME: 1812 and 1816 W Foothill Blvd
PROJECT NO.: 4056-CR
LOCATION: See Boring Location Map

DRILLER: 2R Drilling Inc.
DRILL METHOD: Hollow Stem Auger
HAMMER: 140lbs/30in.

LOGGED BY: JR
OPERATOR: Miguel
RIG TYPE: CME-75
DATE: 1/30/2025

Depth (ft)	SAMPLES			USCS Symbol	BORING NO.: I-1 MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
0				SP	Vegetation/Disturbed Topsoil: Gravelly f-c SAND, brown, slightly moist, trace cobble			
1				GP	Alluvium: F-c sandy GRAVEL, brown, slightly moist, dense, trace cobble			
5					BORING TERMINATED AT 5 FEET No groundwater encountered Boring set up with perforated pipe and gravel			
10								
15								
20								
25								
30								

LEGEND	Sample type:	---Ring	---SPT	---Small Bulk	---Large Bulk	---No Recovery	---Water Table	
	Lab testing:	AL = Atterberg Limits	SR = Sulfate/Resistivity Test	EI = Expansion Index	SH = Shear Test	SA = Sieve Analysis	HC = Consolidation	RV = R-Value Test

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Century Communities SoCal
PROJECT NAME: 1812 and 1816 W Foothill Blvd
PROJECT NO.: 4056-CR
LOCATION: See Boring Location Map

DRILLER: 2R Drilling Inc.
DRILL METHOD: Hollow Stem Auger
HAMMER: 140lbs/30in.

LOGGED BY: JR
OPERATOR: Miguel
RIG TYPE: CME-75
DATE: 1/30/2025

Depth (ft)	SAMPLES			USCS Symbol	BORING NO.: I-2 MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
5				SP	<u>Vegetation/Disturbed Topsoil:</u> Gravelly f-c SAND, brown, slightly moist, trace cobble			
				GP	<u>Alluvium:</u> F-c sandy GRAVEL, brown, slightly moist, dense, trace cobble			
5					BORING TERMINATED AT 5 FEET No groundwater encountered Boring set up with perforated pipe and gravel			
10								
15								
20								
25								
30								

LEGEND	Sample type:		---Ring		---SPT		---Small Bulk		---Large Bulk		---No Recovery		---Water Table
	Lab testing:	AL = Atterberg Limits	SR = Sulfate/Resistivity Test	EI = Expansion Index	SH = Shear Test	SA = Sieve Analysis	HC = Consolidation	RV = R-Value Test	MD = Maximum Density				

APPENDIX B

LABORATORY TEST RESULTS

**Geotechnical and Infiltration Evaluation
Proposed Single-Family Residential Development
APNs 1007-061-08-0000 and 1007-061-23-0000
1812 and 1816 West Foothill Boulevard
Upland, San Bernardino County, California
Project No. 4056-CR**



SUMMARY OF LABORATORY TESTING

Classification

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

Direct Shear

Shear testing was performed on remolded samples in a direct shear machine of the strain-control type in general accordance with ASTM Test Method D 3080. The rate of deformation is approximately 0.035 inch per minute. The samples were sheared under varying confining loads in order to determine the coulomb shear strength parameters, angle of internal friction and cohesion. The results of the testing are presented graphically in Appendix B.

Expansion Index

The expansion potential of the site soil was estimated by performing Expansion Index testing on selected samples in general accordance with ASTM D 4829. The results of the testing are presented graphically in Appendix B.

In-Situ Moisture and Density

The natural water content was determined (ASTM D 2216) on samples of the materials recovered from the subsurface exploration. In addition, in-place dry density determinations (ASTM D 2937) were performed on relatively undisturbed samples to measure the unit weight of the subsurface soils. Results of these tests are shown on the logs at the appropriate sample depths in Appendix A.

Moisture-Density Relationship

Laboratory testing consisting of a moisture-density relationship was performed on samples obtained during the subsurface exploration. The laboratory maximum dry density and optimum moisture content was determined in general accordance with ASTM D 1557 test procedures. The results of the testing are presented graphically in Appendix B.

Sulfate Content, Resistivity and Chloride Content

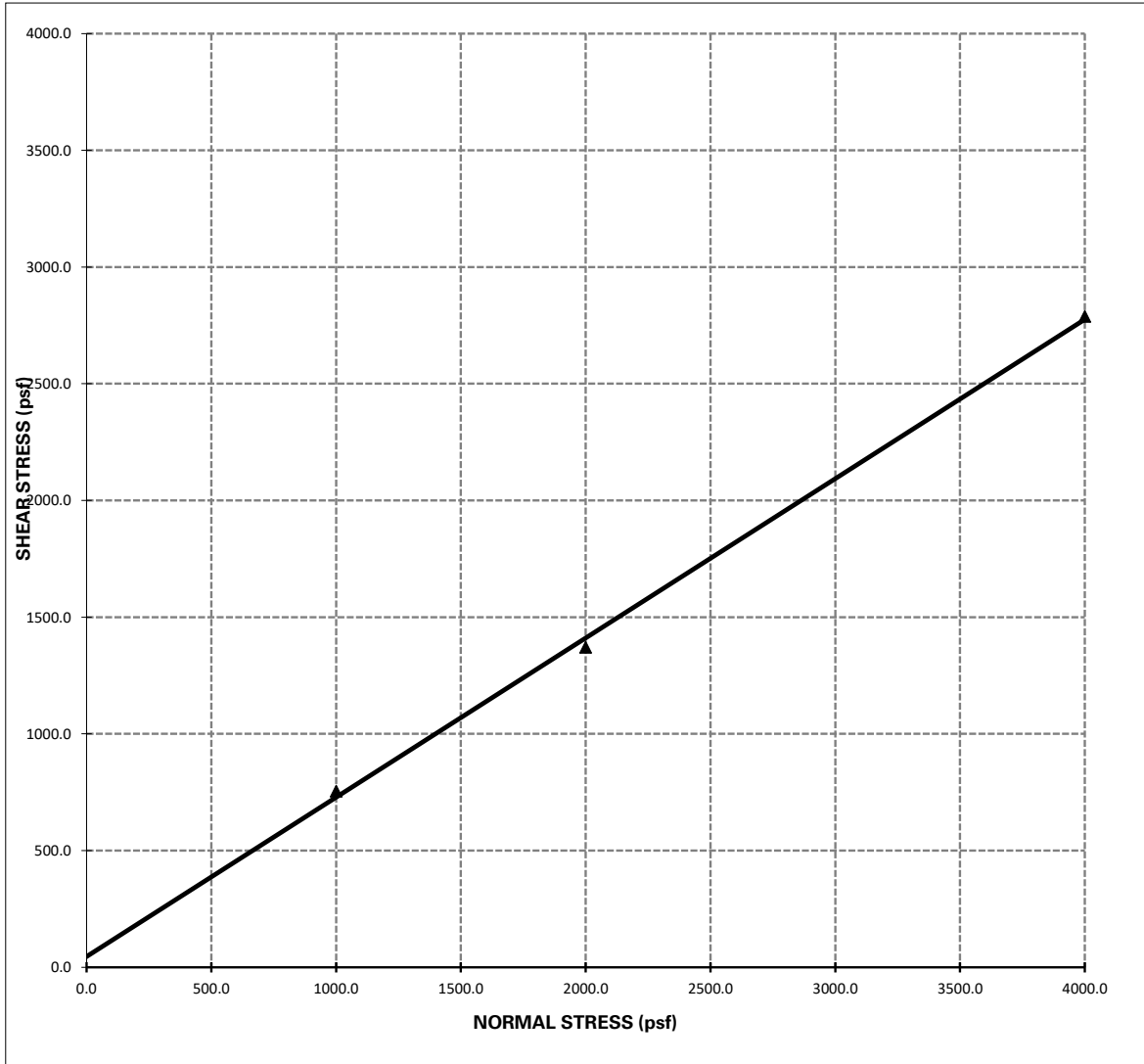
Laboratory testing was performed by Project X Corrosion Engineering in general accordance with ASTM procedures. The testing included pH and water-soluble sulfate content determinations, and resistivity and chloride content testing. The results of the testing are presented in Appendix B.



