Preliminary

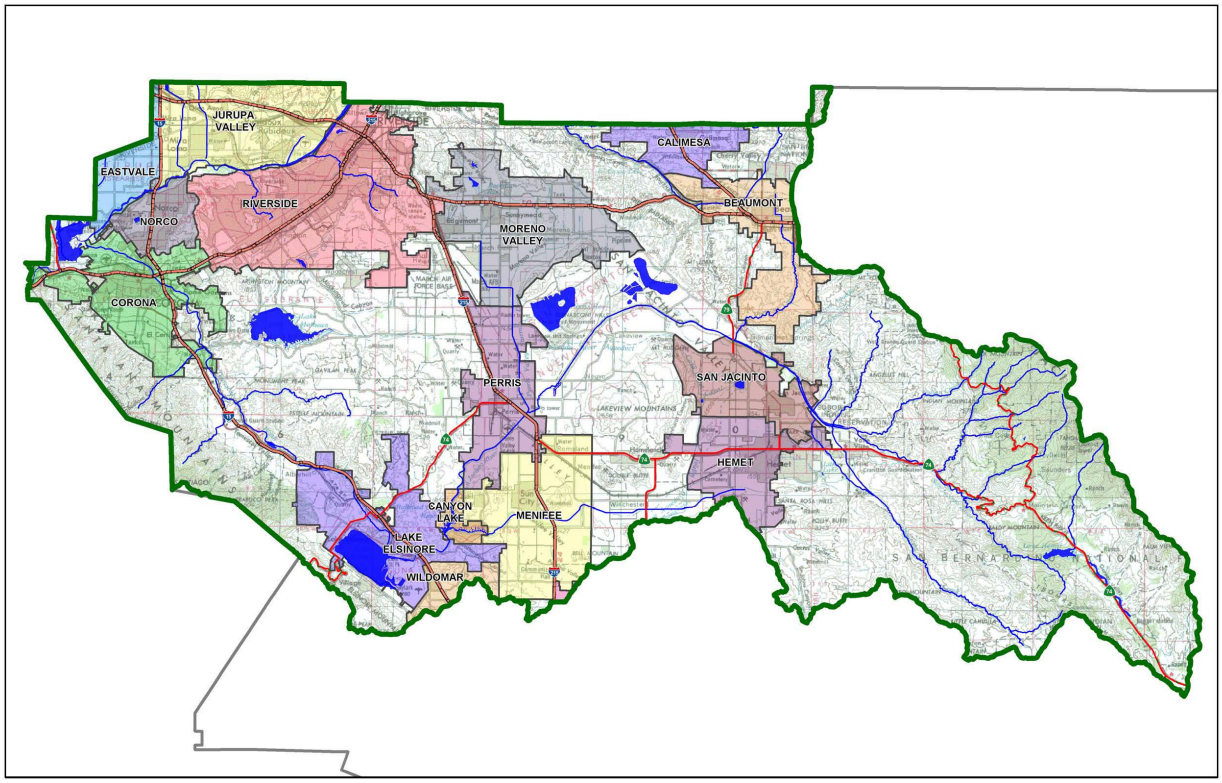
Project Specific Water Quality Management Plan

*Project Specific WQMP for Projects located within the **Santa Ana Watershed** Region of Riverside County*

Project Title: **51 SFR lots & 2 Lettered lots for Future Development**

Development No: **Tentative Tract No. 37558**

Design Review/Case No: **ZC20-001 and MP20-002 (TTM 37558)**



☒ **Preliminary**
☐ **Final**

Original Date Prepared: **01-27-2020**

Revision Date: **01-28-2021**

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

Contact Information:

Prepared for:
Mr. Shizao Zheng
1378 West Zhorgshan Road,
Ningbo City, Zhejiang Province, china

Prepared by:
Sikand Engineering Associates
15230 Burbank Blvd., Suite 100
Van Nuys CA 91411
(818)787-8550

OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for **Mr. Shizao Zheng** by **Sikand Engineering Associates** for the **TTM 37558** project.

This WQMP is intended to comply with the requirements of **County of Riverside** for **Order Number R8-2010-0033, NPDES Permit Number CAS618033** which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. In addition, the property owner accepts responsibility for interim operation and maintenance of Stormwater BMPs until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under **County of Riverside** Water Quality Ordinance (Municipal Code Section 754.2).

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

Owner's Signature

2/3/2021
Date

Shizao Zheng
Owner's Printed Name

Owner's Title/Position

PREPARER'S CERTIFICATION

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

Preparer's Signature

2-2-2021
Date

Doug Farmer, PE
Preparer's Printed Name

Supervising Project Engineer
Preparer's Title/Position

Preparer's Licensure:

REGISTERED PROFESSIONAL ENGINEER
DOUG FARMER
No.49041
Exp. 09-30-2022
CIVIL
STATE OF CALIFORNIA

Table of Contents

List of Tables

List of Appendices

Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	Residential Development
Planning Area:	
Community Name:	TTM 37558
Development Name:	51 SFR lots & 2 Lettered lots for Future Development
PROJECT LOCATION	
Latitude & Longitude (DMS): 33.760480, -116.952860	
Project Watershed and Sub-Watershed: San Jacinto River Basin	
Gross Acres: 14.1 ac	
APN(s): 439-230-005	
Map Book and Page No.: Rand McNally Road Atlas p.15, SK-14	
PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	Residential Dev't
Proposed or Potential SIC Code(s)	N/A
Area of Impervious Project Footprint (SF)	235,906 sf
Total Area of proposed Impervious Surfaces within the Project Footprint (SF)/or Replacement	235,906 sf
Does the project consist of offsite road improvements?	☐ Y ☒ N
Does the project propose to construct unpaved roads?	☐ Y ☒ N
Is the project part of a larger common plan of development (phased project)?	☐ Y ☒ N
EXISTING SITE CHARACTERISTICS	
Total area of existing Impervious Surfaces within the Project limits Footprint (SF)	0 sf
Is the project located within any MSHCP Criteria Cell?	☐ Y ☒ N
If so, identify the Cell number:	N/A
Are there any natural hydrologic features on the project site?	☐ Y ☒ N
Is a Geotechnical Report attached?	☒ Y ☐ N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)	
What is the Water Quality Design Storm Depth for the project?	D85=0.70 inch

A.1 Maps and Site Plans

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

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

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

A.2 Identify Receiving Waters

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

Table A.1 Identification of Receiving Waters

Receiving Waters	EPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
Buena Vista Basin	N/A	N/A	N/A
San Jacinto River Reach 3	◦ ***Warm Freshwater Habitat*** Arsenic, Bifenthrin, Cadmium, Chlordane, Chlorpyrifos, Chromium, Copper, Cyfluthrin, Cyhalothrin, Lambda, Cypermethrin, DDD (Dichlorodiphenyldichloroethane), DDE (Dichlorodiphenyldichloroethylene), DDT (Dichlorodiphenyltrichloroethane), Deltamethrin, Diazinon, Dieldrin, Endrin, Esfenvalerate/Fenvalerate, Fenpropathrin, Lead , Lindane/gamma Hexachlorocyclohexane (gamma-HCH), Mercury, Methyl Parathion, Nickel, PCBs (Polychlorinated biphenyls), Permethrin, total, Zinc ◦ ***Cold Freshwater Habitat*** Toxicity	AGR, GWR, REC1, REC2, WARM, WILD, RARE	29 mi
San Jacinto River Reach 1	Benthic Community Effects	MUN, AGR, GWR, REC1, REC2, WARM, WILD, RARE	38 mi

Table 3-1 BENEFICIAL USES - Continued

INLAND SURFACE STREAMS	BENEFICIAL USE																		Hydrologic Unit	
	MUN	AGR	IND	PROC	GWR	NAV	POW	REC1	REC2	COMM	WARM	LWRM	COLD	BIOL	WILD	RARE	SPWN	EST	Primary	Secondary
Reach 6 – Elsinore Groundwater Subbasin Boundary to Lake Elsinore Outlet	+				I			I	I		I				I				801.35	
Coldwater Canyon Creek	X	X			X			X	X		X				X		X		801.32	
Bedford Canyon Creek	+				I			I	I		I				I	X			801.32	
Dawson Canyon Creek	I				I			I	I		I				I				801.32	
Other Tributaries to these Creeks	I				I			I	I		I				I				801.32	
SAN JACINTO RIVER BASIN																				
San Jacinto River																				
Reach 1 – Lake Elsinore to Canyon Lake	I	I			I			I	I		I				I	X			801.32	802.31
Reach 2 – Canyon Lake (see Lakes Pg. 3-45)																				
Reach 3 – Canyon Lake to Nuevo Road	+	I			I			I	I		I				I	X			802.11	
Reach 4 – Nuevo Road to North-South Mid-Section Line, T4S/R1W-S8	+	I			I			I	I		I				I	X			802.21	802.21

X Existing or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

8	San Jacinto River Reach 3 (Canyon Lake (Railroad Canyon Reservoir) to Nuevo Road)	River & Stream	80211000 / 18070202	• Aquatic Life Support ◦ *Warm Freshwater Habitat* Arsenic, Bifenthrin, Cadmium, Chlordane, Chlorpyrifos, Chromium, Copper, Cyfluthrin, Cyhalothrin, Lambda, Cypermethrin, DDD (Dichlorodiphenyldichloroethane), DDE (Dichlorodiphenyldichloroethylene), DDT (Dichlorodiphenyltrichloroethane), Deltamethrin, Diazinon, Dieldrin, Endrin, Esfenvalerate/Fenvalerate, Fenpropathrin, Lead , Lindane/gamma Hexachlorocyclohexane (gamma-HCH), Mercury, Methyl Parathion, Nickel, PCBs (Polychlorinated biphenyls), Permethrin, total, Zinc ◦ *Cold Freshwater Habitat* Toxicity	9.6 Miles
8	San Jacinto River, Reach 1 (Lake Elsinore to Canyon Lake (Railroad Canyon Reservoir)	River & Stream	80231000 / 18070202	• Aquatic Life Support ◦ *Warm Freshwater Habitat* Benthic Community Effects	5.1 Miles

A.3 Additional Permits/Approvals required for the Project:

Table A.2 Other Applicable Permits

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

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

NOTE: All applicable permits will be included in the Final WQMP.

Section B: Optimize Site Utilization (LID Principles)

The 2010 Santa Ana MS4 Permit further requires that LID Retention BMPs (Infiltration Only or Harvest and Use) be used unless it can be shown that those BMPs are infeasible. Therefore, the project is proposing to use an infiltration basin as mitigation BMP.

Site Optimization

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

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

The proposed project is a full development of the entire site, which on its existing condition is vacant and with little vegetation. The only pattern that was preserved is the site drainage outlet pattern. The existing condition drains from southeast end to the northwest end of the property. Following this, the proposed condition is draining from southeast end to the northwest end of the property as well. Both conditions have drainage outlets at the northwest corner of site and along Girard Street. However, the landscaped lawn of each lot could be designed during the precise grading phase to include small depressions to encourage "micro" storage throughout the site.

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

The existing condition of the site shows little vegetation. There were no well-grown trees that are present in the site.

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

Yes. The proposed infiltration basin is located in a graded cut area, where the natural infiltration capacity is not tampered.

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

Yes. The proposed development's total impervious area (paved streets, sidewalks, driveways and roofs) is approximately less than 40% of the entire site. The remaining 60% are landscaped areas, slopes, and infiltration basin area.

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

Yes. Most of the runoffs that come from the roofs, and at some extent house driveways, are to be directed into the landscaped lawns within the lots; while most of the street and sidewalk runoffs are to be pickup and directed into the infiltration basin.

Section C: Delineate Drainage Management Areas (DMAs)

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

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s)[1][2]	Area (Sq. Ft.)	DMA Type
DMA 1	Residential development (Mixed roofs, landscape and paved surfaces)	614,196	"D"

[1]*Reference Table 2-1 in the WQMP Guidance Document to populate this column*
[2]*If multi-surface provide back-up*

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

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

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

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

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

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

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

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

DMA Name or ID	BMP Name or ID
DMA 1	BMP 1 (Infiltration Basin)

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

Section D: Implement LID BMPs

D.1 Infiltration Applicability

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

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

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

Geotechnical Report

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

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

Infiltration Feasibility

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

Table D.1 Infiltration Feasibility

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

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

D.2 Harvest and Use Assessment

Please check what applies*:*

☐ Reclaimed water will be used for the non-potable water demands for the project.

☐Downstream water rights may be impacted by Harvest and Use as approved by the Regional Board (verify with the Copermittee).

☒The Design Capture Volume will be addressed using Infiltration Only BMPs. In such a case, Harvest and Use BMPs are still encouraged, but it would not be required if the Design Capture Volume will be infiltrated or evapotranspired.

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

Irrigation Use Feasibility

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

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

Total Area of Irrigated Landscape: N/A

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

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

Total Area of Impervious Surfaces: N/A

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

Enter your EIATIA factor: N/A

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

Minimum required irrigated area: N/A

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

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

Toilet Use Feasibility

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

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

Projected Number of Daily Toilet Users: N/A

Project Type: Residential

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

Total Area of Impervious Surfaces: N/A

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

Enter your TUTIA factor: N/A

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

Minimum number of toilet users: N/A

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

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

Other Non-Potable Use Feasibility

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

N/A

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

Average Daily Demand: N/A

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

Total Area of Impervious Surfaces: N/A

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

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

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

Minimum required use: N/A

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

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

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

D.3 Bioretention and Biotreatment Assessment

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

Select one of the following:

☐ LID Bioretention/Biotreatment BMPs will be used for some or all DMAs of the project as noted below in Section D.4 (note the requirements of Section 3.4.2 in the WQMP Guidance Document).

☐ A site-specific analysis demonstrating the technical infeasibility of all LID BMPs has been performed and is included in Appendix 5. If you plan to submit an analysis demonstrating the technical infeasibility of LID BMPs, request a pre-submittal meeting with the Copermittee to discuss this option. Proceed to Section E to document your alternative compliance measures.

NOTE: This segment is Not Applicable since the project is proposing to use Infiltration Basin as the BMP.

D.4 Feasibility Assessment Summaries

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

Table D.2 LID Prioritization Summary Matrix

DMA Name/ID	LID BMP Hierarchy				No LID (Alternative Compliance)
	1. Infiltration	2. Harvest and use	3. Bioretention	4. Biotreatment	
DMA 1	☒	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

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

The project is already proposing the use Infiltration Basin as the BMP. This is the highest BMP based on the prioritization list, and considered the most appropriate for the site.

D.5 LID BMP Sizing

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

Table D.3 DCV Calculations for LID BMPs

DMA Type/ID	**DMA Area (square feet)**	**Post-Project Surface Type**	**Effective Impervious Fraction, I_f**	**DMA Runoff Factor**	**DMA Areas x Runoff Factor**	***Enter BMP Name / Identifier Here***		
	[A]		[B]	[C]	[A] x [C]			
Please See Calculations on Appendix 6								
See Summary Below								
						Design Storm Depth (in)	*Design Capture Volume,* $\mathbf{V_{BMP}}$ *(cubic feet)*	*Proposed Volume on Plans (cubic feet)*
	$A_T = \Sigma[A]$				$\Sigma = [D]$	[E]	$[F] = \frac{[D]x[E]}{12}$	[G]

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

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

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

DCV Calculation Summary:

DMA No. = DMA 1

BMP ID = BMP 1

BMP Type = Infiltration Basin

Design Capture Volume = 14,714 cu-ft

Proposed Volume = 30,275 cu-ft

Section E: Alternative Compliance (LID Waiver Program)

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

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

- *Or* -

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

N/A

E.1 Identify Pollutants of Concern

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

Table E.1 Potential Pollutants by Land Use Type

Priority Development Project Categories and/or Project Features (check those that apply)	General Pollutant Categories							
	Bacterial Indicators	Metals	Nutrients	Pesticides	Toxic Organic Compounds	Sediments	Trash & Debris	Oil & Grease
☒ Detached Residential Development	P	N	P	P	N	P	P	P
☐ Attached Residential Development	P	N	P	P	N	P	P	P(2)
☐ Commercial/Industrial Development	P(3)	P	P(1)	P(1)	P(5)	P(1)	P	P
☐ Automotive Repair Shops	N	P	N	N	P(4, 5)	N	P	P
☐ Restaurants (>5,000 ft^2)	P	N	N	N	N	N	P	P
☐ Hillside Development (>5,000 ft^2)	P	N	P	P	N	P	P	P
☐ Parking Lots (>5,000 ft^2)	P(6)	P	P(1)	P(1)	P(4)	P(1)	P	P
☐ Retail Gasoline Outlets	N	P	N	N	P	N	P	P
Project Priority Pollutant(s) of Concern	☒	☐	☒	☒	☐	☒	☒	☒

P = Potential

N = Not Potential

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

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

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

(4) Specifically petroleum hydrocarbons

(5) Specifically solvents

(6) Bacterial indicators are routinely detected in pavement runoff

E.2 Stormwater Credits

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

Table E.2 Water Quality Credits

Qualifying Project Categories	Credit Percentage[2]
N/A	
Total Credit Percentage[1]	

[1]*Cannot Exceed 50%*
[2]*Obtain corresponding data from Table 3-8 in the WQMP Guidance Document*

E.3 Sizing Criteria

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

Table E.3 Treatment Control BMP Sizing

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

[B], [C] is obtained as described in Section 2.3.1 from the WQMP Guidance Document
[E] is for Flow-Based Treatment Control BMPs [E] = .2, for Volume-Based Control Treatment BMPs, [E] obtained from Exhibit A in the WQMP Guidance Document
[G] is for Flow-Based Treatment Control BMPs [G] = 43,560, for Volume-Based Control Treatment BMPs, [G] = 12
[H] is from the Total Credit Percentage as Calculated from Table E.2 above
[I] as obtained from a design procedure sheet from the BMP manufacturer and should be included in Appendix 6

E.4 Treatment Control BMP Selection

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

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

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

Table E.4 Treatment Control BMP Selection

Selected Treatment Control BMP Name or ID[1]	Priority Pollutant(s) of Concern to Mitigate[2]	Removal Efficiency Percentage[3]
BMP1: Infiltration Basin	Phosphorus, Toxicity	High

[1] Treatment Control BMPs must not be constructed within Receiving Waters. In addition, a proposed Treatment Control BMP may be listed more than once if they possess more than one qualifying pollutant removal efficiency.
[2] Cross Reference Table E.1 above to populate this column.
[3] As documented in a Co-Permittee Approved Study and provided in Appendix 6.