DIRECT SHEAR TEST

Project Name: 1812 & 1816 West Foothill Blvd.
Project Number: 4056-CR

Sample Location: B-1 @ 0-5 Feet
Date Tested: 2/4/2025



Shear Strength: $\Phi = 34^\circ$; **C = 46 psf**

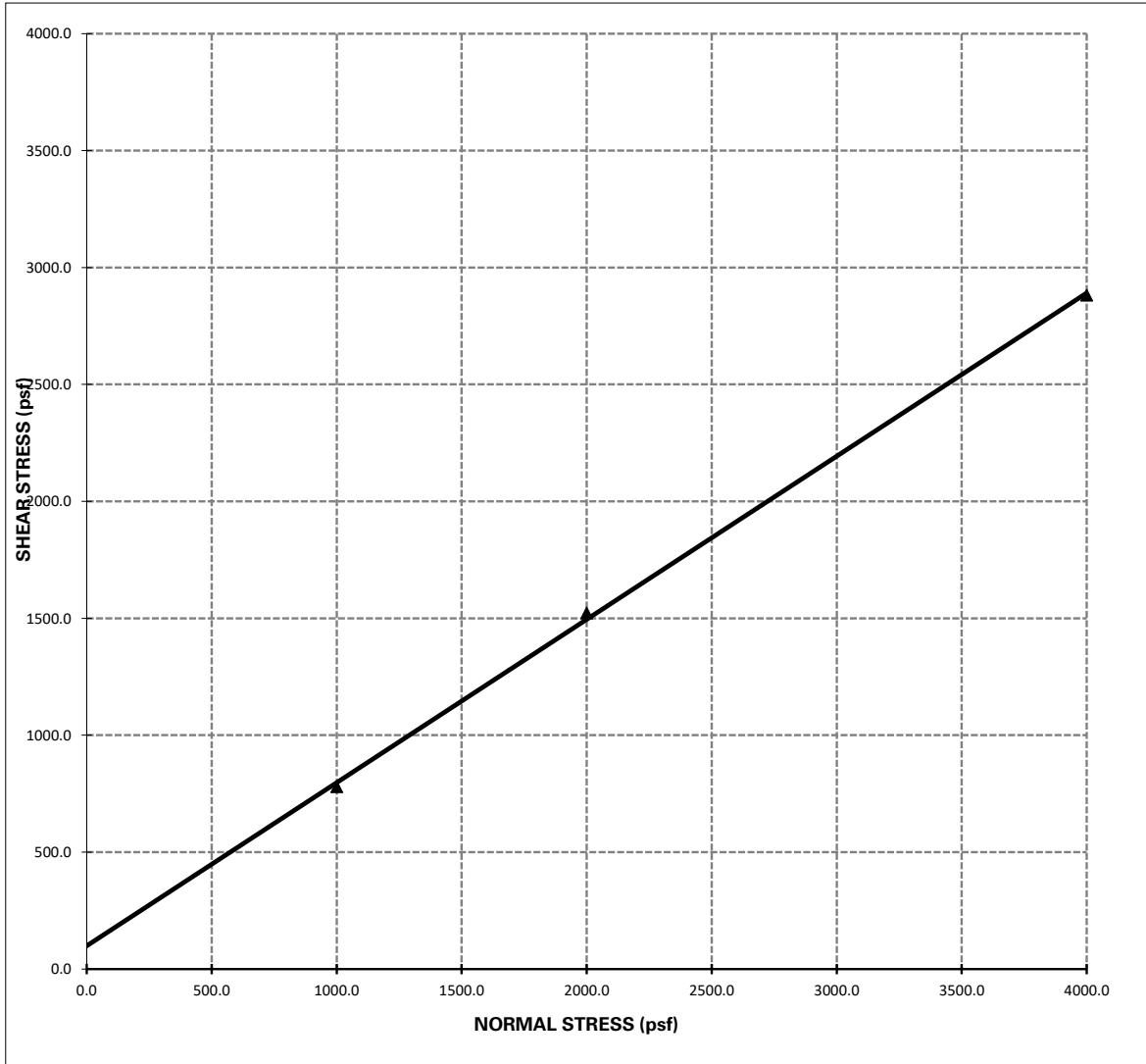
- Notes:**
- 1 - The soil specimen used in the shear box was a ring sample remolded to approximately 90% relative compaction from a bulk sample collected during the field investigation.
 - 2 - The above reflect direct shear strength at saturated conditions.
 - 3 - The tests were run at a shear rate of 0.01 in/min.