Section F: Hydromodification

F.1 Hydrologic Conditions of Concern (HCOC) Analysis

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

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

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

If Yes, HCOC criteria do not apply.

HCOC EXEMPTION 2: The volume and time of concentration[1] of storm water runoff for the post-development condition is not significantly different from the pre-development condition for a 2-year return frequency storm (a difference of 5% or less is considered insignificant) using one of the following methods to calculate:

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

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

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

Table F.1 Hydrologic Conditions of Concern Summary

	2 year – 24 hour		
	Pre-condition	**Post-condition**	**% Difference**
Time of Concentration	22.35	16.01	28%
Volume (Cubic Feet)	13,047	37,832	66%

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

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

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

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

N/A

F.2 HCOC Mitigation

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

a. Additional LID BMPS are implemented onsite or offsite to mitigate potential erosion or habitat impacts as a result of HCOCs. This can be conducted by an evaluation of site-specific conditions utilizing accepted professional methodologies published by entities such as the California Stormwater Quality Association (CASQA), the Southern California Coastal Water Research Project (SCCRWP), or other Co-Permittee approved methodologies for site-specific HCOC analysis.

b. The project is developed consistent with an approved Watershed Action Plan that addresses HCOC in Receiving Waters.

c. Mimicking the pre-development hydrograph with the post-development hydrograph, for a 2-year return frequency storm. Generally, the hydrologic conditions of concern are not significant, if the post-development hydrograph is no more than 10% greater than pre-development hydrograph. In cases where excess volume cannot be infiltrated or captured and reused, discharge from the site must be limited to a flow rate no greater than 110% of the pre-development 2-year peak flow.

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

NOTE: The Difference in volume for 2-yr, 24-hour storm pre- and post-development is 24,785 cu-ft. The total retention capacity of the proposed basin is 35,018 cu-ft. Therefore, the site has sufficient room to infiltrate the excess volume. In addition, the basin at maximum level depth of 5.9' and capacity of 39,119 cu-ft, only releases flow of 2.7 cfs. This proposed flow is less than the existing condition flow of 6.49 cfs.

Section G: Source Control BMPs

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

1. ***Identify Pollutant Sources*:** Review Column 1 in the Pollutant Sources/Source Control Checklist. Check off the potential sources of Pollutants that apply to your site.

2. ***Note Locations on Project-Specific WQMP Exhibit*:** Note the corresponding requirements listed in Column 2 of the Pollutant Sources/Source Control Checklist. Show the location of each Pollutant source and each permanent Source Control BMP in your Project-Specific WQMP Exhibit located in Appendix 1.

3. ***Prepare a Table and Narrative*:** Check off the corresponding requirements listed in Column 3 in the Pollutant Sources/Source Control Checklist. In the left column of Table G.1 below, list each potential source of runoff Pollutants on your site (from those that you checked in the Pollutant Sources/Source Control Checklist). In the middle column, list the corresponding permanent, Structural Source Control BMPs (from Columns 2 and 3 of the Pollutant Sources/Source Control Checklist) used to prevent Pollutants from entering runoff. **Add additional narrative** in this column that explains any special features, materials or methods of construction that will be used to implement these permanent, Structural Source Control BMPs.

4. ***Identify Operational Source Control BMPs:*** To complete your table, refer once again to the Pollutant Sources/Source Control Checklist. List in the right column of your table the Operational BMPs that should be implemented as long as the anticipated activities continue at the site. Copermittee stormwater ordinances require that applicable Source Control BMPs be implemented; the same BMPs may also be required as a condition of a use permit or other revocable Discretionary Approval for use of the site.

Table G.1 Permanent and Operational Source Control Measures

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
On-site Storm Drain Inlets	Mark all inlets with the words, "Only Rain Down the Storm Drain" or similar.	Maintain and periodically repair or replace inlet markings. Provide stormwater pollution prevention information to new site owners.
Interior parking garages	Parking garage floor drains will be plumbed to the sanitary sewer.	Inspect and maintain drains to prevent blockages and overflow.
Landscape/Outdoor Pesticide use	Final landscape plan will accomplish: Preserve existing trees and ground covers, minimize irrigation, minimize use of fertilizers and pesticides, use pest-resistant plants, and proper choice of plants to use.	Maintain landscaping using minimum or no pesticides.

Section H: Construction Plan Checklist

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

Table H.1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)	BMP Location (Lat/Long)
BMP 1	Infiltration Basin	In Final WQMP	

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

Section I: Operation, Maintenance and Funding

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

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

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

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

Maintenance Mechanism: *The proposed BMP, Infiltration Basin, will be constructed by the developer and the HOA will have ongoing maintenance responsibilities.*

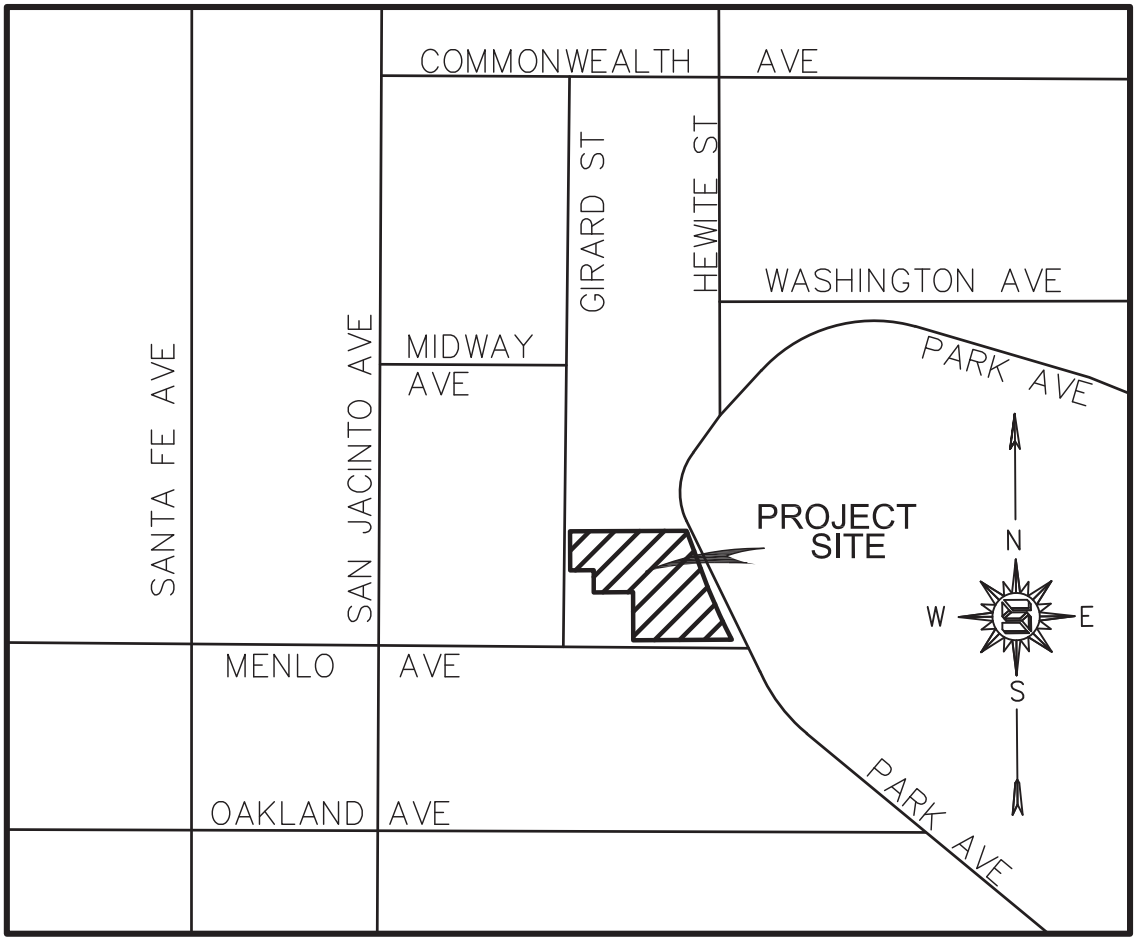
Will the proposed BMPs be maintained by a Home Owners' Association (HOA) or Property Owners Association (POA)?

☒ Y ☐ N

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

Appendix 1: Maps and Site Plans

Location Map, WQMP Site Plan and Receiving Waters Map



VICINITY MAP

NOT TO SCALE

Aerial Map

NTS

Latitude and Longitude Finder

Latitude and Longitude are the units that represent the *coordinates at geographic coordinate system*. To make a search, use the name of a place, city, state, or address, or click the location on the map to **find lat long coordinates**.

Place Name

800 N Girard Hemet Ca

Find

Add the country code for better results. Ex: London, UK

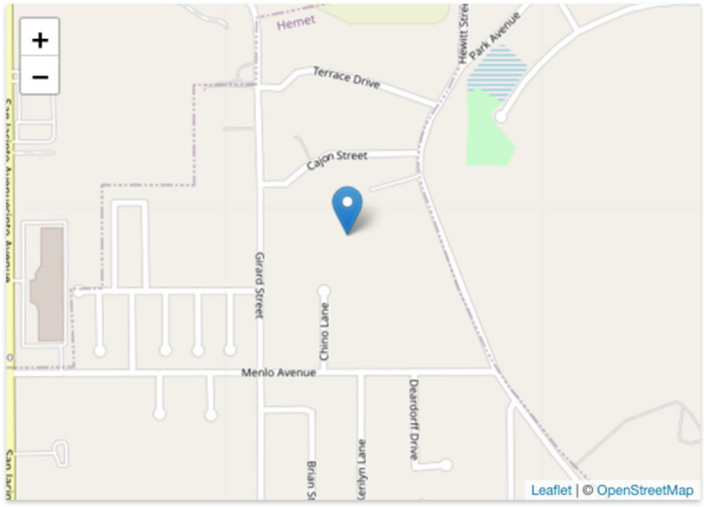
Latitude

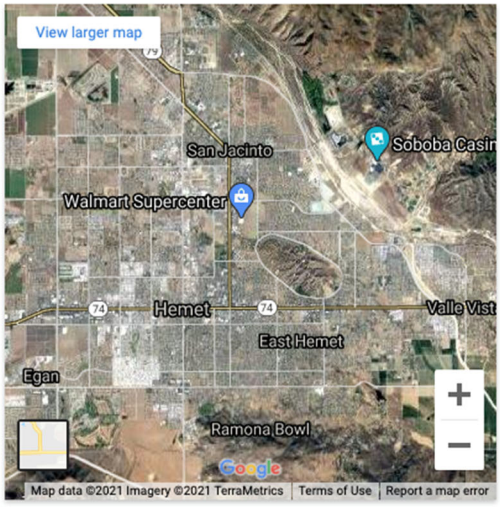
33.760480

Longitude

-116.952860

For better accuracy please type Name Address City State Zipcode.





Lat Long	GPS Coordinates
(33.760480, -116.952860)	33° 45' 37.728'' N 116° 57' 10.296'' W

Final 2014/2016 California Integrated Report (Clean Water Act Section 303(d) List / 305(b) Report)

2014 and 2016 Integrated Report | Map | 303(d) List | References | Data Download | Contact Us

2014 AND 2016 INTEGRATED REPORT — ALL ASSESSED WATERS

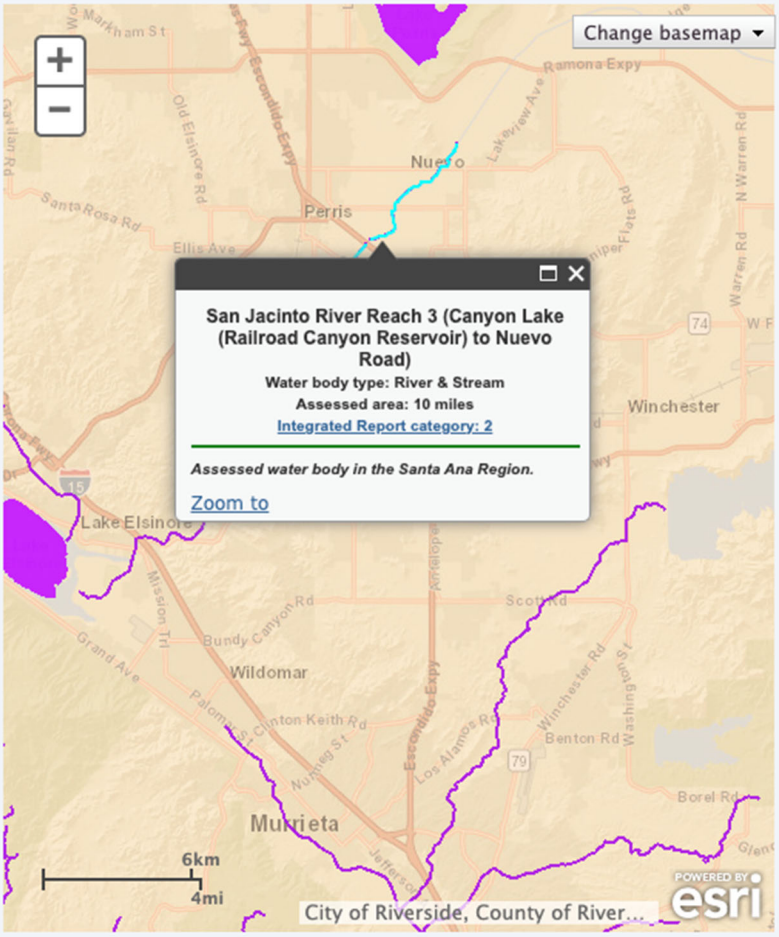
Zoom to county: Riverside — Show county

Zoom to Regional Board: All — Show Regional Board

Map Help

Zoom to water body: *(Filter: All)*

Filter list by: | Reset list



San Jacinto River Reach 3 (Canyon Lake (Railroad Canyon Reservoir) to Nuevo Road) Close

Pollutant assessments

Pollutants	Listing Decision	Report Link	Potential Sources	Schedule	*Comments*
Arsenic	Do Not List on 303(d) list (TMDL required list)	65164	n/a		
Bifenthrin	Do Not List on 303(d) list (TMDL required list)	65165	n/a		
Cadmium	Do Not List on 303(d) list (TMDL required list)	65166	n/a		

Final 2014/2016 California Integrated Report (Clean Water Act Section 303(d) List / 305(b) Report)

2014 and 2016 Integrated Report | Map | 303(d) List | References | Data Download | Contact Us

2014 AND 2016 INTEGRATED REPORT — ALL ASSESSED WATERS

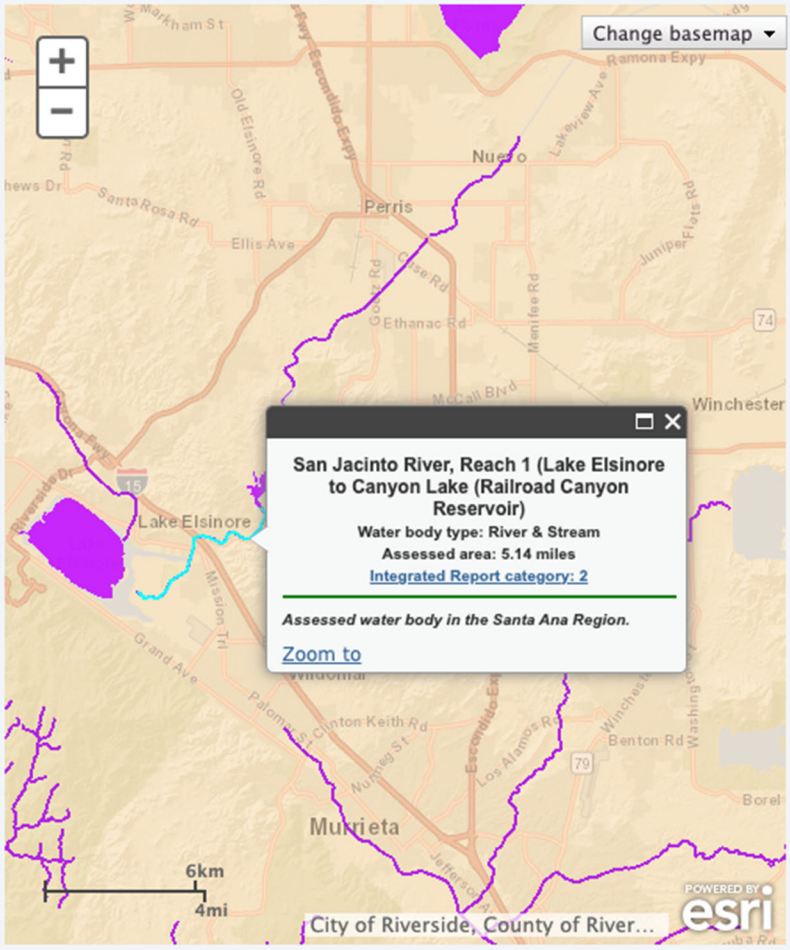
Zoom to county: Riverside — Show county

Zoom to Regional Board: All — Show Regional Board

Map Help

Zoom to water body: *(Filter: All)*

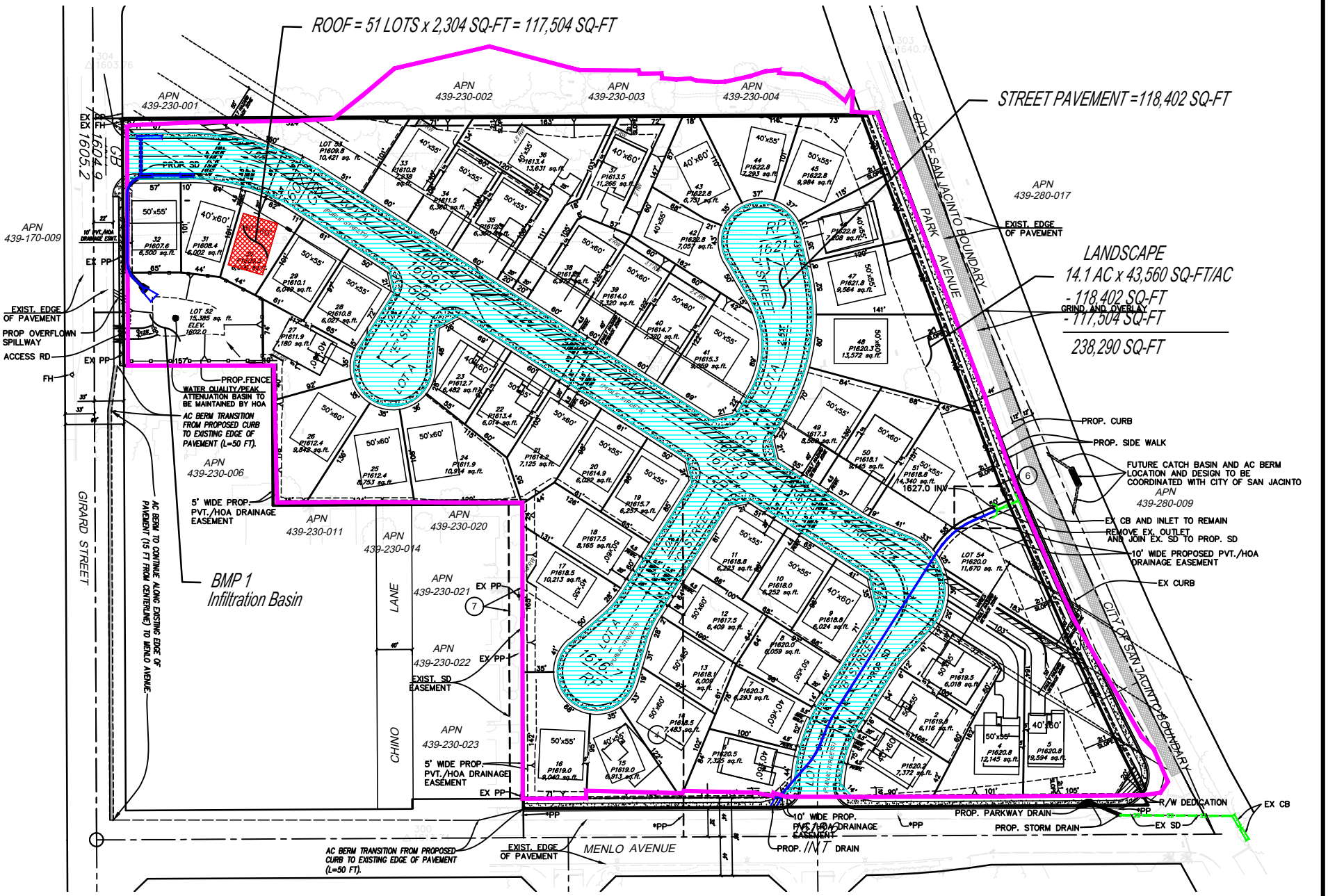
Filter list by: | Reset list



San Jacinto River, Reach 1 (Lake Elsinore to Canyon Lake (Railroad Canyon Reservoir) Close

Pollutant assessments

Pollutants	Listing Decision	Do Not List on 303(d) list (TMDL required list)
	Report Link	65472
	Potential Sources	n/a
	Schedule	
	Comments	
Benthic Community Effects		

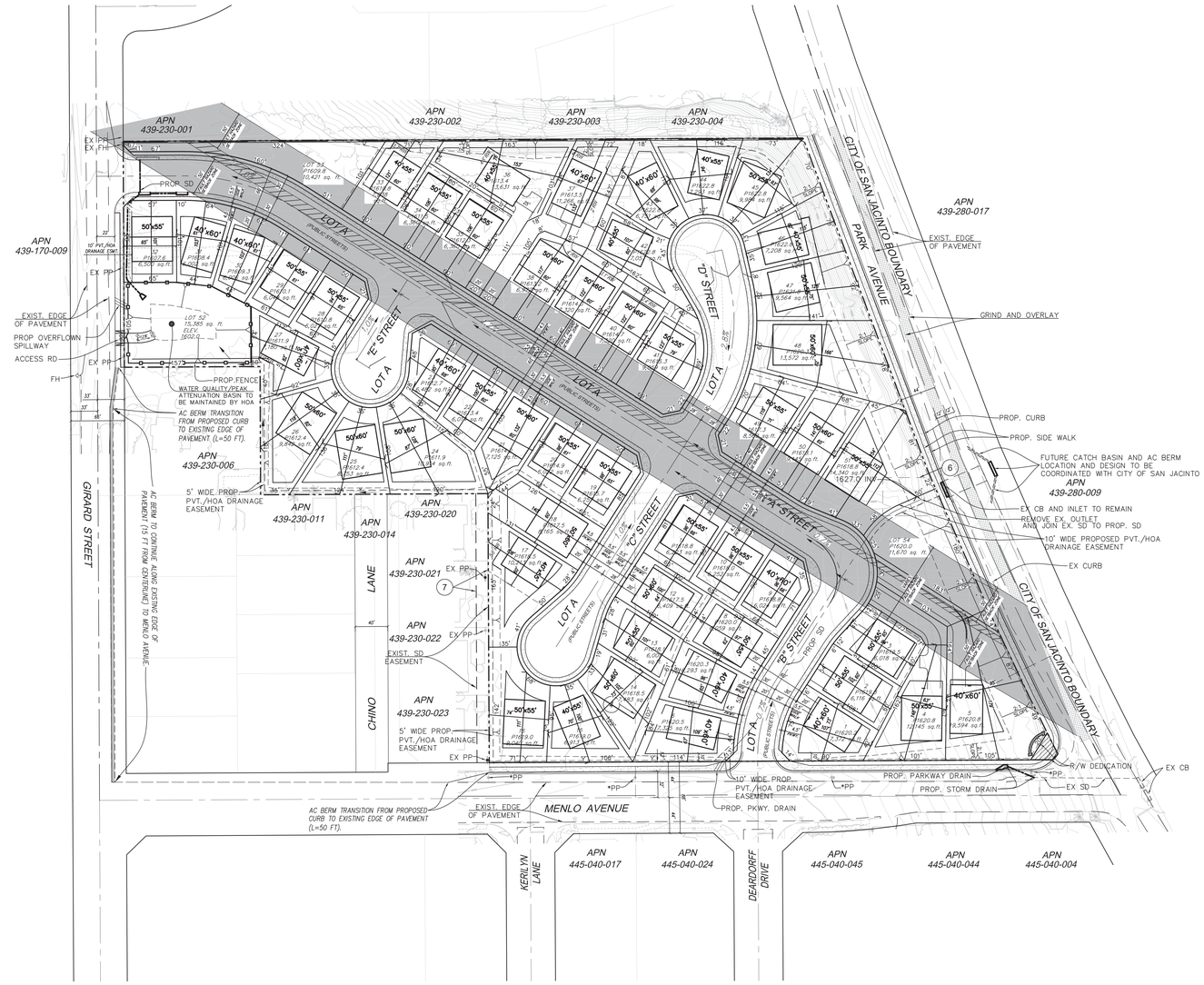


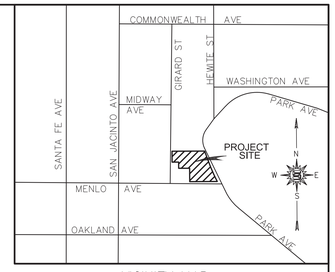
P-WQMP EXHIBIT MAP

TTM 37558 (APN 439-230-005)
IN THE CITY OF HEMET, RIVERSIDE COUNTY

NORTH
SCALE: 1"=150'

SHEET 1 OF 1 SHEET





VICINITY MAP
NOT TO SCALE

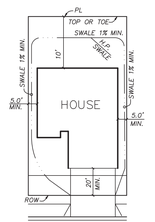
GENERAL NOTES:

1. PROJECT SHALL COMPLY WITH GENERAL REQUIREMENTS FOR NEW DEVELOPMENT PROJECTS IN THE SINGLE FAMILY RESIDENTIAL ZONES SECTION 90-314.
2. PROJECT SHALL COMPLY WITH SITE DEVELOPMENT REQUIREMENTS FOR SINGLE FAMILY HOMES SECTION 90-315.
3. PARKING SHALL COMPLY WITH SECTION 90-1423, 2 SPACES IN GARAGE.
4. LANDSCAPING SHALL BE DROUGHT TOLLERANT AND PER SECTION 90-317 AND ARTICLE XLVIII .
5. LANDSCAPE IMPROVEMENTS WITHIN THE PUBLIC PARKWAY SHALL INCLUDE CLEARING AND GRUBBING, NEW PLANTING AND IRRIGATION.
6. PUBLIC STREET LIGHTS SHALL BE PROVIDED ALONG PROJECT FRONTAGE.
7. COMMON SPACES AND FACILITIES WITHIN TRACT BOUNDARIES SHALL BE MAINTAINED BY HOA.
8. CUL-DE-SACS SHALL BE DESIGNED PER RIVERSIDE COUNTY STANDARD PLAN 800 OR 800A.
9. HOUSES SHOWN ON SOME LOTS ARE EXAMPLES ONLY TO SHOW A POSSIBLE FIT.
10. GRADING IS APPROXIMATE ONLY AND SUBJECT TO THE SATISFACTION OF THE PLANNING DEPARTMENT AND PUBLIC WORKS DEPARTMENT.
11. ASSESSOR PARCEL MAP NO. 439-230-005.
12. TOPOGRAPHIC MAPPING BY CALVADA, 1 FT CONTOUR INTERVAL. (APRIL 2018)
13. REQUEST PERMISSION TO ADJUST LOT LINES TO THE SATISFACTION OF THE PLANNING DEPARTMENT AND PUBLIC WORKS DEPARTMENT.
14. R.W. = RETAINING WALL.
15. REQUEST PERMISSION TO CREATE ADDITIONAL OPEN SPACE AND PRIVATE DRIVEWAY LOTS TO THE SATISFACTION OF THE PLANNING DEPARTMENT AND PUBLIC WORKS DEPARTMENT.
16. BOUNDARY LINE DIMENSIONS ARE TAKEN FROM RECORD DATA.
17. TOPS AND TOES OF SLOPES ARE SUBJECT TO CHANGE IN FINAL ENGINEERING.
18. MAXIMUM SLOPE GRADE IS 2:1 FOR ALL SLOPES.
19. A LANDSCAPE MAINTENANCE DISTRICT OR HOMEOWNERS ASSOCIATION WILL BE ESTABLISHED FOR MAINTENANCE OF OPEN SPACE AREAS AND ALL COMMON SLOPE AREAS.
20. ALL SLOPES WITHIN HOMEOWNER'S ASSOCIATION COMMON AREAS OR LANDSCAPE MAINTENANCE DISTRICTS ARE TO BE PLANTED AND IRRIGATED WITH CITY APPROVED MATERIAL.
21. FUTURE CORNER NEIGHBORHOOD MONUMENT ( ) WILL BE REVIEWED BY THE PLANNING DEPARTMENT DURING FINAL ENGINEERING AND SUBJECT TO ALL APPLICABLE ORDINANCES FOR MONUMENTS IN THE CITY OF HEMET JURISDICTION.
22. REQUEST PERMISSION TO PHASE GRADING TO THE SATISFACTION OF THE PLANNING DEPARTMENT AND PUBLIC WORKS DEPARTMENT. ALL GRADING TO BALANCE ON SITE.
23. ALL OPEN SPACE LOTS TO BE DESIGNATED AS RESTRICTED USE AREAS-OPEN SPACE.
24. THE DEVELOPER/ENGINEER ACKNOWLEDGE THAT THE SIZE OF THE WATER QUALITY BASIN WILL BE REVIEWED AT THE IMPROVEMENT PLAN STAGE. SIGNIFICANT CHANGE OF THE SIZE OF THE BASIN FROM WHAT IS SHOWN ON THE TENTATIVE MAP MAY RESULT IN REVISING PLANNING DOCUMENTS BY PLANNING DEPARTMENT.
25. REQUEST PERMISSION TO ADJUST PAD ELEVATIONS BY UP TO 10' TO ACCOMMODATE GRADING BALANCE (IF REQUIRED FOR GRADING BALANCE).

LOT SUMMARY TABLE:

LOT NO.	GROSS AREA (sq.ft.)	NET AREA (sq.ft.)	FRONTAGE (ft)
1	7,372	7,372	91
2	6,116	6,116	60
3	6,018	6,018	65
4	12,145	12,145	29
5	19,594	18,375	36
6	7,325	7,325	44
7	6,293	6,293	52
8	6,059	6,059	59
9	6,024	6,024	41
10	6,252	6,252	65
11	6,223	6,223	51
12	6,409	6,409	64
13	6,009	6,009	61
14	7,483	7,483	52
15	6,913	6,913	35
16	9,040	9,040	68
17	10,213	10,213	123
18	8,165	8,165	60
19	6,257	6,257	50
20	6,022	6,022	61
21	7,125	7,125	60
22	6,014	6,014	60
23	6,482	6,482	69
24	10,914	10,914	36
25	8,753	8,753	35
26	9,842	9,842	35
27	7,180	7,180	35
28	6,027	6,027	50
29	6,049	6,049	61
30	6,006	6,006	73
31	6,002	6,002	74
32	6,500	6,500	57
33	7,238	7,238	60
34	6,360	6,360	60
35	6,360	6,360	60
36	13,631	13,631	20
37	11,266	11,266	20
38	6,972	6,972	60
39	7,320	7,320	60
40	7,230	7,320	60
41	9,059	9,059	69
42	7,057	7,057	108
43	6,751	6,751	35
44	7,293	7,293	37
45	9,984	9,984	37
46	7,208	7,208	48
47	9,564	9,564	60
48	13,572	13,572	60
49	8,569	8,569	55
50	9,145	9,145	64
51	14,340	14,340	83
52*	15,385	15,385	105
53**	10,421	10,020	289
54**	11,670	11,670	25
A***	130,700	130,700	N/A

* - WATER QUALITY BASIN
** - OPEN SPACE
*** - PUBLIC STREET



TYPICAL LOT DRAINAGE
NO SCALE

PROJECT SUMMARY:

EXISTING ZONING:	R2, (MULTI-FAMILY DESIGNATION)
PROPOSED ZONING:	R-1-6, (SINGLE-FAMILY DESIGNATION)
EXISTING GENERAL PLAN DESIGNATION:	LMDR (LOW MEDIUM DENSITY RESIDENTIAL)
PROPOSED GENERAL PLAN DESIGNATION:	LMDR (LOW MEDIUM DENSITY RESIDENTIAL)
TOTAL NUMBER OF LOTS	51 RESIDENTIAL, 1 WATER QUALITY BASIN AND 2 OPEN SPACE LOTS
EXISTING LAND USE:	VACANT
PROPOSED LAND USE:	SINGLE FAMILY RESIDENTIAL

UTILITIES AND SERVICES:

WATER:*	LAKE HEMET MUNICIPAL WATER DISTRICT
SEWER:	LAKE HEMET MUNICIPAL WATER DISTRICT
GAS:	SOUTHERN CALIFORNIA GAS COMPANY
ELECTRIC:	SOUTHERN CALIFORNIA EDISON
STORM DRAIN:	CITY OF HEMET

* NOTE: A FEASIBILITY STUDY BETWEEN EASTERN MUNICIPAL WATER DISTRICT AND LAKE HEMET MUNICIPAL WATER DISTRICT IS IN PROCESS. THE STUDY WILL EVALUATE THE FEASIBILITY FOR ADDITIONAL WATER TO BE SUPPLIED TO LHMWD IN ORDER FOR THE PROJECT TO QUALIFY AS AN EXEMPTION TO ORDINANCE NO. 176.