DIRECT SHEAR TEST

Project Name: 1812 & 1816 West Foothill Blvd.
Project Number: 4056-CR

Sample Location: B-5 @ 0-5 Feet
Date Tested: 2/4/2025



Shear Strength: $\Phi = 35^\circ$; **C = 100 psf**

- Notes:**
- 1 - The soil specimen used in the shear box was a ring sample remolded to approximately 90% relative compaction from a bulk sample collected during the field investigation.
 - 2 - The above reflect direct shear strength at saturated conditions.
 - 3 - The tests were run at a shear rate of 0.01 in/min.



EXPANSION INDEX TEST

(ASTM D4829)

Client: Century Communities

Project Number: 4056-CR

Project Location: 1812 and 1816 West Foothill Boulevard

Tested/ Checked By: KLP Lab No Corona

Date Tested: 2/3/2025

Sample Source: B-1 @ 0-5 Feet

Sample Description:

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

DENSITY DETERMINATION

Weight of compacted sample & ring (gm)	801.2
Weight of ring (gm)	372.9
Net weight of sample (gm)	428.3
Wet Density, lb / ft3 (C*0.3016)	129.2
Dry Density, lb / ft3 (D/1.F)	120.5

SATURATION DETERMINATION

Moisture Content, %	7.2
Specific Gravity, assumed	2.70
Unit Wt. of Water @ 20°C, (pcf)	62.4
% Saturation	48.8

READINGS		
DATE	TIME	READING
2/3/2025		0.4040
2/3/2025		0.4040
2/4/2025		0.4090

Initial
10 min/Dry

Final

FINAL MOISTURE	
Final Weight of wet sample & tare	% Moisture
819.3	11.4

EXPANSION INDEX = 5



EXPANSION INDEX TEST

(ASTM D4829)

Client: Century Communities

Project Number: 4056-CR

Project Location: 1812 and 1816 West Foothill Boulevard

Tested/ Checked By: KLP Lab No Corona

Date Tested: 2/3/2025

Sample Source: B-5 @ 0-5 Feet

Sample Description:

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

DENSITY DETERMINATION

Weight of compacted sample & ring (gm)	782.8
Weight of ring (gm)	363.4
Net weight of sample (gm)	419.4
Wet Density, lb / ft3 (C*0.3016)	126.5
Dry Density, lb / ft3 (D/1.F)	116.6

SATURATION DETERMINATION

Moisture Content, %	8.5
Specific Gravity, assumed	2.70
Unit Wt. of Water @ 20°C, (pcf)	62.4
% Saturation	51.6

READINGS		
DATE	TIME	READING
2/3/2025		0.6540
2/3/2025		0.6540
2/4/2025		0.6540

Initial
10 min/Dry

Final

FINAL MOISTURE	
Final Weight of wet sample & tare	% Moisture
805.5	13.9

EXPANSION INDEX = 0



Report No: PTR:25-00022-S01

Proctor Report

Client: Century Communities SoCal
 4695 MacArthur Court,
 Newport Beach CA 92660

CC:

Project: 4056-CR
 1812 and 1816 West Foothill Boulevard

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

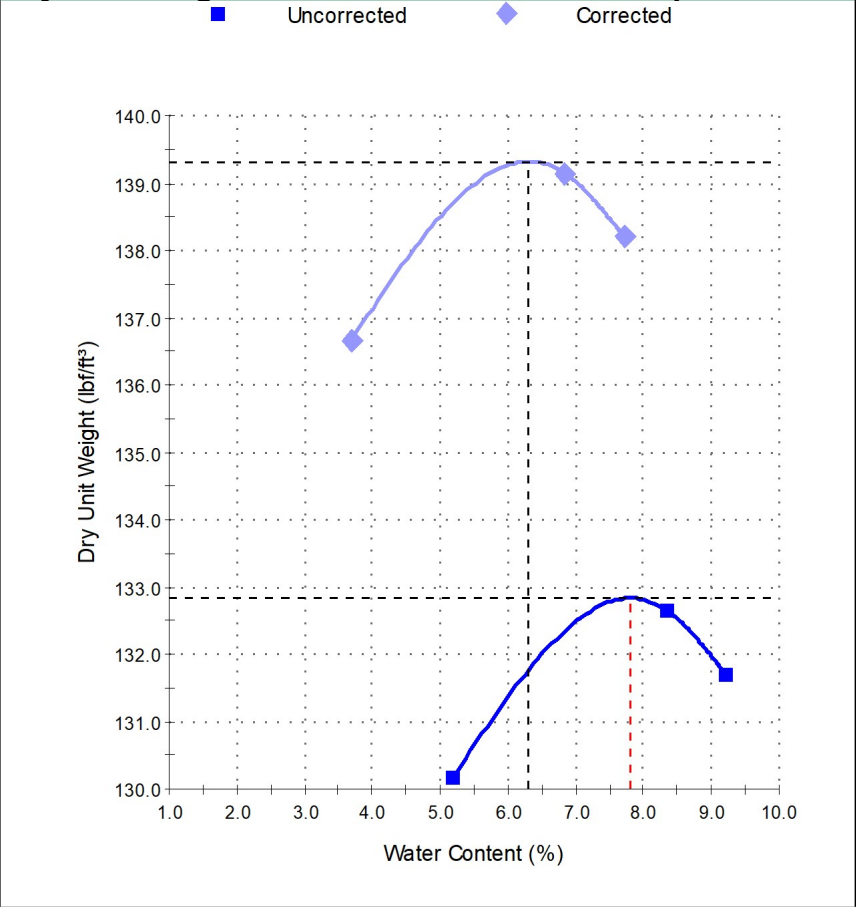
Sample ID: 25-00022-S01 **Date Sampled:** 2/3/2025

Sampled By:

Material: Fine to Coarse Sandy GRAVEL

Location: B-1 @ 0-5 Feet

Dry Unit Weight - Water Content Relationship



Test Results

ASTM D 1557	
Maximum Dry Unit Weight (lb/ft³):	132.8
Optimum Water Content (%):	7.8
Method:	C
Preparation Method:	Moist
Retained Sieve 3/4" (19mm) (%):	22
Passing Sieve 3/4" (19mm) (%):	78
Tested By:	Eduardo Cuevas
Date Tested:	1/31/2025
ASTM D 4718	
Corrected Maximum Dry Unit Weight (lb/ft³):	139.3
Corrected Optimum Water Content (%):	6.3
Specific Gravity (Oversize):	2.70
Sieve Size (Oversize):	3/4
Oversize Particles (%):	22