EASEMENT TABLE:

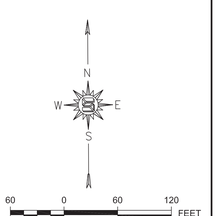
ITEM #	FIRST AMERICAN TITLE COMPANY ORDER NO. NHSC – 6071963 (tc) DATED OCTOBER 10, 2019	STATUS
3	AN EASEMENT FOR PIPELINES AND INCIDENTAL PURPOSES, RECORDED MAY 17, 1909 IN BOOK 283, PAGE 268 OF DEEDS.	BLANKET IN NATURE
4	AN EASEMENT FOR POLE LINES AND INCIDENTAL PURPOSES, RECORDED FEBRUARY 27, 1952 IN BOOK 1345, PAGE 40 OF OFFICIAL RECORDS.	TO BE VACATED
6	AN EASEMENT FOR DRAINAGE EASEMENT AND INCIDENTAL PURPOSES, RECORDED SEPTEMBER 10, 1996 AS INSTRUMENT NO. 96-342523 OF OFFICIAL RECORDS.	TO BE VACATED
7	AN EASEMENT FOR TEMPORARY CONSTRUCTION EASEMENT AND INCIDENTAL PURPOSES, RECORDED SEPTEMBER 10, 1996 AS INSTRUMENT NO. 96-342524 OF OFFICIAL RECORDS.	TO REMAIN, OUTSIDE TRACT BOUNDARY

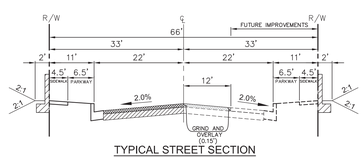
EARTHWORK QUANTITIES:

CUT = 34,500 C.Y.
FILL = 34,500 C.Y.
(TO BE BALANCED ON SITE)

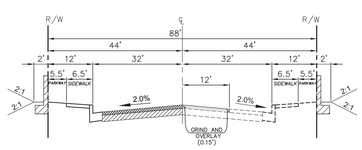
LEGEND:

- EX PP
- EX FH
- *PP EX PP TO BE REMOVED AND UTILITIES TO BE UNDERGROUND
- EX SD
- PROP SD
- EX CB
- PROP CB
- SD EASEMENT
- FENCE



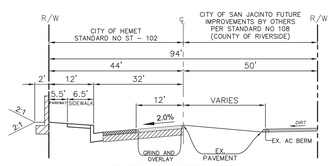


TYPICAL STREET SECTION
(STANDARD. NO. ST-103)
GIRARD STREET
N.T.S.

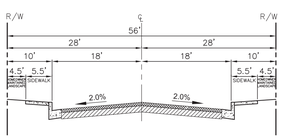


NOTE: BOTH SIDES OF MENLO SHALL BE STRIPED TO INCLUDE CLASS II BIKEWAY

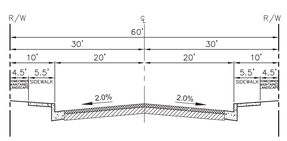
TYPICAL STREET SECTION
(STANDARD. NO. ST-102)
MENLO AVENUE
N.T.S.



TYPICAL STREET SECTION
PARK AVENUE
N.T.S.



TYPICAL STREET SECTION
(STANDARD. NO. ST-106)
"C", "D" & "E" STREET
N.T.S.



TYPICAL STREET SECTION
(STANDARD. NO. ST-104)
"A"& "B" STREET
N.T.S.

PREPARED FOR:

Mr. Zheng

1378 West Zhorgshan Road
Ningbo City, Zhejiang Provence

NO.	REVISIONS	REVISED BY	APPROVED BY	DATE

REGISTERED PROFESSIONAL ENGINEER CRAIG YOUNG NO.32363 EXP.12-31-20 CIVIL STATE OF CALIFORNIA

PROJECT ENGINEER DATE

PREPARED BY:

SIKAND
Engineering | Planning | Surveying

15230 Burbank Blvd,
Van Nuys, CA 91411
Tel: (818) 787-8550
Fax: (818) 901-7451
info@sikand.com

VESTING TENTATIVE TRACT 37558

DATE : 09-09-2020
DRAWING NO. : 5118 – 007
SHEET NUMBER: 1 OF 1 SHEETS
SCALE: 1"=60'

X:\Civil3D\5118-007\Tentative Maps\Preliminary Site Plan\Site Plan_.dwg

R 07 W | R 06 W | R 05 W | R 04 W | R 03 W | R 02 W | R 01 W | R 01 E | R 02 E | R 03 E | R 04 E | R 05 E

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

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

Santa Ana River Watershed
Santa Margarita Watershed

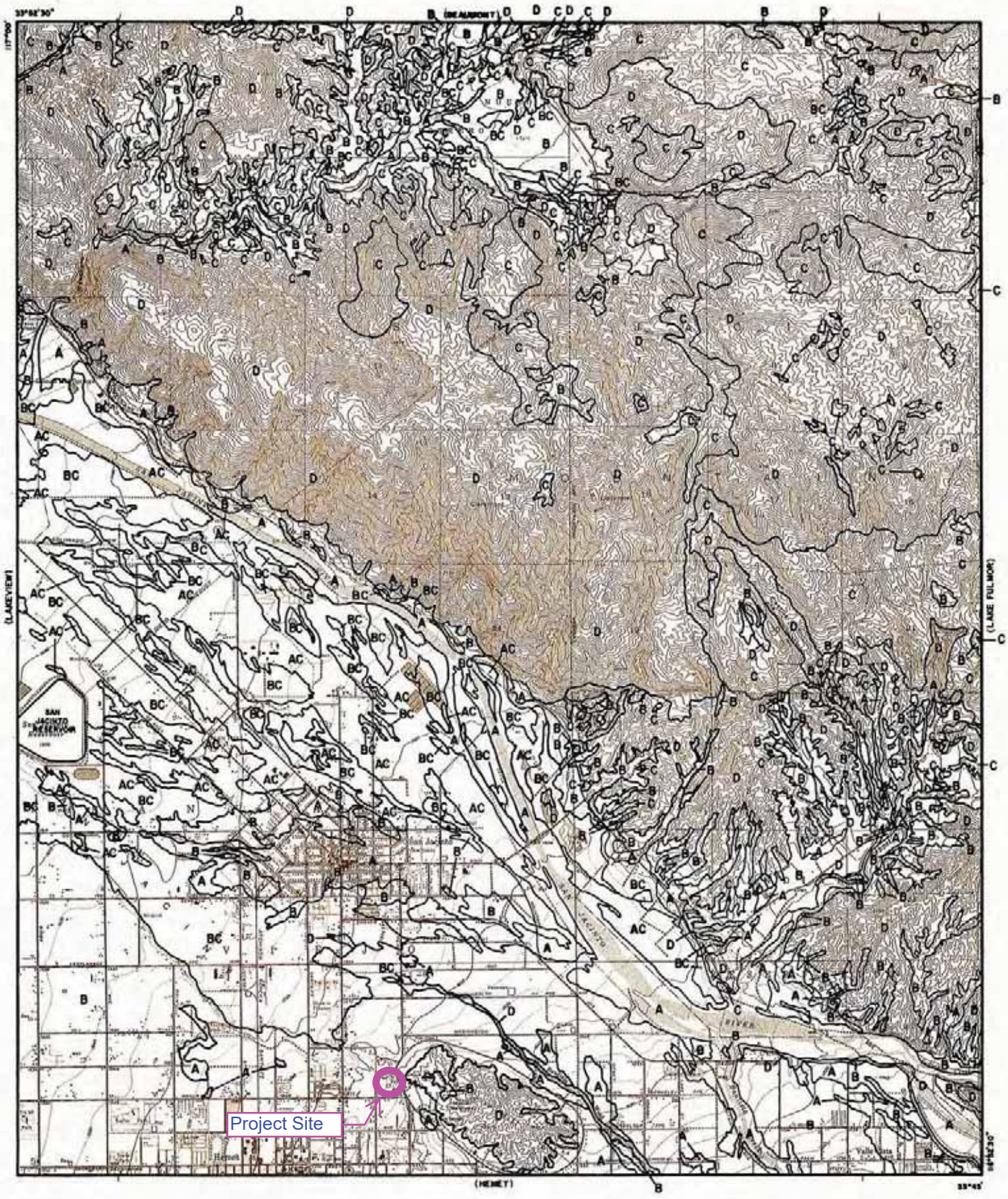
N

Rain Gage Locations

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

Isohyetal Map for the 85th Percentile 24 hour Storm Event

July 2011



LEGEND

—— SOILS GROUP BOUNDARY

A SOILS GROUP DESIGNATION

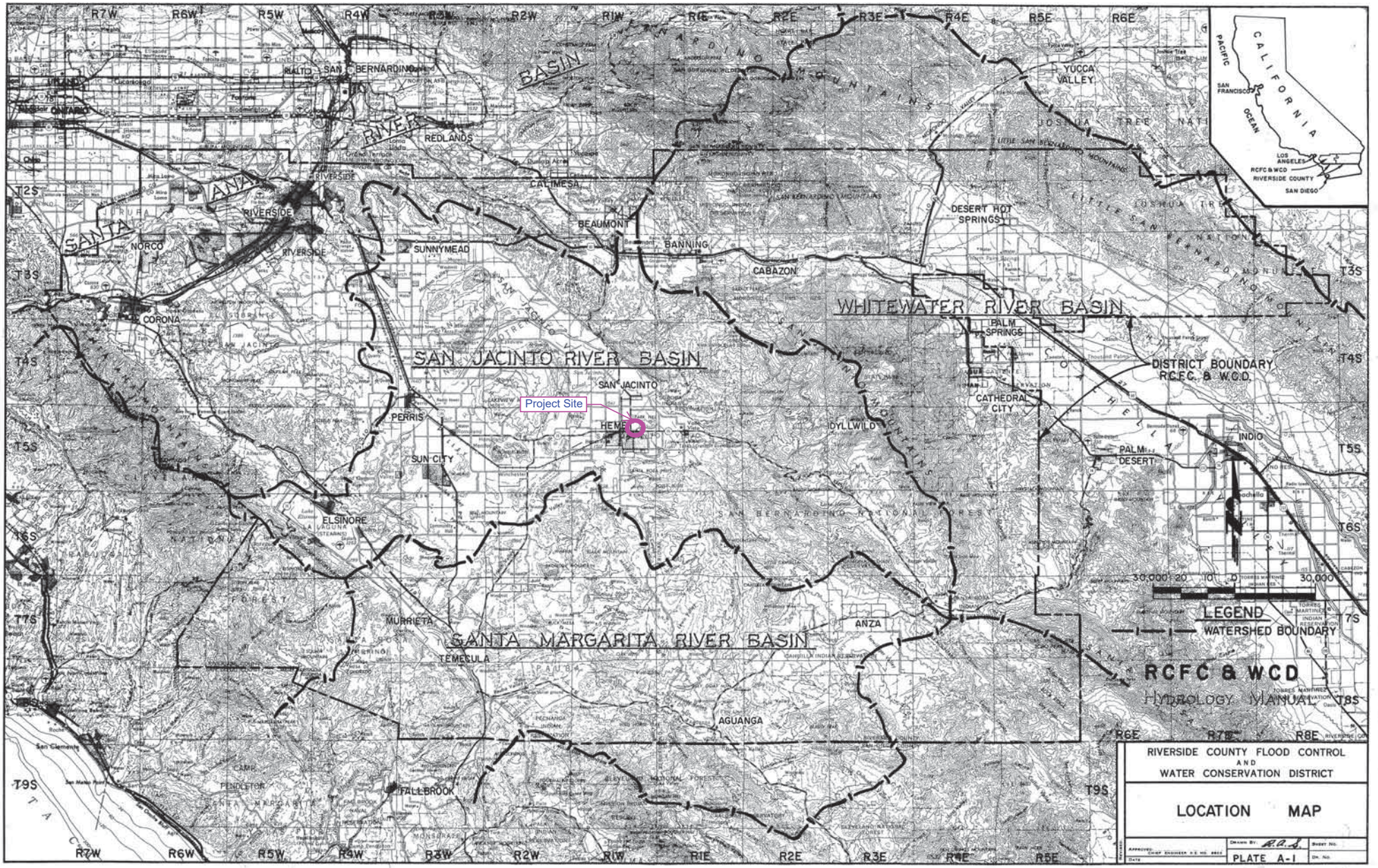
RCFC & WCD

HYDROLOGY MANUAL

0 FEET 5000

HYDROLOGIC SOILS GROUP MAP FOR SAN JACINTO

PLATE C-1.32


Project Site
SAN JACINTO RIVER BASIN
WHITEWATER RIVER BASIN
SANTA MARGARITA RIVER BASIN
DISTRICT BOUNDARY
R.C.F.C. & W.C.D.
LEGEND
WATERSHED BOUNDARY
RCFC & WCD
HYDROLOGY MANUAL
RIVERSIDE COUNTY FLOOD CONTROL
AND
WATER CONSERVATION DISTRICT
LOCATION MAP
PLATE A-1
CALIFORNIA
PACIFIC OCEAN
SAN FRANCISCO
LOS ANGELES
RCFC & WCD
RIVERSIDE COUNTY
SAN DIEGO
SAN BERNARDINO
RIVERSIDE
CORONA
NORCO
RIALTO
REDLANDS
YUCCA VALLEY
BEAUMONT
BANNING
CABAZON
DESERT HOT SPRINGS
PALM SPRINGS
CATHEDRAL CITY
DILLWILD
INDIO
PALM DESERT
SUNNYMEAD
CALIMESA
SAN JACINTO
HEMET
PERRIS
SUN CITY
ELSINORE
MURRIETA
TEMECULA
ANZA
AGUANGA
FALLBROOK
SAN CLEMENTE
CAMP PENDLETON
JOSHUA TREE NAT.
SAN BERNARDINO NATIONAL FOREST
30,000 20 10 0 30,000

Appendix 2: Construction Plans

Grading and Drainage Plans

NOTE: All construction plans will be provided in the Final WQMP.

Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data

LGC GEO-ENVIRONMENTAL, INC.

Preliminary Geotechnical Investigation Report for the Proposed Duplex Residential Development, Located at 800 North Girard Street, City of Hemet, Riverside County, California

Dated: October 21, 2019
Project No. G18-1647-10

Prepared For:

Mr. Shizao Zheng
1378 West Zhorgshan Road
Ningbo City, Zhejiang Province
China

27570 Commerce Center Drive, Suite. 128, Temecula, California 92590
Phone: 951.297.2450 I Fax: 951.719.2998 I www.lgcgeoenv.com

LGC GEO-ENVIRONMENTAL, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING

October 21, 2019

Project No. G18-1647-10

Mr. Shizao Zheng
1378 West Zhorgshan Road
Ningbo City, Zhejiang Province
China

Subject: Preliminary Geotechnical Investigation Report for the Proposed Duplex Residential Development, Located at 800 North Girard Street, City of Hemet, Riverside County, California.

LGC Geo-Environmental, Inc. (LGC) is pleased to submit herewith our preliminary geotechnical investigation report for the proposed duplex residential development at 800 North Girard Street in the city of Hemet, Riverside County, California. This report presents the results of our research of published geologic/geotechnical reports and/or maps, review of aerial photographs, field exploration, geologic mapping, and laboratory testing; in addition to our geotechnical and geologic judgment, opinions, conclusions and preliminary recommendations associated with the proposed residential development.

Based on the results of our field exploration, geologic mapping, laboratory testing, geologic and geotechnical engineering evaluations, along with review of published literature and the preliminary grading plan, it is our opinion that the subject site is suitable for the proposed multi-family residential development, provided that the recommendations presented herein are utilized during design and implemented during grading and construction. LGC should review all pertinent grading plans, as well as any foundation/structural plans when these become available, and revise the recommendations presented herein, if necessary.

It has been a pleasure to be of service to you during the design stages of this project. If you have any questions regarding the contents of this report or require additional information, please do not hesitate to contact us.

Respectfully submitted,

LGC Geo-Environmental, Inc.

Larry Cooley, RCE 54037
Civil Engineer

REGISTERED PROFESSIONAL ENGINEER
LARRY DWAIN COOLEY
No. C54037
Exp. 12/31/19
CIVIL
STATE OF CALIFORNIA

CERTIFIED ENGINEERING GEOLOGIST
MARK C. BERGMANN
No. 1348
EXP. 10/31/20
STATE OF CALIFORNIA

Mark Bergmann, CEG 1348
Certified Engineering Geologist/President

JJL/AJR/MB/LC

Distribution: (4) Addressee

TABLE OF CONTENTS

LIST OF TABLES, APPENDICES AND ILLUSTRATIONS

Tables

Figures & Plates

Appendices

1.0 INTRODUCTION

This report presents the results of LGC Geo-Environmental, Inc.'s (LGC) preliminary geotechnical investigation report for the proposed duplex residential development located at 800 N. Girard Street in the city of Hemet, Riverside County, California. The purposes of this geotechnical investigation are to determine the nature of surface and subsurface soil conditions, evaluate the soil characteristics, and provide geotechnical recommendations with respect to grading, construction, foundation design, and other relevant aspects to the proposed commercial development. The referenced preliminary site plan, which was provided, was utilized as the base map for our Geotechnical Map (Plate 1) of the site.

Our scope of services consists of:

- Review of available previous geologic/geotechnical literature, geologic maps, and aerial photographs pertinent to the site (Appendix A).
- Geologic mapping of the site.
- Subsurface exploration consisting of the sampling and logging of five (5) trenches to depths of approximately 5.5' feet to 17.5' feet, using a backhoe. Logs of the trenches as presented in Appendix B, with approximate locations depicted on the Geotechnical Map (Plate 1). The trenches were excavated to evaluate the general characteristics of the subsurface geologic/geotechnical conditions on the subject project site including classification of site soil, determination of depth to groundwater (if present), and to obtain representative soil samples.
- Core two (2) borings in the pavement on Menlo Park to depths of 5.0 feet and 6.0 feet.
- Laboratory testing of representative soil samples obtained during our current subsurface exploration (Appendix C).
- Geotechnical engineering and geologic analysis of the data with respect to the proposed duplex residential development.
- Preparation of General Earthwork and Grading Specifications (Appendix D).
- Preparation of this report presenting our findings, conclusions and preliminary geotechnical design recommendations for the proposed duplex residential development.

1.1 Proposed Construction and Grading

The referenced "Preliminary Site Plan", prepared by Sikand Engineering Associates, indicates that the proposed residential duplex development will be comprised of 48 graded pads, associated roadways, one water quality detention basin, and landscape and hardscape areas. The development is proposed to be two family duplex dwelling units per graded pad at this time. Based on the referenced preliminary site plan, maximum proposed cut and fill depths are approximately 12.0 feet to 2.5 feet, respectively. Slope and retaining walls are not proposed at this time.