Comments



Report No: PTR:25-00022-S02

Proctor Report

Client: Century Communities SoCal
 4695 MacArthur Court,
 Newport Beach CA 92660

CC:

Project: 4056-CR
 1812 and 1816 West Foothill Boulevard

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

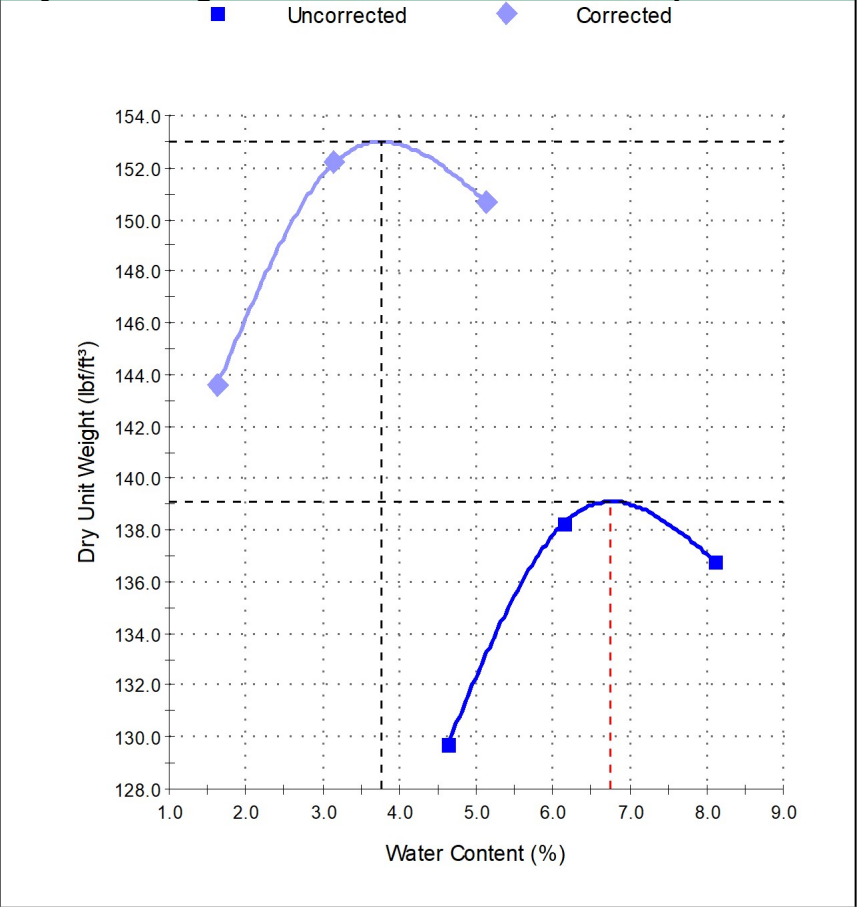
Sample ID: 25-00022-S02 **Date Sampled:**

Sampled By:

Material: Fine to Coarse Sandy GRAVEL

Location: B-5 @ 0-5 Feet

Dry Unit Weight - Water Content Relationship



Test Results

ASTM D 1557	
Maximum Dry Unit Weight (lb/ft³):	139.1
Optimum Water Content (%):	6.8
Method:	C
Preparation Method:	Moist
Retained Sieve 3/4" (19mm) (%):	52
Passing Sieve 3/4" (19mm) (%):	48
Tested By:	Eduardo Cuevas
Date Tested:	1/31/2025
ASTM D 4718	
Corrected Maximum Dry Unit Weight (lb/ft³):	153.0
Corrected Optimum Water Content (%):	3.8
Specific Gravity (Oversize):	2.70
Sieve Size (Oversize):	3/4
Oversize Particles (%):	52

Comments



Results Only Soil Testing for 1812 & 1816 W.Foothill Blvd.

February 3, 2025

Prepared for:

Eddy Cuevas
GeoTek USA
1548 N. Maple Avenue
Corona, CA 92878
Ecuevas@geotekusa.com, jbrucelas@geotekusa.com

Project X Job#: S250131F
Client Job or PO#: 4056-CR

Prepared by:
M. Williams

Respectfully Submitted,

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





Soil Analysis Lab Results

Client: GeoTek USA
 Job Name: 1812 & 1816 W.Foothill Blvd.
 Client Job Number: 4056-CR
 Project X Job Number: S250131F
 February 3, 2025

Bore# / Description	Method	ASTM D4327		ASTM D4327		ASTM G187		ASTM G51	ASTM G200	SM 4500-D	ASTM D4327	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D4327	ASTM D4327	
		Depth	Sulfates		Chlorides		Resistivity		pH	Redox	Sulfide	Nitrate	Ammonium	Lithium	Sodium	Potassium	Magnesium	Calcium	Fluoride
	(ft)	(mg/kg)	(wt%)	(mg/kg)	(wt%)	As Rec'd	Minimum		(mV)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
B-1	0-5	45.5	0.0045	55.5	0.0056	44,890	13,400	8.8	126	2.01	1.4	4.8	ND	70.4	12.2	65.2	251.1	1.5	0.5
B-3	0-5	17.6	0.0018	22.6	0.0023	26,130	8,040	8.5	128	0.48	19.3	2.5	ND	20.0	14.2	53.0	207.1	0.8	0.7

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

For AWWA 105C: 0-3mg/kg sulfide = Negative; 3-6mg/kg = trace; >6mg/kg = Positive

Note: Sometimes a bad sulfate hit is a contaminated spot. Typical fertilizers are Potassium chloride, ammonium sulfate or ammonium sulfate nitrate (ASN). So this is another reason why testing full corrosion series is good because we then have the data to see if those other ingredients are present meaning the soil sample is just fertilizer-contaminated soil. This can happen often when the soil samples collected are simply surface scoops. This is why it's best to dig in a foot, throw away the top and test the deeper stuff. Dairy farms are also notorious for these items.

If one sample pops up much more corrosive than all others, we would recommend collecting more samples surrounding the problem sample location to determine if the peak is isolated to it. This allows us to conclude it was a contaminated sample and able to declare it an outlier.

Try out our new online forms: [SOIL CORROSIVITY & THERMAL RESISTIVITY LAB REQUEST FORM](#) & [IN-SITU WENNER 4 PIN QUOTE REQUEST FORM](#)

APPENDIX C

INFILTRATION TEST DATA AND PORCHET CALCULATIONS

**Geotechnical and Infiltration Evaluation
Proposed Single-Family Residential Development
APNs 1007-061-08-0000 and 1007-061-23-0000
1812 and 1816 West Foothill Boulevard
Upland, San Bernardino County, California
Project No. 4056-CR**



PERCOLATION DATA SHEET

Project: 1812 and 1816 W Foothill Blvd

Job No.: 4056-CR

Test Hole No.: I-1

Tested By: JR

Date: 1/30/2025

Depth of Hole As Drilled: 60"

Before Test: 60"

After Test: 60"

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ in Water Level (Inches)	Rate (Minutes per Inch)	Comments
1	1:45 PM		60	36				presoaked
	2:10 PM	25			0	36	0.7	
2	2:11 PM		60	36				
	2:36 PM	25			0	36	0.7	
1	2:37 PM		60	36				
	2:47 PM	10			7	29	0.3	
2	2:48 PM		60	36				
	2:58 PM	10			7 7/8	28 1/8	0.4	
3	2:59 PM		60	36				
	3:09 PM	10			8 3/8	27 5/8	0.4	
4	3:10 PM		60	36				
	3:20 PM	10			9	27	0.4	
5	3:21 PM		60	36				
	3:31 PM	10			9 1/4	26 3/4	0.4	
6	3:32 PM		60	36				
	3:42 PM	10			9 5/8	26 3/8	0.4	



PERCOLATION DATA SHEET

Project: 1812 and 1816 W Foothill Blvd

Job No.: 4056-CR

Test Hole No.: I-2

Tested By: JR

Date: 1/30/2025

Depth of Hole As Drilled: 60"

Before Test: 60"

After Test: 60"

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ in Water Level (Inches)	Rate (Minutes per Inch)	Comments
1	1:33 PM		60	36				presoaked
	1:58 PM	25			0	36	0.7	
2	1:59 PM		60	36				
	2:24 PM	25			0	36	0.7	
1	2:25 PM		60	36				
	2:35 PM	10			10	26	0.4	
2	2:36 PM		60	36				
	2:46 PM	10			10 5/8	25 3/8	0.4	
3	2:47 PM		60	36				
	2:57 PM	10			11 1/8	24 7/8	0.4	
4	2:58 PM		60	36				
	3:08 PM	10			11 1/2	24 1/2	0.4	
5	3:09 PM		60	36				
	3:19 PM	10			11 7/8	24 1/8	0.4	
6	3:20 PM		60	36				
	3:30 PM	10			12 1/4	23 3/4	0.4	



Client: Century Communities SoCal
Project: 1812 and 1816 W Foothill Blvd
Project No: 4056-CR
Date: 1/30/2025

Boring No. I-I

Percolation to Infiltration Rate (Porchet Method)

Time Interval, $\Delta t =$ 10
 Final Depth to Water, $D_F =$ 33.625
 Test Hole Radius, $r =$ 4
 Initial Depth to Water, $D_O =$ 36
 Total Test Hole Depth, $D_T =$ 60

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

$H_O = D_T - D_O =$ 36
 $H_F = D_T - D_F =$ 26.375
 $\Delta H = \Delta D = H_O - H_F =$ 9.625
 $H_{avg} = (H_O + H_F) / 2 =$ 31.1875

$I_t =$ 3.48 Inches per Hour



Client: Century Communities SoCal
Project: 1812 and 1816 W Foothill Blvd
Project No: 4056-CR
Date: 1/30/2025

Boring No. I-2

Percolation to Infiltration Rate (Porchet Method)

Time Interval, $\Delta t =$ 10
 Final Depth to Water, $D_F =$ 36.25
 Test Hole Radius, $r =$ 4
 Initial Depth to Water, $D_O =$ 24
 Total Test Hole Depth, $D_T =$ 60

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

$H_O = D_T - D_O =$ 36
 $H_F = D_T - D_F =$ 23.75
 $\Delta H = \Delta D = H_O - H_F =$ 12.25
 $H_{avg} = (H_O + H_F) / 2 =$ 29.875

$I_t =$ 4.61 Inches per Hour



APPENDIX D

GENERAL GRADING GUIDELINES

**Geotechnical and Infiltration Evaluation
Proposed Single-Family Residential Development
APNs 1007-061-08-0000 and 1007-061-23-0000
1812 and 1816 West Foothill Boulevard
Upland, San Bernardino County, California
Project No. 4056-CR**



GENERAL GRADING GUIDELINES

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

General

Grading should be performed to at least the minimum requirements of governing agencies, Chapters 18 and 33 of the Uniform Building Code, CBC (2022) and the guidelines presented below.

Preconstruction Meeting

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

Grading Observation and Testing

1. Observation of the fill placement should be provided by our representative during grading. Verbal communication during the course of each day will be used to inform the contractor of test results. The contractor should receive a copy of the "Daily Field Report" indicating results of field density tests that day. If our representative does not provide the contractor with these reports, our office should be notified.
2. Testing and observation procedures are, by their nature, specific to the work or area observed and location of the tests taken, variability may occur in other locations. The contractor is responsible for the uniformity of the grading operations; our observations and test results are intended to evaluate the contractor's overall level of efforts during grading. The contractor's personnel are the only individuals participating in all aspects of site work. Compaction testing and observation should not be considered as relieving the contractor's responsibility to properly compact the fill.
3. Cleanouts, processed ground to receive fill, key excavations, and subdrains should be observed by our representative prior to placing any fill. It will be the contractor's responsibility to notify our representative or office when such areas are ready for observation.