When a rough grading plan is available, LGC should review and make any additional recommendations.

1.2 Location and Site Description

The subject site is irregular in shape and is located on the northwest corner of East Menlo Avenue and Park Avenue in the City of Hemet, Riverside County, California. The site is bounded on the north by residential development, on the west by Girard Street and residential development, on the south by East Menlo Avenue and residential development, and east by Park Avenue. The general location and configuration of the site is shown on the Site Location Map (Figure 1).

1.3 Topography and Drainage

The topography of the site is slightly inclined with sheet drainage appearing to flow from east to west. The existing site elevations vary from approximately 1,637 feet above mean sea level (msl) near the northeast corner of the site, to approximately 1,607 msl at the northwest corner of the site.

FIGURE 1
SITE LOCATION MAP

Project Name	SIKAND
Project No.	G18-1647-10
Geol./ Eng.	MB/LC
Scale	NOT TO SCALE
Date	OCTOBER 2019

1.4 Existing Improvements and Vegetation

The subject site is a vacant property with several concrete pads, a roadway, and various small concrete structures. Annual weeds are abundant on the project site, along with trees, shrubs, and debris.

1.5 Research of Previous Geological and Geotechnical Data

This firm researched and reviewed available published and unpublished geotechnical and geologic reports, maps and data. Based on this firm's research, pertinent information was incorporated into the conclusions and recommendations presented in our report.

2.0 FIELD INVESTIGATION

2.1 Geologic Mapping

Surface geologic mapping of the site and accessible surrounding areas was accomplished by a geologist from this firm on October 3, 2019, utilizing the referenced "Preliminary Site Plan" for plotting geologic units. This information is plotted on the enclosed Geotechnical Map (Plate 1).

2.2 Field Exploration

Subsurface exploration was performed on October 3, 2019 and involved the excavation of five (5) exploratory trenches (Trenches TR-1 through TR-5) to depths of approximately 5.5 feet to 17.5 feet utilizing a rubber tire backhoe. Additionally, two (2) core borings were excavated within East Menlo Ave to evaluate existing pavement design.

Prior to our subsurface work, an underground utilities clearance was obtained from Underground Services Alert of Southern California. At the conclusion of the subsurface exploration, all of the exploratory trenches were backfilled with on-site materials with some compactive effort. Minor settlement of the backfill soil may occur over time.

Earth materials encountered within the trenches were classified and logged by a geologist from LGC in accordance with the visual-manual procedures of the Unified Soil Classification System. The approximate locations of the exploratory trenches and core borings are shown on the Geotechnical Map (Plate 1) and descriptive logs are presented in Appendix B.

Bulk samples of soil associated with the initial subsurface exploration were collected for laboratory testing. Bulk samples consisted of selected soil materials obtained at various depth intervals from the exploratory trenches.

2.3 Laboratory Testing

During our subsurface exploration, relatively undisturbed and bulk samples were retained for laboratory testing. Laboratory testing was performed on selected representative samples of onsite soil materials and included maximum dry density and optimum water content, expansion index, sulfate content, chloride content, pH, resistivity, shear strength, R-Value, and Atterberg limits. A brief description of the laboratory test criteria and test data are presented in Appendix C. In-situ water contents and dry densities are included in the exploration trench and core logs (Appendix B).

3.0 FINDINGS

3.1 Regional Geologic Setting

Regionally, the site is located in the Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are characterized by steep, elongated valleys that trend west to northwest. The northwest-trending topography is controlled by the Elsinore Fault Zone, which extends from the San Gabriel River Valley southeasterly to the United States/Mexico border. The Santa Ana Mountains lie along the western side of the Elsinore Fault Zone, while the Perris Block is located along the eastern side of the fault zone. The mountainous regions are underlain by Pre-Cretaceous, metasedimentary and metavolcanic rocks and Cretaceous plutonic rocks of the Southern California Batholith. Holocene to Pleistocene-aged alluvium overlie Quaternary and Tertiary rocks, which are generally comprised of non-marine sediments consisting of sandstone, mudstones, conglomerates, and occasional volcanic units. A map of the regional geology is presented on the Regional Geologic Map (Figure 2).

3.2 Local Geology and Soil Conditions

Based on our review of available geological and geotechnical literature, current field mapping, and exploratory trenches conducted at the site, it is our understanding that the site is primarily underlain by undocumented artificial fill, alluvium, and Bautista Formation bedrock. Each unit is described in greater detail below and presented within the exploratory trench logs (Appendix B). The approximate locations of the observed geologic units are depicted on the Geotechnical Map (Plate 1).

- Artificial Fill, Undocumented (Afu) – Undocumented artificial fill was encountered in Trenches TR-1 through TR-5 to depths ranging from approximately 1.5 feet to 2.5 feet below the surface. These materials consisted of silty sand which was various shades of brown; dry; loose to medium dense; very fine to coarse grained with some gravels; roots; roothairs; blocky; and desiccated.
- Alluvium (Qal) – Alluvium was encountered on the site during our subsurface exploration and was observed at depths ranging from approximately 2.0 feet to 17.5 feet below the surface, in all trenches except trench TR-3, below the undocumented artificial fill. The alluvium generally consists of alternating layers of poorly graded sand, silty sand, clayey sand, and silty clay, and is various shades of brown and gray; moist and loose to medium dense. The material was also noted to be very fine to medium grained with occasional coarse grains and gravels; roothairs; caliche nodules and stringers; pinhole porosity; trace oxidation staining; micaceous; and minor clay in trench TR-5 at a depth of approximately 12.0 feet below the surface.
- Quaternary Bautista Formation (Qts) – Pleistocene age Bautista Formation was encountered in TR-3 below the undocumented artificial fill throughout the entire depth of the trench. This bedrock is generally sandstone with some interbedded siltstone, and is characterized as being various shades of white, gray, and brown; moist; moderately hard; medium to coarse grained with gravels; some highly weathered granitic clasts; manganese staining; and oxidation staining.

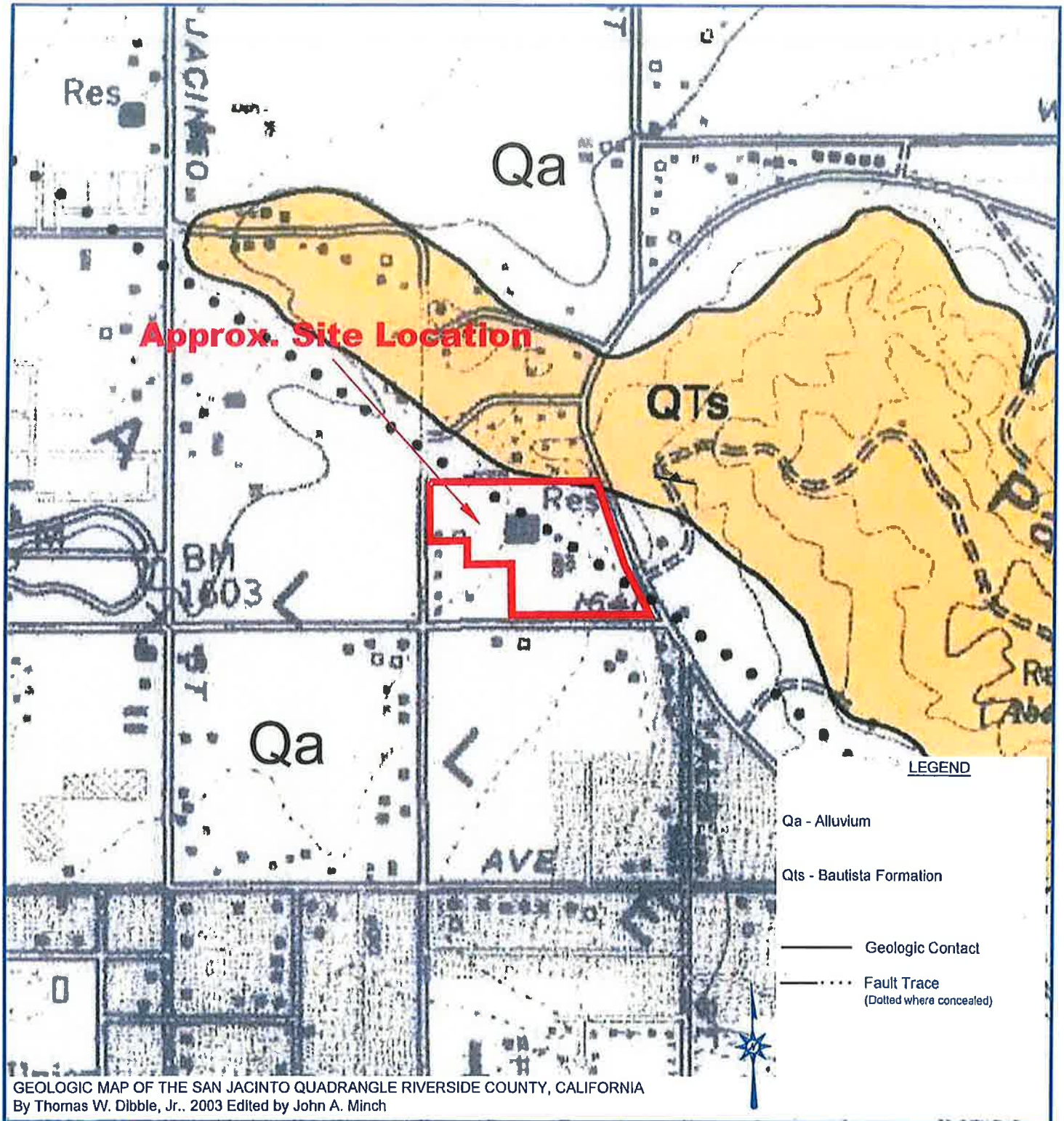
3.3 Landslides

Our investigation did not indicate the presence of landslides on or directly adjacent to the site.

3.4 Groundwater

Groundwater was not encountered during the subsurface exploration.

A review of the California Department of Water Resources, Water Data Library online database indicates the presence of groundwater less than a mile away from the general site area at approximately 267 feet below the existing ground surface according to historical records at an elevation of approximately 1,588 above mean sea level (Well ID: Station 337574N1169698W001).



GEOLOGIC MAP OF THE SAN JACINTO QUADRANGLE RIVERSIDE COUNTY, CALIFORNIA
By Thomas W. Dibble, Jr.. 2003 Edited by John A. Minch

FIGURE 2
REGIONAL GEOLOGIC MAP

Project Name	SIKAND
Project No.	G18-1647-10
Geol./ Eng.	MB/LC
Scale	NOT TO SCALE
Date	OCTOBER 2019

3.5 Caving

Caving was not encountered in the exploratory trenches.

3.6 Surface Water

Surface water runoff relative to project design is within the purview of the project civil engineer and should be designed to be directed away from all structures and walls.

3.7 Faulting

The geologic structure of the Southern California area is dominated mainly by northwest-trending faults associated with the San Andreas system. Faults, such as the Whittier, Elsinore, San Jacinto and San Andreas, are major faults in this system and are known to be active and may produce moderate to strong ground shaking during an earthquake. In addition, the San Andreas, Elsinore and San Jacinto faults are known to have ruptured the ground surface in historic times.

The following table is comprised of a list of the significant faults located within 20 miles of the proposed project site. We have also included the Maximum Earthquake Magnitude predicted for each of these faults.

TABLE 1
Significant Faults in Proximity of the Project Site

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE (mi)	MAXIMUM EARTHQUAKE MAGNITUDE (Mw)
Casa Loma*	Onsite	6.9
San Jacinto-San Jacinto Valley	1.9	6.9
San Jacinto-Anza	3.1	7.2
San Andreas-Southern	17.6	7.4
San Andreas-San Bernardino	17.6	7.3

Source: EQFAULT for Windows Version 3.00b
*Casa Loma located on subject property.

Previous fault investigations conducted by Rasmussen (1988) and LGC (2018) concluded that active or potentially active faulting related to the Casa Loma fault are known to project through the site (Appendix A). The site does lie within an Alquist-Priolo Earthquake Fault Hazard Zone as defined by the State of California in the Alquist-Priolo Earthquake Fault Hazard Zoning Act. According to these reports, the potential for damage because of ground surface rupture is considered a possibility since active or potentially faults are known to cross the site. Accordingly, a structural setback zone has been established for the property as shown on the accompanying Geotechnical Map, Plate 1. No structures for human occupancy should be constructed in this setback zone.

3.8 Seismicity

Secondary effects of seismic shaking resulting from large earthquakes on the major faults in the southern California region, which may affect the site, include soil liquefaction and dynamic settlement. Liquefaction is a seismic phenomenon in which loose, saturated, granular soil behave similarly to a fluid when subject to high-intensity ground shaking. Liquefaction occurs when three general conditions exist: 1) shallow groundwater; 2) low density non-cohesive (granular) soil; and 3) high-intensity ground motion. Studies indicate that saturated, loose to medium dense, near surface cohesionless soil exhibit

the highest liquefaction potential, while dry, dense, cohesionless soil and cohesive soil exhibit low to negligible liquefaction potential.

Due to the shallow depth of bedrock, dense alluvium, and groundwater depth being greater than 50 feet, liquefaction is considered nil.

Other secondary seismic effects include shallow ground rupture, seiches, and tsunamis. In general, these secondary effects of seismic shaking are a possibility throughout the Southern California region and are dependent on the distance between the site and causative fault and the onsite geology. A risk assessment of these secondary effects is provided in the following sections.

3.9 Earthwork and Structural Settlements

The results of our subsurface exploration and laboratory testing indicate that the site is underlain by approximately 1.5 feet to 5 feet of potentially compressible soil, consisting of non-engineered, undocumented artificial fill. These materials exhibit the potential to settle under the surcharge of proposed fill loads, anticipated future structural loads, and improvements.

Where overexcavation to competent underlying alluvium is accomplished, total static settlement from the earthwork and from proposed fill loads is estimated to be 3/4-inch total and 1/2-inch differential over 30 feet.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 General

Based on the results of our current geotechnical investigation, it is our opinion that the proposed duplex residential development, as indicated on the referenced site plan, is feasible from a geotechnical and geologic standpoint, provided that the following recommendations are incorporated into the design criteria and project specifications. When actual grading plans for the site and foundation/structural plans for the proposed development are available, a comprehensive plan review should be performed by this firm. Depending on the results, additional recommendations may be necessary for geotechnical design parameters for both earthwork and foundations. Grading should be conducted in accordance with local codes, the recommendations within this report, and future plan reviews. It is also our opinion that the proposed construction and grading will not adversely impact the geologic stability of adjoining properties.

The following is a summary of the primary geotechnical factors determined from our geotechnical investigation.

- Based on our current subsurface exploration and review of pertinent geological maps and reports, the site is underlain by undocumented artificial fill, alluvium, and Bautista Formation.
- There are not any known landslides impacting the site.
- Groundwater is not considered a constraint for the proposed duplex development.
- Active or potentially active faults are known to exist on the site.
- Laboratory test results of the upper soil (undocumented artificial fill and alluvium) indicate a medium expansion potential and negligible potential for soluble sulfate effects on normal concrete and chloride effects on reinforcing steel.
- Laboratory test results of the soil encountered indicated a moderate corrosion potential to buried metals.
- The majority of the site is underlain by approximately 6.0 feet of potentially compressible undocumented artificial fill and portions of the upper alluvium which may be prone to potential intolerable post-grading settlement under the surcharge of the future proposed fill loads and/or

structural loads. These materials should be overexcavated to underlying competent alluvium deposits.

- From a geotechnical perspective, the existing onsite soil appears to be suitable material for use as fill, provided the soil are relatively free from rocks (larger than 6 inches in maximum dimension), construction debris, and organic material. It is anticipated that the onsite soil may be excavated with conventional heavy-duty construction equipment.

5.0 GEOLOGIC CONSIDERATIONS

5.1 Slopes

Natural slopes or existing cut/fill slopes with adverse conditions are not anticipated.

5.2 Faulting

Geologic hazards due to fault rupture are known to be present on the subject site. Potentially active faulting related to the Casa Loma fault was observed within fault trenches located within the site. The fault trenches and actual fault location are shown on the Geotechnical Map (Plate 1).

5.3 Groundwater

Adverse effects on the proposed development resulting from groundwater are not anticipated.

5.4 Subsidence

In consideration of the anticipated grading, recommended overexcavations and subsurface material types and soil conditions, unfavorable ground subsidence is not anticipated.

5.5 Landsliding

Landslides or surface failures were not observed on or directly adjacent to the site. As a result, the possibility of the site being affected by landsliding is not anticipated.

5.6 Ground Rupture

Ground rupture from active faulting could possibly occur on site from the presence of observed, potentially active faulting related to the Casa Loma. Cracking from shaking from distant seismic events is not considered a significant hazard, although it is a possibility at any site.

5.7 Tsunamis and Seiches

Based on the elevation and location of the proposed residential development on the site with respect to sea level and its distance from large open bodies of water, the potential for seiches and/or tsunamis is not considered to be a possibility.

5.8 Liquefaction

Liquefaction is a seismic phenomenon in which loose, saturated, granular soils behave similarly to a fluid when subject to high-intensity ground shaking. Liquefaction occurs when three general conditions exist: 1) shallow groundwater; 2) low density non-cohesive (granular) soil; and 3) high-intensity ground motion. Studies indicate that saturated, loose to medium dense, near surface cohesionless soils exhibit the highest liquefaction potential, while dry, dense, cohesionless soils and cohesive soils exhibit low to negligible liquefaction potential. Bedrock was found as shallow as 1.5 feet in Trench FT-3. With shallow bedrock, the potential for liquefaction is considered nil.