4. Density tests may be done on the surface material to receive fill, as considered warranted by this firm.
5. In general, density tests would be made at maximum intervals of two feet of fill height, or every 1,000 cubic yards of fill placed. Criteria will vary depending on soil conditions and size of the fill. More frequent testing may be performed. In any case, an adequate number of field density tests should be made to evaluate the required compaction and moisture content is generally being obtained.
6. Laboratory testing to support field test procedures will be performed, as considered warranted, based on conditions encountered (e.g. change of material sources, types, etc.) Every effort will be made to process samples in the laboratory as quickly as possible and in progress construction projects are our first priority. However, laboratory workloads may cause delays and some soils may require a **minimum of 48 to 72 hours to complete test procedures**. Whenever possible, our representative(s) should be informed in advance of operational changes that might result in different source areas for materials.
7. Procedures for testing of fill slopes are as follows:
 - a) Density tests should be taken periodically during grading on the flat surface of the fill, three to five feet horizontally from the face of the slope.
 - b) If a method other than over building and cutting back to the compacted core is to be employed, slope compaction testing during construction should include testing the outer six inches to three feet in the slope face to determine if the required compaction is being achieved.
8. Finish grade testing of slopes and pad surfaces should be performed after construction is complete.

Site Clearing

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

Treatment of Existing Ground

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

Fill Placement

1. Unless otherwise indicated, all site soil and bedrock may be reused for compacted fill; however, some special processing or handling may be required (see text of report).
2. Material used in the compacting process should be evenly spread, moisture conditioned, processed, and compacted in thin lifts six (6) to eight (8) inches in compacted thickness to obtain a uniformly dense layer. The fill should be placed and compacted on a nearly horizontal plane, unless otherwise found acceptable by our representative.
3. If the moisture content or relative density varies from that recommended by this firm, the contractor should rework the fill until it is in accordance with the following:
 - a) The moisture content of the fill should be at or above optimum moisture. Moisture should be evenly distributed without wet and dry pockets. Pre-watering of cut or removal areas should be considered in addition to watering during fill placement, particularly in clay or dry surficial soils. The ability of the contractor to obtain the proper moisture content will control production rates.
 - b) Each six-inch layer should be compacted to at least 90 percent of the maximum dry density in compliance with the testing method specified by the controlling governmental agency. In most cases, the testing method is ASTM Test Designation D 1557.
4. Rock fragments less than eight inches in diameter may be utilized in the fill, provided:
 - a) They are not placed in concentrated pockets;
 - b) There is a sufficient percentage of fine-grained material to surround the rocks;
 - c) The distribution of the rocks is observed by, and acceptable to, our representative.

5. Rocks exceeding eight (8) inches in diameter should be taken off site, broken into smaller fragments, or placed in accordance with recommendations of this firm in areas designated suitable for rock disposal. On projects where significant large quantities of oversized materials are anticipated, alternate guidelines for placement may be included. If significant oversize materials are encountered during construction, these guidelines should be requested.
6. In clay soil, dry or large chunks or blocks are common. If in excess of eight (8) inches minimum dimension, then they are considered as oversized. Sheepsfoot compactors or other suitable methods should be used to break up blocks. When dry, they should be moisture conditioned to provide a uniform condition with the surrounding fill.

Slope Construction

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

UTILITY TRENCH CONSTRUCTION AND BACKFILL

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

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

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

The water should be allowed to dissipate prior to pouring slabs or completing trench compaction.

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

JOB SAFETY

General

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



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

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

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

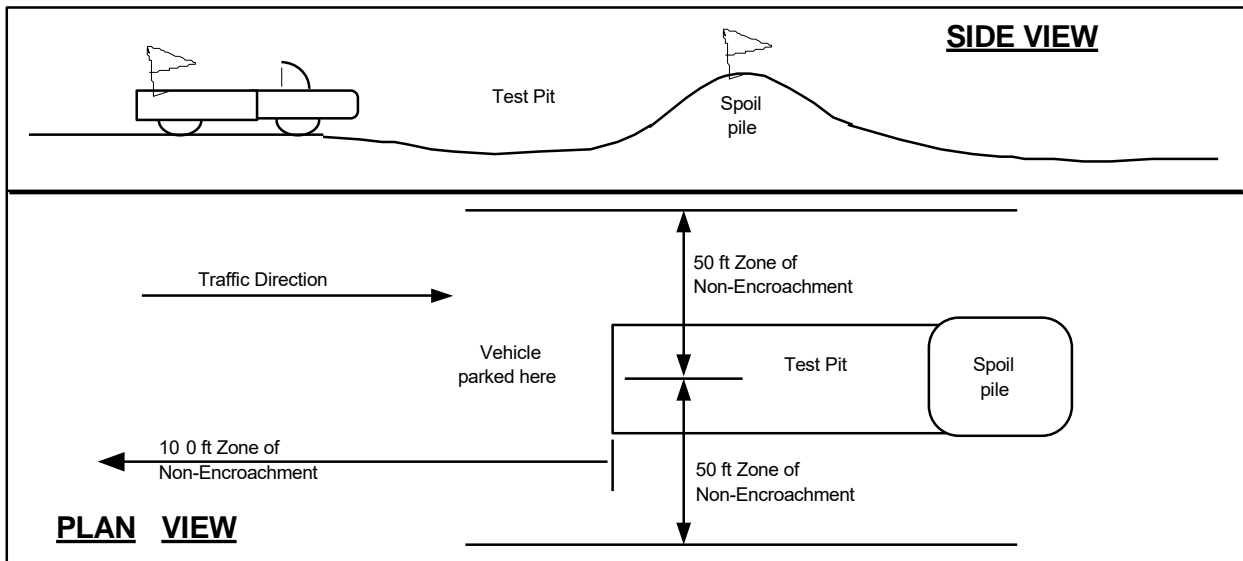
Test Pits Location, Orientation and Clearance

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

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

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

TEST PIT SAFETY PLAN



Slope Tests

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

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

Trench Safety

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

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

Our personnel are directed not to enter any excavation which;

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

4. displays any other evidence of any unsafe conditions regardless of depth.