6.0 SEISMIC-DESIGN CONSIDERATIONS

6.1 Ground Motions

The site will probably experience ground shaking from moderate to large size earthquakes during the life of the proposed development. Furthermore, it should be recognized that the Southern California region is an area of high seismic risk, and that it is not considered feasible to make structures totally resistant to seismic-related hazards.

Structures within the site should be designed and constructed to resist the effects of seismic ground motions as provided in the 2016 CBC, Section 1613. The method of design is dependent on the seismic zoning, site characterizations, occupancy category, building configuration, type of structural system, and building height.

The following seismic design parameters, presented in Table 2, were developed based on the CBC 2016 and should be used for the proposed structures. A site coordinate of 33.5322° N, 117.1795° W was used to derive the seismic parameters presented below. The Mean Peak Ground Acceleration (PGAm) is 0.97 below.

TABLE 2
Seismic Design Soil Parameters

SEISMIC DESIGN SOIL PARAMETERS (2016 CBC Section 1613)	
Site Class Definition ASCE 7; Chapter 20 (Table 20.3-1)	D
Mapped Spectral Response Acceleration Parameter S_s (for 0.2 second) (Figure 1613.5.3.(1)	2.53
Mapped Spectral Response Acceleration Parameter, S_1 (for 1.0 second) (Figure 1613.5.3.(2)	1.14
Site Coefficient F_a (short period) [Table 1613.3.3.(1)]	1.00
Site Coefficient F_v (1-second period) [Table 1613.3.3.(2)]	1.50
Adjusted Maximum Considered Earthquake (MCE) Spectral Response Acceleration Parameter S_{MS} (short period) (Eq. 16-37)	2.53
Adjusted Maximum Considered Earthquake (MCE) Spectral Response Acceleration Parameter S_{M1} (1-second period) (Eq. 16-38)	1.71
Design Spectral Response Acceleration Parameter, S_{DS} (short period) (Eq. 16-39)	1.68
Design Spectral Response Acceleration Parameter, S_{D1} (1-second period) (Eq. 16-40)	1.14
Mean Peak Ground Acceleration (PGA_m)	0.97

6.2 Secondary Seismic Hazards

Secondary effects of seismic activity normally considered as possible hazards to a site include several types of ground failure, as well as induced flooding. Various general types of ground failures which might occur as a consequence of severe ground shaking of the site include liquefaction, landsliding, ground subsidence, ground lurching, and shallow ground rupture. The probability of occurrence of each type of ground failure depends on the severity of the earthquake, distance from faults, topography, subsoils and groundwater conditions, in addition to other factors. Based on the depth to groundwater, proposed grading and recommended overexcavation of potentially compressible materials within areas of proposed development, the secondary effects of liquefaction are considered unlikely.

Seismically induced flooding, which might be considered a potential hazard to a site, normally includes flooding due to a tsunami (seismic sea wave), a seiche (i.e., a wave-like oscillation of the surface of

water in an enclosed basin that may be initiated by a strong earthquake) or failure of a major reservoir or retention structure upstream of the site. Since the site is located several miles inland from the nearest coastline of the Pacific Ocean and elevation exceeds 1,600 feet above msl, there is no potential for seismically induced flooding from a tsunami. Since enclosed bodies of water do not lie adjacent to the site, the potential for induced flooding at the site due to a seiche is also considered nonexistent.

7.0 GEOTECHNICAL DESIGN PARAMETERS

7.1 Shrinkage/Bulking and Subsidence

Volumetric changes in earth quantities will occur when excavated onsite soil are replaced as properly compacted fill. The following table, Table 3, is an estimate of the shrinkage and bulking factors for the various geologic units present onsite. These estimates are based on in-place densities of the various materials and on the estimated average degree of relative compaction that will be achieved during grading.

TABLE 3
Estimated Shrinkage/Bulking

GEOLOGIC UNIT	SHRINKAGE/BULKING PERCENT
Artificial Fill, Undocumented (Afu)	10%-19%
Alluvium (Qal)	11%-20%
Bautista Formation (Qts)	0%-5%

Subsidence of the alluvium deposits is estimated to be about 0.25 to 0.30 feet.

The above estimates of shrinkage are intended as an aid for project engineers in determining earthwork quantities. **However, these estimates should be used with some caution since they are not absolute values.** These are preliminary rough estimates which may vary with depth of removal, stripping losses, field conditions at the time of grading, etc. Handling losses, and reduction in volume due to removal of oversized material, are not included in the estimates.

7.2 Compressible/Collapsible Soil

The results of our laboratory testing indicate that the existing undocumented artificial fill is susceptible to varying degrees of intolerable settlement when a load is applied, or the soil is saturated. Consequently, these materials should be collectively overexcavated to underlying competent alluvium (Qal) and Bautista Formation (Qts) and replaced as engineered compacted fill.

8.0 SITE EARTHWORK

8.1 General Earthwork and Grading Specifications

Earthwork and grading should be performed in accordance with applicable requirements of the grading code of the City of Hemet and in accordance with the following recommendations prepared by this firm. Grading should also be performed in accordance with the applicable provisions of the attached "General Earthwork and Grading Specifications" prepared by LGC (Appendix D), unless specifically revised or amended herein. In case of conflict, the following recommendations shall supersede those included in as part of Appendix D.

8.2 Geotechnical Observations and Testing

Prior to the start of grading, a meeting should be held at the site with the owner, developer, grading contractor, civil engineer and geotechnical consultant to discuss the work schedule and geotechnical

aspects of the grading. Rough grading, which includes clearing, overexcavation, scarification/processing and fill placement, should be accomplished under the full-time observation and testing of the geotechnical consultant. Fills should not be placed without prior approval from the geotechnical consultant.

A representative of the project geotechnical consultant should also be present onsite during grading operations to document proper placement and compaction of fills, as well as to document excavations and compliance with the other recommendations presented herein.

8.3 Clearing and Grubbing

The project geotechnical consultant or his qualified representative should be notified at the appropriate times to provide observation and testing services during clearing and grubbing operations to observe and document compliance with the above recommendations. In addition, buried structures, unusual or adverse soil conditions encountered that are not described or anticipated herein should be brought to the immediate attention of the geotechnical consultant.

8.4 Overexcavation and Ground Preparation

The site is underlain by approximately 3 feet to 6 feet of compressible undocumented artificial fill and portions of the upper alluvium which is considered unsuitable for support of fill, structures, and/or improvements, and should be overexcavated to expose underlying competent alluvium or bedrock. Overexcavation must provide at least 5 feet or more of compacted fill below finished grade within areas of proposed structures or walls. Therefore, those areas should be overexcavated to at least 6 feet or more below proposed grade. Actual depths of overexcavation should be evaluated upon review of final grading and foundation plans, as well as during grading on the basis of observations and testing during grading by the project geotechnical consultant.

Across the site are twelve (12) fault trenches that were excavated in 1988 and 2018. These trenches range in depths of 9 feet to 14 feet. The locations of the trenches can be found on the Geotechnical Map (Plate 1) and should be over excavated and recompacted to each trench depth.

Prior to placing engineered fill, exposed bottom surfaces in each overexcavated area should first be scarified to a depth of approximately 6 inches, watered or air-dried as necessary to achieve a uniform water content of optimum or higher and then compacted in place to a relative compaction of 90 percent or more (based on American Standard of Testing and Materials [ASTM] Test Method D1557).

The estimated locations, extent, and approximate depths for overexcavation of unsuitable materials are indicated on the enclosed Geotechnical Map (Plate 1). The geotechnical consultant should be provided with appropriate survey staking during grading to document that depths and/or locations of recommended overexcavation are adequate.

Sidewalls for overexcavations greater than 5 feet in height should not be steeper than 1:1 horizontal to vertical (h:v) and should be periodically slope-boarded during the excavation to remove loose surficial debris and facilitate mapping. Flatter excavations may be necessary for stability.

The grading contractor will need to consider appropriate measures necessary to excavate existing improvements adjacent to the site without endangering them from caving or sloughing.

8.5 Fill Suitability

Soil materials excavated during grading are generally considered suitable for use as compacted fill provided that they do not contain significant amounts of trash, vegetation, organic material, construction debris, and oversize material.

8.6 Oversized Material

Oversized material that may be encountered during grading, greater than 6 inches, should be reduced in size or removed from the site

8.7 Cut/Fill Transitions and Differential Fill Thicknesses

To mitigate distress to structures related to the potential adverse effects of excessive differential settlement, cut/fill transitions should be eliminated from all building areas where the depth of fill placed within the "fill" portion exceeds proposed footing depths. The entire structure should be founded on a uniform bearing material. This should be accomplished by overexcavating the "cut" portion and replacing the excavated materials as properly compacted fill. Recommended depths of overexcavation are provided in the following table:

Cut/Fill Transition

DEPTH OF FILL ("fill" portion)	DEPTH OF OVEREXCAVATION ("cut" portion)
Up to 5 feet	Equal Depth
5 to 10 feet	5 feet
Greater than 10 feet	One-half the maximum thickness of fill placed on the "fill" portion (20 feet maximum)

Overexcavation of the "cut" portion should extend beyond the perimeter building lines to a horizontal distance equal to the depth of overexcavation or to a minimum distance of 5 feet, whichever is greater.

8.8 Benching

Where compacted fills are to be placed on natural slope surfaces inclining at 5:1 (h:v) or greater, the ground should be excavated to create a series of level benches, which are at least a minimum height of 4 feet, excavated into competent bedrock or existing compacted engineered materials. Typical benching details are described in the attached LGC "Standard Grading Specifications" (Appendix D).

8.9 Fill Placement

Fills should be placed in lifts not greater than 6 inches in uncompacted thickness, watered or air-dried as necessary to achieve a uniform moisture content of at least optimum moisture content, and then compacted in place to relative compaction of 90 percent or more. Fills should be maintained in a relatively level condition. The laboratory maximum dry density and optimum moisture content for each change in soil type should be determined in accordance with ASTM Test Method D1557.

8.10 Inclement Weather

Inclement weather may cause rapid erosion during mass grading and/or construction. Proper erosion and drainage control measures should be taken during periods of inclement weather in accordance with City of Hemet, Riverside County, and California State requirements.

9.0 SLOPE CONSTRUCTION

9.1 Slope Stability

Any proposed cut or fill slopes constructed at a 2:1 horizontal to vertical (h:v) orientation or flatter should be grossly stable.

Portions of any proposed cut slopes may expose low-density, undocumented artificial fill as well as significant layers of relatively non-cohesive alluvium deposits which will likely require stabilization by

overexcavation and replacement with compacted fill. During the grading plan review stages, a detailed slope stability analyses may be warranted.

9.2 Temporary Excavations

Temporary excavations varying up to a height of approximately 5 feet or more below existing grades will be necessary to accommodate the recommended overexcavation of the unsuitable soil materials. Based on the physical properties of the onsite soil, temporary excavations exceeding 5 feet in height should be cut back at a ratio of 1:1 (h:v) or flatter, for the duration of the overexcavation and recompaction of unsuitable soil material. Temporary slopes excavated at the above slope configurations are expected to remain stable during grading operations. However, the temporary excavations should be observed by a representative of the project geotechnical consultant for any evidence of potential instability. Depending on the results of these observations, revised slope configurations may be necessary. Job safety is the sole responsibility of the contractor or sub-contractor.

Other factors which should be considered with respect to the stability of the temporary slopes include construction traffic and storage of materials on or near the tops of the slopes, construction scheduling, presence of nearby walls or structures on adjacent properties, and weather conditions at the time of construction. Applicable requirements of the California Construction and General Industry Safety Orders, the Occupational Safety and Health Act of 1970, and the Construction Safety Act should also be followed.

10.0 POST-GRADING CONSIDERATIONS

10.1 Control of Surface Water and Drainage Control

Positive-drainage devices such as sloping sidewalks, graded-swales, and/or area drains, should be provided to collect and direct water away from the structure and any slopes. Neither rain nor excess irrigation water should be allowed to collect or pond against the building foundations. Drainage should be directed to adjacent driveways, adjacent streets or storm-drain facilities and maintained at all times. The site is in a semi-arid climate area, from a geotechnical standpoint, the ground surface adjacent to the structures should be sloped at a gradient of at least 2 percent for a distance of at least 10 feet. The graded lot should be further maintained by a swale or drainage path at a gradient of at least 1 percent. Where necessary, drainage paths may be shortened by use of area drains and collector pipes.

Planters with open bottoms adjacent to buildings should be avoided. Planters should not be designed adjacent to buildings unless provisions for drainage are made, such as catch basins, liners, and/or area drains. Over watering must be avoided.

10.2 Utility Trenches

Utility-trench backfill within roadways, utility easements, under walls, sidewalks, driveways, floor slabs and any other structures or improvements should be compacted. The onsite soil should generally be suitable as trench backfill provided the soil is screened of rocks and other material over 3 inches in diameter and organic matter. Trench backfill should be compacted in uniform lifts (generally not exceeding 6 inches to 8 inches in uncompacted thickness) by mechanical means to at least 90 percent relative density (per ASTM Test Method D1557).

Where onsite soils are utilized as backfill, mechanical compaction should be used. Density testing, along with probing, should be performed by the project geotechnical consultant or his representative, to document proper compaction.

If trenches are shallow, the use of conventional equipment may result in damage to the utilities. Clean sand, having a sand equivalent (SE) of 30 or greater should be used to bed and shade the utilities. Sand backfill should be densified. The densification may be accomplished by jetting or flooding and

then tamping to ensure adequate compaction. A representative from LGC should observe, probe, and test the backfill to verify compliance with the project specifications.

Utility-trench sidewalls deeper than 5 feet should be laid back at a ratio of 1:1 (h:v) or flatter or braced. A trench box may be used in lieu of shoring. If shoring is anticipated, LGC should be contacted to provide design parameters.

To avoid point-loads and subsequent distress to clay, cement or plastic pipe, imported sand bedding should be placed 1-foot or more above pipe in areas where excavated trench materials contain significant cobbles. Sand-bedding materials should be compacted and tested prior to placement of backfill.

Where utility trenches are proposed parallel to building footings (interior and/or exterior trenches), the bottom of the trench should not be located within a 1:1 (h:v) plane projected downward from the outside bottom edge of the adjacent footing.

11.0 PRELIMINARY FOUNDATION DESIGN RECOMMENDATIONS

11.1 General

Provided that site grading is performed in accordance with the recommendations of this report, conventional shallow foundations are considered feasible for support of the proposed commercial building. Tentative foundation recommendations are provided herein. However, these recommendations may require modification depending on as-graded conditions existing within the building sites upon completion of grading.

11.2 Allowable-Bearing Values

An allowable-bearing value of 1,500 pounds per square foot (psf) may be used for 12-inch wide or greater continuous footings or 24-inch square pad footings, founded completely within competent compacted fill at a depth of 12-inches or more below the lowest adjacent final grade. This value may be increased by 20 percent for each additional foot of width and depth, to a value no greater than 3,000 psf. The recommended allowable-bearing value includes both dead and live loads and may not be increased by one-third for short-duration wind and seismic forces. The bearing capacities should be re-evaluated when loads and footing sizes have been finalized.

11.3 Settlement

Based on the general settlement characteristics of compacted fill, the previous overexcavation recommendations in this report and anticipated fill loading, it is estimated the site would be subjected to a total static settlement about 0.75-inch, and a differential settlement of about 0.50-inch over a distance of about 30 feet. It is anticipated that the majority of the settlement will occur during construction or shortly thereafter as building loads are applied.

The above settlement estimates are based on the assumption that the proposed precise grading will be performed in accordance with the grading recommendations presented in this report and that the project geotechnical consultant will observe and/or test the soil conditions in the footing excavations.

11.4 Lateral Resistance

Lateral forces on footings should be resisted by passive earth resistance and friction at the bottom of the footing. Foundations should be designed for a passive earth pressure of 230 psf per foot of depth to a maximum 3,000 psf and a coefficient of friction of 0.30. The passive earth pressure incorporates a minimum factor of safety of 1.5. When combining passive and friction forces, passive resistance should be reduced by 1/3. The above values may not be increased by 1/3 when designing for short-duration

wind or seismic forces.

The above values are based on footings placed directly against compacted fill soil. In the case where footing sides are formed, backfill placed against the footings should be compacted to 90 percent or more of maximum dry density as determined by ASTM D1557.

11.5 Footing Setbacks from Descending Slopes

Where structures are proposed near the tops of descending graded or natural slopes, the footing setbacks from the slope face should conform to the 2016 CBC, Figure 1808.7.1. The required setback is H/3 (one-third the slope height) measured along a horizontal line projected from the lower outside face of the footing to the slope face. The footing setbacks should be 5 feet or more where the slope height is 15 feet or less and vary up to 40 feet where the slope height exceeds 15 feet.

11.6 Building Clearances from Ascending Slopes

Building setbacks from ascending graded or natural slopes should conform with the 2016 CBC, Figure 1808.7.1, which requires a building clearance of H/2 (one-half the slope height) varying from 5 to 15 feet. The building clearance is measured along a horizontal line projected from the toe of the slope to the face of the building. A retaining wall may be constructed at the base of the slope to achieve the required building clearance.

11.7 Footing Observations

Footing trenches should be observed by the project geotechnical consultant to document that those have been excavated into competent bearing soil. The foundation trenches should be observed prior to the placement of forms, reinforcement or concrete. The trenches should be trimmed neat, level and square. Loose, sloughed or moisture-softened soil should be removed prior to concrete placement.

Excavated materials from footing trenches should not be placed in slab-on-ground areas unless the soil are compacted to 90 percent or more of maximum dry density as determined by ASTM D1557.

11.8 Expansive Soil Considerations

Results of preliminary laboratory tests by LGC indicate onsite soil materials exhibit expansion potentials of **MEDIUM** in accordance with 2016 CBC, Chapter 18. Expansive soil conditions of the near surface finish grade soil should be evaluated and tested for individual building pads on a pad-by-pad basis during and at the completion of rough grading to verify and/or modify the anticipated conditions. The design and construction details presented herein are intended to provide recommendations for the levels of expansion potential which may be evident at the completion of rough grading. Furthermore, it should be noted that additional slab thickness, footing sizes and/or reinforcement more stringent than the recommendations that follow should be provided as recommended by the project structural engineer.

11.9 Footing/Floor Slabs: Medium Expansion Potential

The following are our recommendations where foundation soil exhibits a **MEDIUM** expansion potential as classified in accordance with 2016 CBC, and it is recommended that footings and floors be constructed and reinforced in accordance with the following criteria.

- ***Footings***

  - Exterior continuous footings should be founded into compacted engineered fill below the lowest adjacent final grade at minimum depths of 18 inches deep for one-story to two-story construction and 24 inches deep for three-story to four-story construction. Interior continuous footings may be founded at a depth of 18 inches or greater into compacted engineered fill below the lowest

adjacent final grade. Continuous footings should have a minimum width of 15 inches or more for one-story and two-story structures and 18-inches for three-story to four-story structures.

- Continuous footings should be reinforced with four (4) No. 4 bars, two near top and two near bottom.

- Interior isolated pad footings should be 24 inches or more square and founded at a depth of 18 inches or more below the lowest adjacent grade. Footings should be reinforced in accordance with the structural engineer's recommendation.

- Exterior pad footings should be 24 inches or more square and founded at a depth of 24 inches or more below the lowest adjacent grade. Footings should be reinforced in accordance with the structural engineer's recommendations.

- ***Floor Slabs***

- Concrete floor slabs should be 5 inches or more thick and reinforced with No. 3 bars spaced 18 inches or less on-centers, both ways. Slab reinforcement should be supported on concrete chairs or bricks so that the desired placement is near mid-depth.

- Concrete floors should be underlain with a moisture-vapor retarder consisting of 15-mil thick vapor barrier. Laps within the membrane should be sealed and overlapped 12 inches. Two inches or more of clean sand should be placed above and below the membrane to promote uniform curing of the concrete.

- Garage area floor slabs should be a minimum of 5 inches thick and should be reinforced in a similar manner as concrete interior living area floor slabs. Garage area floor slabs should be placed separately from adjacent wall footings with a positive separation maintained with 3/8-inch minimum felt expansion joint materials and quartered with weakened-plane joints. A 12-inch wide grade beam founded at the same depth as adjacent footings should be provided across garage entrances. The grade beam should be reinforced with a minimum of two No. 4 bars, one near top and one at bottom.

- Prior to placing concrete, the subgrade soils below all floor slabs should be pre-watered to achieve a moisture content that is equal to 120% of the optimum water content of the subgrade soils. The water content should penetrate to a minimum depth of 18 inches. This will promote uniform curing of the concrete and minimize the development of shrinkage cracks.

11.10 Post-Tensioned Foundation Slab Design

Post-tensioned slabs may be utilized for the support of the proposed residential structures. We recommend that the foundation engineer design the foundation system using the geotechnical parameters provided in the following Table 4. These parameters have been determined in general accordance with ACI 302 and the Post Tension Institute (PTI). In utilizing these parameters, the foundation engineer should design the foundation system in accordance with the allowable deflection criteria of applicable codes and the requirements of the structural engineer/architect. We recommend using a P.I. of 12 pertinent to the foundation/slab design.

Table 4
Preliminary Geotechnical Parameters for Post-Tensioned Foundation Slab Design

PARAMETER		*VALUE*
Expansion Index		Medium
Thornthwaite Moisture Index		-20
Constant Soil Suction		P.F. 4.0
Center Lift	Edge moisture variation distance, e_m Center lift, y_m	8.0 feet 0.25 inches
Edge Lift	Edge moisture variation distance, e_m Edge lift, y_m	4.0 feet 1.0 inches
Soluble Sulfate Content for Design of Concrete Mixtures in Contact with Site Soils in Accordance with ACI 318 R-05; Table 4.3.1		Low
Modulus of Subgrade Reaction, k (assuming presaturation as indicated below)		120 lbs/in^3
Minimum Perimeter Foundation Embedment		18 inches
Sand and Visqueen[a]		15 mil thick Visqueen or equivalent moisture retardant in conformance with ASTM 1745 Class A material

[a] The above sand and Visqueen recommendations are traditionally included with geotechnical foundation recommendations although they are generally not a major factor influencing the geotechnical performance of the foundation. The sand and Visqueen requirements are the purview of the foundation engineer/corrosion engineer and the homebuilder to ensure that the concrete cures correctly and is protected from corrosive environments and moisture penetration of the floor is acceptable to the future homeowners. Therefore, the above recommendations may be superceded by the requirements of the previously mentioned parties.

It is noteworthy that the post-tensioned design methodology reflected by the (PTI) is based on the assumption that soil-moisture changes around and beneath the post-tensioned slabs are primarily influenced by climatological conditions. The variability in soil moisture below slabs is the major factor in foundation damages relative to expansive soil. The design methodology does not take into consideration such factors as presaturation, homeowner irrigation, or other such artificial influences on the moisture content of subgrade soils. In recognition of these factors, LGC has modified the geotechnical parameters obtained from this methodology to introduce a more conservative design. In addition, we recommend that prior to foundation construction, the upper 18 inches of slab subgrade for each lot be presoaked to approximately ten percent above optimum moisture content prior to trenching and maintained to the associated pouring of concrete. Future homeowners should be informed of the importance of maintaining a constant level of soil-moisture. **The owners should be made aware of the potential negative consequences of both excessive watering, as well as allowing expansive soils to become too dry. The soil will undergo shrinkage of approximately 8% as it dries up, followed by swelling during the rainy winter season, or when irrigation is resumed. This may result in distress to the improvements and structures.**

12.0 RETAINING WALLS

12.1 Lateral Earth Pressures and Retaining Wall Design Parameters

Conventional footings for retaining walls founded in properly compacted fill within competent bedrock should be embedded at least 18 inches below lowest adjacent grade. At this depth, an allowable bearing capacity of 1,500 psf may be assumed for retaining walls founded in competent compacted fill.

The following are lateral earth pressures are recommended for retaining walls up to 10 feet high that may be proposed. The recommended lateral pressures for approved on-site or import soil **(with an**

expansion index of 20 or less and an angle of internal friction (phi) of at least 28 degrees) for level or sloping backfill are presented in Table 5. Onsite soil should be screened of rocks and other material over 3 inches in diameter.

TABLE 5
Lateral Earth Pressures

CONDITIONS	EQUIVALENT FLUID WEIGHT (pcf)			
	Level Backfill (up to 6 feet)	Level Backfill Dynamic (>6 feet to 10 feet)	2:1 Backfill Ascending (up to 6 feet)	2:1 Backfill Ascending-Dynamic (>6 feet to 10 feet)
Active	45	80	80	115
At-Rest	65	100	100	130
Passive	235	235	105	105

Notes:
1. Applicable to retaining walls only.
2. Active force applied a 1/3 wall height.
3. Seismic force applied to at 1/2 to 6/10 wall height.
4. Lateral pressure acts normally to vertical stem.

For sliding resistance, the friction coefficient of 0.30 may be used at the concrete and soil interface. Wall footings should be designed in accordance with structural considerations. The passive resistance value may be increased by one-third when considering loads of short duration such as wind or seismic loads.

Embedded structural walls should be designed for lateral earth pressures exerted on them. Restrained structural walls should be designed for at rest conditions. The magnitude of those pressures depends on the amount of deformation that the wall can yield under load. If the wall can yield enough to mobilize the full shear strength of the soil, it can be designed for "active" pressure. If the wall cannot yield under the applied load, the shear strength of the retained soil cannot be mobilized and the earth pressure will be higher. Such walls should be designed for "at-rest" conditions. If a structure moves toward the soil, the resulting resistance developed by the soil is the "passive" resistance.

The equivalent fluid pressure values assume free-draining conditions and a soil expansion index of 20 or less. If conditions other than those assumed above are anticipated, revised equivalent fluid pressure values should be provided on an individual-case basis by the geotechnical engineer.

Surcharge loading effects from the adjacent structures should be evaluated by the geotechnical and structural engineers.

12.2 Footing Embedments

The base of retaining wall footings constructed on level ground may be founded at a depth of 18 inches or more below the lowest adjacent final grade. Where retaining walls are proposed on or within 15 feet from the top of an adjacent descending fill slopes, the footings should be deepened such that a horizontal clearance of H/3 or more (one-third the slope height) is maintained between the outside bottom edges of the footings and the face of the slope but not to exceed 15 feet nor be less than 5 feet. The above recommended footing setbacks are preliminary and may be revised based on site specific soil conditions. Footing or pier excavations should be observed by the project geotechnical representative to document that the footing trenches have been excavated into competent bearing soil and to the embedments recommended above. These observations should be performed prior to placing forms or reinforcing steel.

12.3 Drainage

Surcharge loading effects from the adjacent structures should be evaluated by the geotechnical and structural engineers. All retaining wall structures should be provided with appropriate wall drainage and appropriately waterproofed. The outlet pipe should be sloped to drain to a suitable outlet. It should be noted that recommended wall drains do not provide protection against seepage through the face of the wall and/or efflorescence. If such seepage or efflorescence is undesirable, retaining walls should be waterproofed to reduce this potential.

Weep holes or open vertical masonry joints should be provided in retaining walls 3 feet or less in height to reduce the likelihood of entrapment of water in the backfill. Weep holes, if used, should be 3 inches or more in diameter and provided at intervals of 6 feet or less along the wall. Open vertical masonry joints, if used, should be provided at 32-inch or less intervals. A continuous gravel fill, 12 inches by 12 inches, should be placed behind the weep holes or open masonry joints. The gravel should be wrapped in filter fabric to reduce infiltration of fines and subsequent clogging of the gravel. Filter fabric may consist of Mirafi 140N or equivalent.

In lieu of weep holes or open joints, for retaining walls less than 3 feet, a perforated pipe and gravel subdrain may be used. Perforated pipe should consist of 4-inch or more diameter PVC Schedule 40 or ABS SDR-35, with the perforations laid down. The pipe should be embedded in 1.5 cubic feet per foot of 0.75 or 1.5-inch open graded gravel wrapped in filter fabric. Filter fabric may consist of Mirafi 140N equivalent.

Retaining walls greater than 3 feet high should be provided with a continuous backdrain for the full height of the wall. This drain could consist of geosynthetic drainage composite, such as Miradrain 6000 or equivalent, or a permeable drain material, placed against the entire backside of the wall. If a permeable drain material is used, the backdrain should be 1 or more feet thick. Caltrans Class II permeable material or open graded gravel or crushed stone may be used as permeable drain material. If gravel or crushed stone is used, it should have less than 5 percent material passing the No. 200 sieve. The drain should be separated from the backfill with a geofabric. The upper 1-foot of the backdrain should be covered with compacted fill. A drainage pipe consisting of 4-inch diameter perforated pipe (described above) surrounded by 1 cubic foot per foot of gravel or crushed rock wrapped in a filter fabric should be provided along the back of the wall. The pipe should be placed with perforations down, sloped at 2 percent or more and discharge to an appropriate outlet through a solid pipe. The pipe should outlet away from structures and slopes. The outside portions of retaining walls supporting backfill should be coated with an approved waterproofing compound to inhibit infiltration of moisture through the walls.

12.4 Temporary Excavations

Retaining walls should be constructed and backfilled as soon as possible after backcut excavations are constructed. Prolonged exposure of backcut slopes may result in some localized slope instability. To facilitate retaining wall construction, the lower 5 feet of temporary slopes may be cut vertical and the upper portions exceeding a height of 5 feet should be cut back at a gradient of 1:1 (h:v) or flatter for the duration of construction. However, temporary slopes should be observed by the project geotechnical consultant for evidence of potential instability. Depending on the results of these observations, flatter slopes may be necessary. The potential effects of various parameters such as weather, heavy equipment travel, storage near the tops of the temporary excavations and construction scheduling should also be considered in the stability of temporary slopes. Water should not be permitted to drain away from the slope. Surcharges due to equipment, spoil piles, etc., should not be allowed within 10 feet of the top of the slope.

All excavations should be made in accordance with Cal/OSHA. Excavation safety is the sole responsibility of the contractor.

12.5 Retaining Wall Backfill

The retaining wall backfill soil (with an angle of internal friction of at least 33 degrees) should be placed in 6 to 8 inch loose lifts, watered or air-dried as necessary to achieve near optimum moisture conditions, and compacted to at least 90 percent relative density (based on ASTM Test Methods D2922 and D3017).

13.0 MASONRY GARDEN WALLS

13.1 Construction on Level Ground

Where masonry screen walls or garden walls are proposed on level ground and 5 feet or more from the tops of descending slopes, the footings for these walls may be founded at a depth of 18 inches or more below the lowest adjacent final grade. These footings should also be reinforced with four No. 4 bars, two top and two bottom and in accordance with the structural engineer's recommendations.

13.2 Construction Joints

In order to mitigate the potential for unsightly cracking related to the effects of differential settlement, positive separations (construction joints) should be provided in the walls at horizontal intervals of approximately 25 feet and at each corner. The separations should be provided in the blocks only and not extend through the footings. The footings should be placed monolithically with continuous rebar to serve as effective "grade beams" along the full lengths of the walls.

14.0 CONCRETE FLATWORK

14.1 Nonstructural Concrete Flatwork

Concrete flatwork (such as walkways, bicycle trails, etc.) has a high potential for cracking because of changes in soil volume related to soil-moisture fluctuations. To reduce the potential for excessive cracking and lifting, concrete should be designed in accordance with the minimum guidelines outlined in Table 6. These guidelines will reduce the potential for irregular cracking and promote cracking along construction joints but will not eliminate all cracking or lifting. Thickening the concrete and/or adding additional reinforcement will further reduce cosmetic distress.

TABLE 6
Nonstructural Concrete Flatwork for Medium Expansive Soils

	Private Sidewalks	*Private Drives*	*Patios/Entryways*	*City Sidewalk Curb and Gutters*
Minimum Thickness (in.)	4 (nominal)	5 (full)	4 (full)	City/Agency Standard
Presaturation	Presoak to 18 inches	Presoak to 18 inches	Presoak to 18 inches	City/Agency Standard
Reinforcement	—	No. 3 at 18 inches on centers	No. 3 at 18 inches on centers	City/Agency Standard
Thickened Edge	—	8" x 8"	8" X 8"	City/Agency Standard
Crack Control	Saw cut or deep open tool joint to a minimum of 1/3 the concrete thickness	Saw cut or deep open tool joint to a minimum of 1/3 the concrete thickness	Saw cut or deep open tool joint to a minimum of 1/3 the concrete thickness	City/Agency Standard
Maximum Joint Spacing	5 feet	10 feet or quarter cut whichever is closer	6 feet	City/Agency Standard

14.2 Joint Spacing

To reduce the potential for unsightly cracking, concrete sidewalks and patio type slabs should be provided with construction or expansion joints every 6 feet or less. Concrete driveway slabs should be provided with construction or expansion joints every 10 feet or less.

14.3 Subgrade Preparation

As a further measure to reduce cracking of concrete flatwork, the upper 12 inches of subgrade soil below concrete-flatwork areas should first be compacted to a relative density of 90 percent of more and then thoroughly wetted to achieve a moisture content that is equal to or slightly greater than optimum moisture content. This moisture should extend to a depth of 12 inches or more below subgrade and maintained in the soil during placement of concrete. Pre-watering of the soil will promote uniform curing of the concrete and reduce the potential for the development of shrinkage cracks. A representative of the project geotechnical consultant should observe and document the density and moisture content of the soil and depth of moisture penetration prior to placing concrete.

15.0 PLANTERS

Area drains should be extended into planters that are located within 5 feet of building walls, foundations, retaining walls and masonry garden walls to reduce excessive infiltration of water into the adjacent foundation soil. The surface of the ground in these areas should also be sloped at a gradient of 2 percent or more away from the walls and foundations. Drip-irrigation systems are also recommended to reduce overwatering and subsequent saturation of the adjacent foundation soil.

16.0 SOIL CORROSIVITY

16.1 Corrosivity to Concrete and Metal

The National Association of Corrosion Engineers (NACE) defines corrosion as "a deterioration of a substance or its properties because of a reaction with its environment". From a geotechnical viewpoint, the "environment" is the prevailing foundation soil and the "substances" are the reinforced concrete foundations or various buried metallic elements such as rebar, piles, pipes, etc., which are in direct contact with or within close vicinity of the foundation soil.

In general, soil environments that are detrimental to concrete have high concentrations of soluble sulfates. ACI 318R-05, Table 4.3.1 provides specific guidelines for the concrete mix design based on different amount of soluble sulfate content. The minimum amount of chloride ions in the soil environment that are corrosive to steel, either in the form of reinforcement protected by concrete cover, or plain steel substructures such as steel pipes or piles, is 500 ppm per California Test 532 and ACI 318R-05, Table 4.4.1.

The corrosion potential of the onsite materials was evaluated for its effect on steel and concrete. The corrosion potential was evaluated using the results of laboratory tests on representative samples obtained during our field exploration. Laboratory testing was performed to evaluate pH, minimum electrical resistivity and chloride and soluble sulfate content. Based on testing performed during this investigation within the project site, the onsite soil are classified as having a **negligible** sulfate exposure condition in accordance with ACI 318R-05, Table 4.3.1, and **negligible** chloride exposure condition in accordance with ACI 318R-05, Table 4.4.1. Based on laboratory testing of on-site soil it is also our opinion that onsite soil should be considered **moderately** corrosive to buried metals due to the low resistivity. Metal piping should be corrosion-protected or consideration should be given to using plastic piping instead of metal or plastic sleeving around the metal pipe.