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

Procedures

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

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

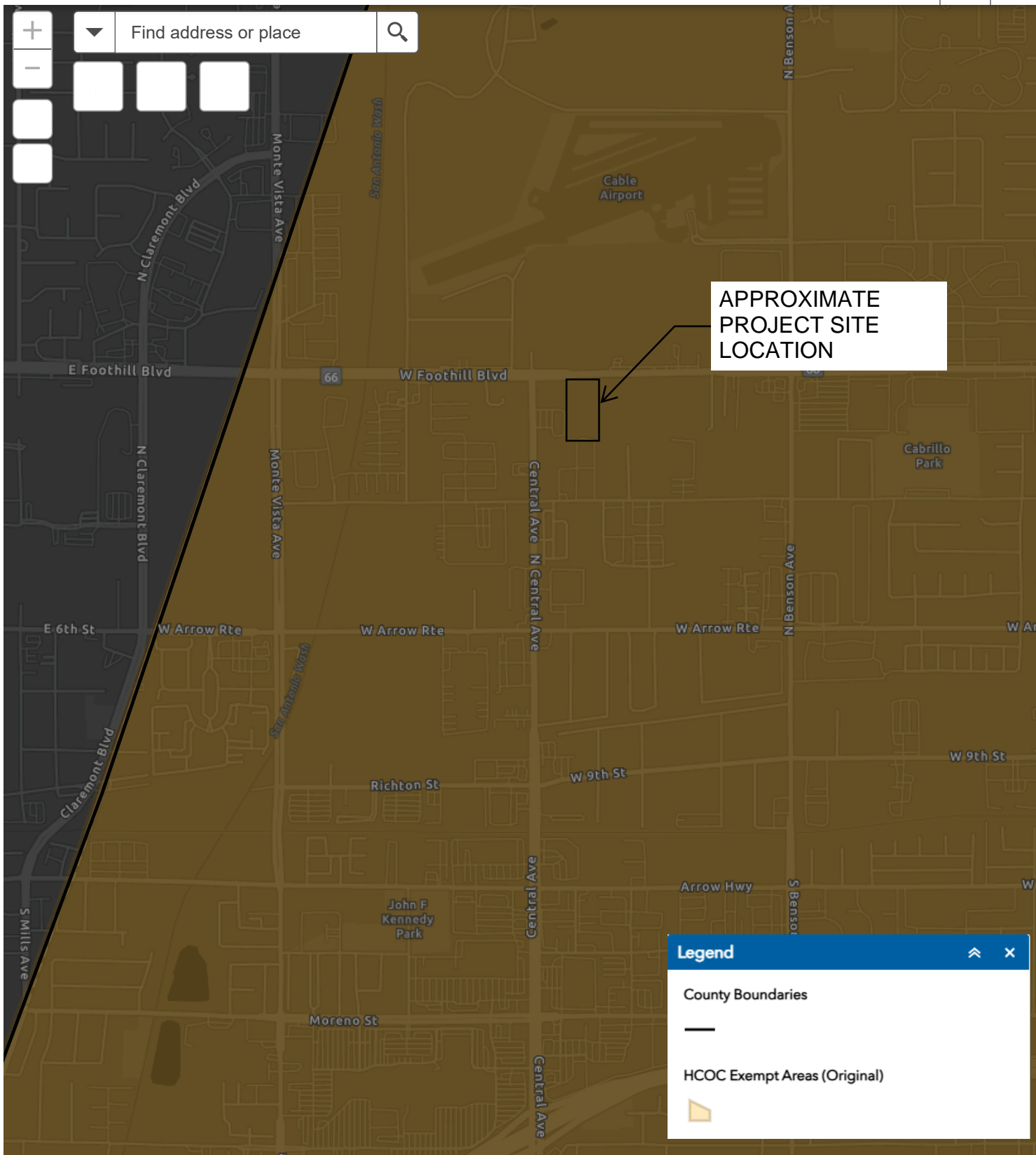
The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures, particularly the zone of non-encroachment.

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

6.7 Hydrologic Conditions of Concern



Stormwater Facility Mapping Tool



6.8 Education Materials

Education Materials will be provided during Final Engineering.