Despite the minimum recommendation above, LGC is not a corrosion-engineering firm. Therefore, we recommend that you consult with a competent corrosion engineer and conduct additional testing (if required) to evaluate the actual corrosion potential of the site and to provide recommendations to reduce the corrosion potential with respect to the proposed improvements. The recommendations of the corrosion engineer may supersede the above requirements.

These recommendations are based on the current and previous samples of the subsurface soil or bedrock. The initiation of grading at the site could blend various soil types and import soil may be used locally. These changes made to the foundation soil could alter sulfate-content levels. Accordingly, it is recommended that additional testing be performed at the completion of grading.

17.0 PRELIMINARY PAVEMENT DESIGN

17.1 Visual Inspection and Mapping

Surface mapping of the existing pavement conditions was accomplished utilizing the Google Earth imagery for assessing the magnitude of the existing distress and field mapping. This was performed by an engineer from this firm on October 3, 2019.

Overall, the existing pavement exhibits moderate to severe shrinkage cracking, slight to moderate potholing, slight rutting, and local areas of moderate pavement settlement along Menlo Avenue and Girard Street. Shrinkage cracks were present in the form of longitudinal cracking, transverse cracking, and alligator cracking with an average maximum thickness of 1.5 inches. Typical factors that can cause shrinkage cracking within the AC include volume change in the AC mix, volume changes in the subgrade materials, age of the pavement, and/or combinations of these factors. Rutting was observed within severe areas of shrinkage cracking along within localized areas of pavement settlement. Rutting

and pavement settlement in AC is usually caused by consolidation or lateral movement of subgrade materials from traffic loading and/or inadequate pavement section thickness. Potholing was observed in areas where cracks were present throughout entire thicknesses of asphaltic concrete representing complete structural failure of pavement section.

Generally, Menlo Avenue was observed to have moderate to severe shrinkage cracking, slight rutting, slight to moderate rutting, and local areas of moderate pavement settlement was observed in the following areas:

- Moderate to severe shrinkage cracking within Menlo Avenue was observed in both the east and west bound lanes.
- Severe longitudinal cracking and alligator cracking was observed along the centerline of Menlo Avenue.
- Moderate to severe transverse cracking was observed throughout Menlo Avenue.
- Slight rutting was observed along the centerline of Menlo Avenue within areas of severe shrinkage cracking.
- A localized area of pavement settlement was observed in the east bound lane that appeared to be in line within an existing utility trench.
- Moderate cracking ranged from ¼ inches to ¾ inches and severe cracking ranged from ¾ inches to 2 inches wide.

Light to severe shrinkage cracking was observed within Girard Avenue along with localized areas of moderate pavement section settlement:

- Light to moderate longitudinal shrinkage cracking was observed along the centerline of Girard Avenue.
- Moderate to severe transverse shrinkage cracking was observed within Girard Avenue. Severe cracks were observed to have widths up to 3.5 inches.
- Severe alligator cracking and moderate pavement settlement was observed within southbound lane of Girard Avenue.

17.2 Subsurface Exploration

The site subsurface conditions were explored by LGC on October 3, 2019 by means of two (2) cores excavated with a hand auger within Menlo Avenue. Continuous logs of the subsurface borings are presented within Appendix B. The approximate locations of the cores, with respect to the subject streets, are presented on the Geotechnical Map (Figure 1). Cores C-1 and C-2 were distributed throughout critical areas of the proposed street improvements and ranged in depth from approximately 5.0 feet below ground surface to approximately 6.0 feet below ground surface. Excavations were performed in such a manner to expose, observe, and measure the contacts between the pavement, base materials, and the subgrade. Additionally, the pavement structural sections were measured during our subsurface exploration. Field measurements of the core log thicknesses are presented within Appendix B of this report. The materials encountered in the exploratory cores were continuously logged and visually classified by a geologist from this firm, in accordance with the visual manual procedures of the Unified Soil Classification System.

A representative bulk sample was collected during the field exploration for pavement evaluation.

17.3 Preliminary Pavement Structural Section Designs

Structural pavement section design recommendations presented herein are based on soil samples recovered during our subsurface exploration. However, it should be understood that the soil material exposed during grading may differ from the materials sampled and tested during this investigation. Therefore, preliminary pavement recommendations are subject to verification and possible revision based on observations and possible sampling and testing of subgrade soils that exist after grading.

For purposes of design, we have prepared the following pavement structural sections based on R-values acquired during our recent laboratory testing (Appendix C). The assigned Traffic Indices (T.I.) of 5.5, 7.0, and 8.5 utilized in pavement section calculations was taken from the City of Hemet General Plan 2030, Chapter 4, and County of Riverside Roadway Design Requirements. Since the subgrade R-Value quality of the soils may change, laterally, based on the available laboratory testing, Table 7 proposes the following pavement designs for the areas indicated below:

TABLE 7
Preliminary Pavement Design

AREA	ASSUMED TRAFFIC INDEX	DESIGN R-VALUE	ASPHALTIC CONCRETE (AC) Inches)	AGGREGATE BASE (AB) (AB)(Inches)
Menlo Avenue	8.5	30	6.0	11.0
N. Girard Street	7.0	17	5.0	11.0
Park Avenue	8.5	67	6.0	11.0
Interior Roads	5.5	67	3.0	6.0

Aggregate base materials may consist of crushed miscellaneous base (CMB) or Class 2 aggregate base materials.

Subgrade soil immediately below the aggregate base (base) should be compacted to a minimum of 95 percent relative compaction based on ASTM Test Method D1557 to a minimum depth of 12 inches. Final subgrade compaction should be performed prior to placing base or asphaltic concrete and after all utility trench backfills have been compacted and tested.

Base materials should consist of crushed aggregate base conforming to Section 200-2 of Greenbook and should be compacted to at least 95 percent of the laboratory maximum dry density determined in accordance with ASTM D1557.

Our preliminary pavement recommendations should be considered as minimum and can be revised once actual T.I.'s are known or superseded by the City of Hemet.

17.4 *Pavement Rehabilitation*

Based on existing pavement section thicknesses observed within Menlo Avenue, lack of base material, and the extent of observed cracking within Menlo Avenue and Girard Avenue, the existing pavement does not meet current standards and has started failing due to traffic loads. Areas of moderate to severe cracking and localized areas of moderate settlement should be overexcavated at least 3 feet below existing AC grade and 3 feet outside the distressed area; then replaced with 2 feet of compacted fill to 90% compaction, except for the upper 12 inches of subgrade which should be 95% compaction within all streets. Table 7 above provides preliminary pavement designs to assist in the rehabilitation.

18.0 PLAN REVIEWS AND CONSTRUCTION SERVICES

This is a preliminary geotechnical investigation report prepared for the exclusive use of **Sikand Engineering,** to assist the project engineer and architect in the design of the proposed development. It is recommended that LGC be engaged to review the rough grading plans, foundation plans and other pertinent final design drawings and specifications prior to construction. This is to document that the recommendations contained in this report have been properly interpreted and are incorporated into the project specifications. LGC's review of the final grading plans may indicate that additional subsurface exploration, laboratory testing and analysis should be

performed to address areas of concern. If LGC is not accorded the opportunity to review these documents, we can take no responsibility for misinterpretation of our recommendations.

We recommend that LGC be retained to provide geotechnical engineering services during both the rough grading and construction phases of the work. This is to document compliance with the design, specifications or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

If the project plans change significantly (e.g., building loads or type of structures), LGC should be retained to review our original design recommendations and their applicability to the revised construction. If conditions are encountered during construction that appear to be different than those indicated in this report, this office should be notified immediately. Design and construction revisions may be required.

19.0 LIMITATIONS

Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable engineers and geologists practicing in this or similar localities. The professional opinions contained herein have been derived in accordance with current standards of practice for preliminary reports. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report. The samples taken and submitted for laboratory testing, the observations made and the in-situ field testing performed are believed representative of the entire project; however, soil and geologic conditions can vary in characteristics between excavations, both laterally and vertically and may be different than our preliminary findings.

If this occurs, the changed conditions must be evaluated by the project geotechnical engineer and engineering geologist and design(s) adjusted as required or alternate design(s) recommended.

This report is issued with the understanding that it is the responsibility of the owner, or of his/her representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and/or project engineer and incorporated into the plans, and the necessary steps are taken to see that the contractor and/or subcontractor properly implements the recommendations in the field. The contractor and/or subcontractor should notify the owner if they consider any of the recommendations presented herein to be unsafe.

The conclusions and opinions contained in this report are based on the results of the described geotechnical evaluations and represent our professional judgment. The findings, conclusions and recommendations contained in this report are to be considered preliminary only and subject to confirmation by the undersigned during the construction process. Without this confirmation, this report is to be considered incomplete and LGC or the undersigned professionals assume no responsibility for its use.

The conclusions and opinions contained in this report are valid up to a period of 2 years from the date of this report. Changes in the conditions of a property can and do occur with the passage of time, whether they be because of natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate codes or standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, if any of the above-mentioned situations occur, an update of this report should be completed.

This report has not been prepared for use by parties or projects other than those named or designed above. It may not contain sufficient information for other parties or other purposes.

The opportunity to be of service is appreciated. Should you have any questions regarding the content of this report, or should you require additional information, please do not hesitate to contact this office at your earliest convenience.

APPENDIX A

REFERENCES

APPENDIX A

References

Blake, T.F., 1998, Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada, Prepared by California Division of Mines and Geology.

California Division of Mines and Geology, 2000, "Digital Images of Official Maps of Alquist-Priolo Earthquake Fault Zones of California, Southern Region", CD 2000-003.

California Department of Water Resources, Water Data Library, Groundwater Levels for Station 337574N1169698W001, accessed October 10. 2019.

Dibble, Thomas W., and Minch, John A., 2003, Geologic Map of The San Jacinto Quadrangle Riverside County, California. Dibble Geological Foundation.

EQFAULT, Seismic Hazard Analysis, (33.7594, -1169525), accessed October 10, 2019.

Gary S Rasmussen & Associates, 1988, Geologic Update and Supplementary Subsurface Engineering Geology Investigation of Approximately 13.4 Acres, Northwest Corner of Menlo Avenue and Park Avenue, Hemet, California, Project No. 1428.1.

Greensfelder, R.W., 1974, Maximum Credible Rock Accelerations from Earthquakes in California, CDMG, MS-23.

Hart, Earl W., and William, A. Bryant, 1997, Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Map, Special Publication 42, Revised 1997, Supplements 1 and 2 added 1999.

Hayes, Walter W., 1980, Procedures for Estimating Earthquake Engineering, edited by R.W. Weigel.

Jennings, Charles W., 1994, Fault Activity Map of California and Adjacent areas, Map No. 6, California Division of Mines and Geology.

LGC Geo-Environmental, Inc., 2018 "*Supplmental Geologic Hazard Study Of The Riverside County Earthquake Zone, For The Proposed Residential Development, Located At 800 N.Girard Street, City Of Hemet, Riverside County, California*" dated September 10.

Sikand Engineering, 2018, Preliminary Site Plan, Scale 1" = 60', Sheet 1 of 1, no date.

APPENDIX B

FIELD EXPLORATION TRENCHES AND CORE LOGS

APPENDIX B

Field Exploration

B-1 General

Geologic mapping of the site was carried out by LGC's personnel. The locations of the exploratory excavations were chosen to obtain subsurface information needed to achieve the objective for this investigation.

A visual survey was conducted to verify that the proposed excavations would not encounter any subsurface utility lines. No underground lines were encountered during the field exploratory program.

B-2 Excavation, Trenching and Sampling

Our initial subsurface exploration was performed on October 3, 2019, which included trenching, logging and sampling five (5) trenches, to depths ranging from 5.5 feet to 17.5 feet, and hand augering 2 cores on Menlo Ave to depths of 5 feet and 6 feet, for pavement evaluation. Logs of the trenches and cores are presented in Appendix B, and their approximate locations are depicted on the Geotechnical Map (Plate 1).

Prior to the subsurface work, an underground utilities clearance was obtained from Underground Service Alert of Southern California. At the conclusion of the subsurface investigation, all borings were backfilled with native materials. Minor settlement of the backfill soil may occur over time.

During our subsurface investigation, representative bulk and relatively undisturbed samples were retained for laboratory testing. Laboratory testing was performed on selected representative samples of onsite soil samples and included maximum dry density and optimum moisture content, expansion index, sulfate content, chloride content, pH, resistivity, direct shear, Atterberg limit, and R-Values. A discussion of the tests performed and a summary of the results are presented in Appendix C. Moisture and density test results are presented on the trench logs which are presented on the following pages.

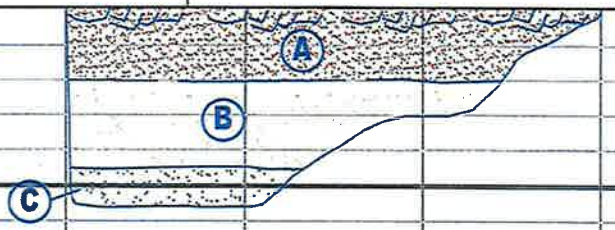
B-3 Miscellaneous

The trench logs describe the earth materials encountered, sampling method used, and field and laboratory tests performed. The logs also show the trench number, date of completion, and the name of the logger. A geologist logged the trenches in accordance with the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2488-93. The boundaries between soil types shown on the logs are approximate and the transition between different soil layers may be gradual. The logs of the trenches are presented on the following pages.

Project Name: Sikand	Logged by: JL	LOG OF TRENCH TR-1
Project Number: G18-1647-10	Elevation: 1607'	Engineering Properties
Equipment: BACKHOE	Location/Grid: SEE INFILTRATION TEST MAP	

Depth	Date: 10/3/2019 Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0.0'-2.0'	A ARTIFICIAL FILL, UNDOCUMENTED: Silty SAND; light brown, dry, loose to medium dense, very fine to fine grained, roots, roothairs, blocky, desiccated	Afu	SM	Bulk @ 0.0'-3.0' Nuke @0.0'	1.5	94.3
2.0'-4.5'	B ALLUVIUM: Silty SAND; yellowish brown, moist, loose, very fine to fine grained with occasional coarse grains, roothairs	Qal		Bulk @ 2.0'-5.0' Nuke @ 3.0'	3.2	85.7
4.5'-5.5'	C @4.5'; brown, caliche nodules			Nuke @ 5.5'	2.3	91.9

GRAPHICAL REPRESENTATION: EAST WALL	SCALE: 1" = 5'	SURFACE SLOPE: LEVEL	TREND: N5W

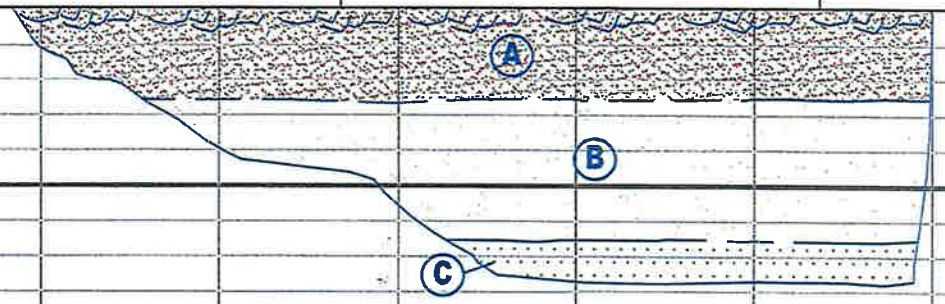


TOTAL DEPTH= 5.5 FEET
NO GROUNDWATER ENCOUNTERED

Project Name: Sikand	Logged by: JL	LOG OF TRENCH TR-2
Project Number: G18-1647-10	Elevation: 1611'	Engineering Properties
Equipment: BACKHOE	Location/Grid: SEE INFILTRATION TEST MAP	

Depth	Date: 10/3/2019 / Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0.0'-2.5'	A ARTIFICIAL FILL, UNDOCUMENTED: Silty SAND; yellowish brown, dry, loose to medium dense, very fine to fine grained with some coarse grains, roots, roothairs, blocky, desiccated	Afu	SM	Nuke @ 0.0'	1.4	99.4
2.5'-6.5'	B ALLUVIUM: Silty SAND; light brown to brown, moist, loose, very fine to fine grained, roothairs, tree roots, pinhole pores	Qal		Nuke @ 6.5'	5.7	83.8
6.5'-7.5'	C @6.5'; orangish brown, moist, medium dense, fine grained, caliche stringers		SM/ML	Nuke @ 7.5'	4.8	97.3

GRAPHICAL REPRESENTATION: EAST WALL	SCALE: 1" = 5'	SURFACE SLOPE: LEVEL	TREND: N70E

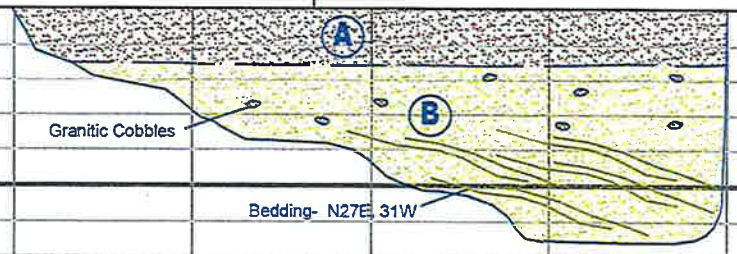


TOTAL DEPTH= 7.5 FEET
NO GROUNDWATER ENCOUNTERED

Project Name: Sikand	Logged by: JL	LOG OF TRENCH TR-3
Project Number: G18-1647-10	Elevation: 1616'	Engineering Properties
Equipment: BACKHOE	Location/Grid: SEE INFILTRATION TEST MAP	

Depth	Date: 10/