6.9 Vicinity Map



VICINITY MAP

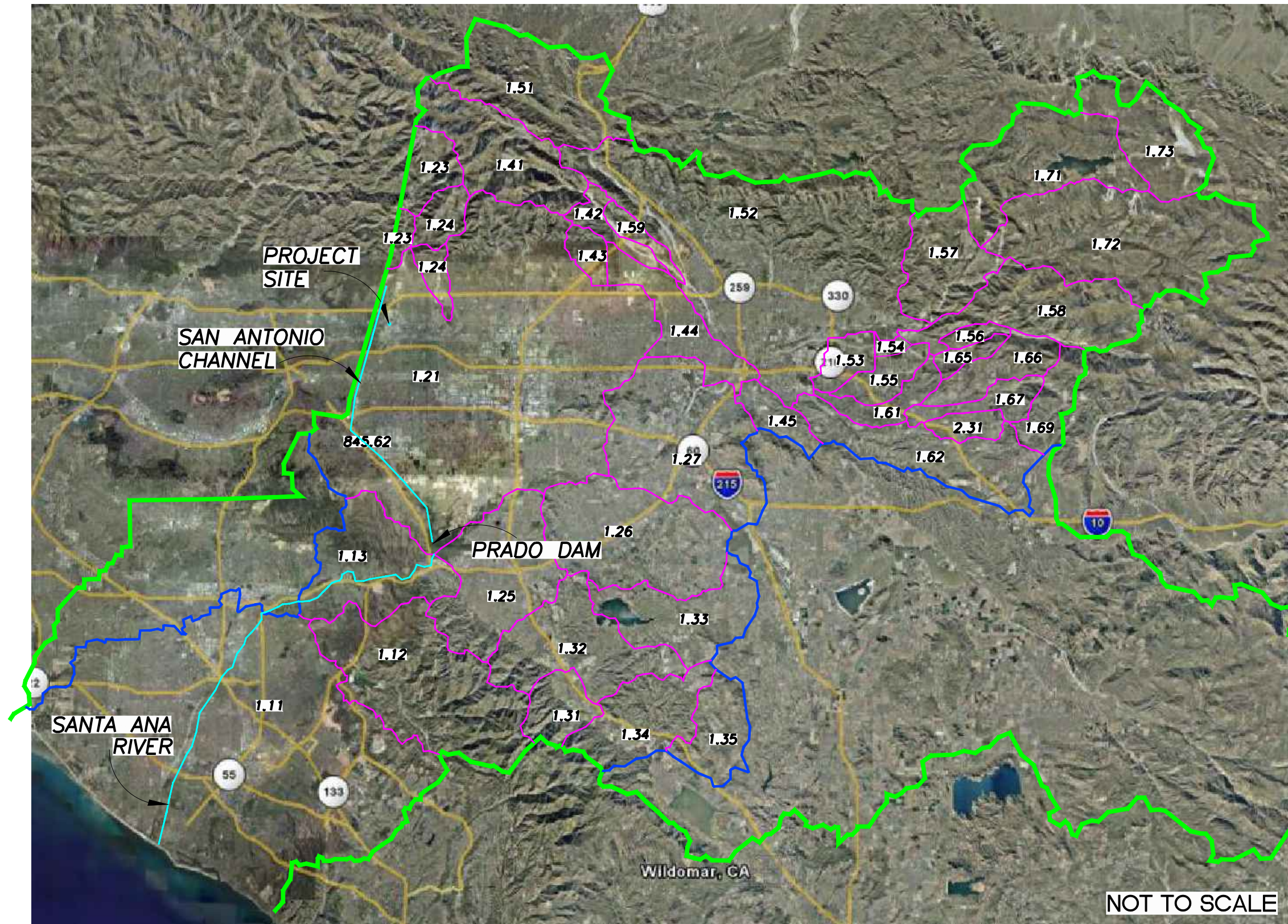
FIGURE 1



41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

6.10 Receiving Waters Map

Drawing Name: O:\320.05.25\Engineering\WQMP\6.10 - Receiving Waters Map\Figure 2--Receiving waters--Santa Ana.dwg
Last Opened: Apr 24, 2025 - 2:15pm by Sophie



BUFFALO GROVE RECEIVING WATERS MAP



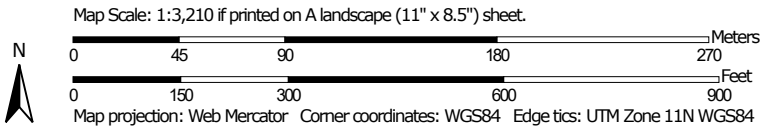
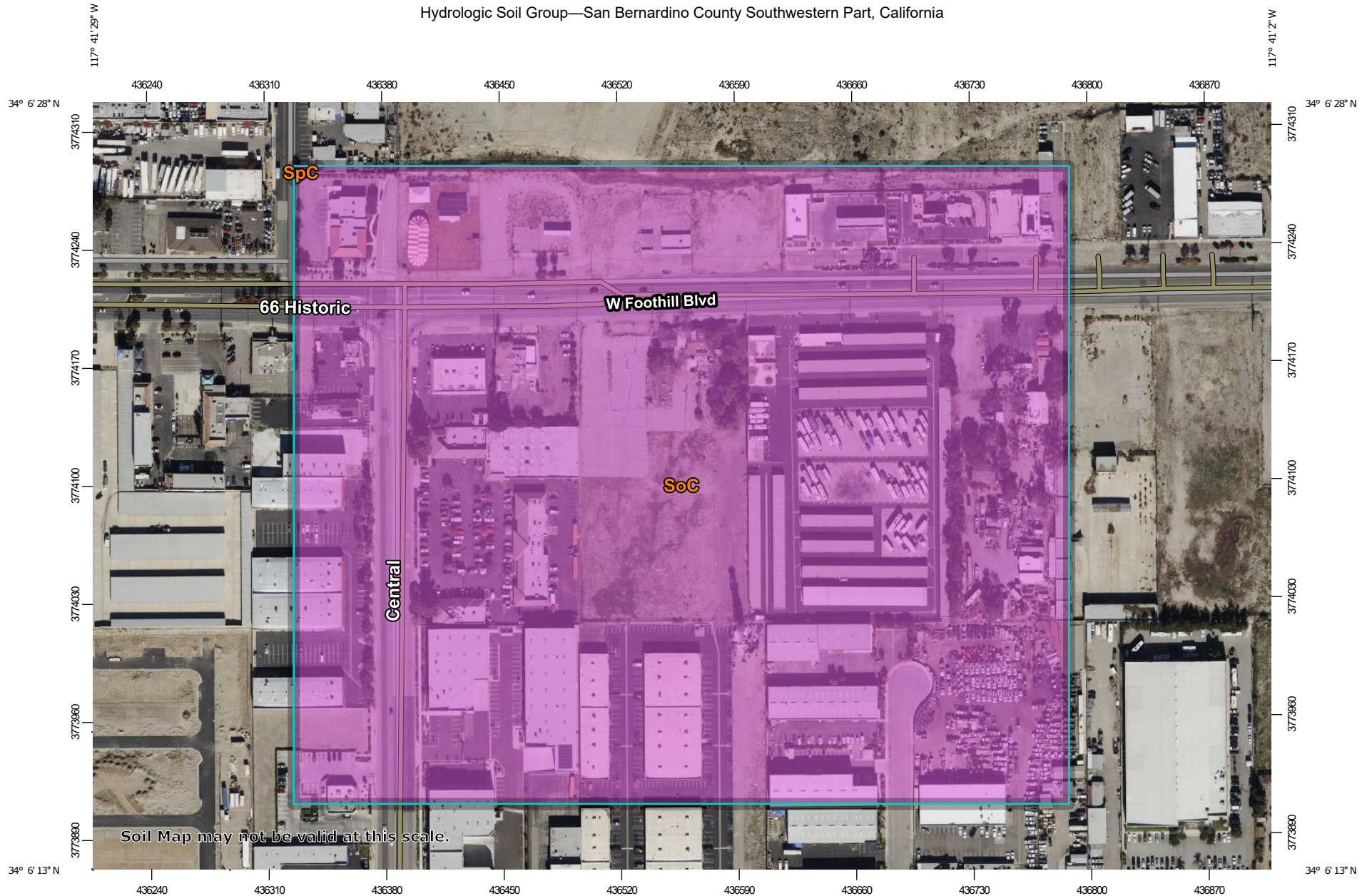
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

FIGURE 2

6.11 Improvement Plans


6.12 Hydrologic Soils Map

Hydrologic Soil Group—San Bernardino County Southwestern Part, California



MAP LEGEND

Area of Interest (AOI)









 Area of Interest (AOI)

Soils

Soil Rating Polygons





 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Lines


 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Points






 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: San Bernardino County Southwestern Part, California
 Survey Area Data: Version 16, Aug 30, 2024

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

Date(s) aerial images were photographed: Nov 20, 2022—Nov 25, 2022

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
SoC	Soboba gravelly loamy sand, 0 to 9 percent slopes	A	43.4	100.0%
SpC	Soboba stony loamy sand, 2 to 9 percent slopes	A	0.0	0.0%
Totals for Area of Interest			43.4	100.0%

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher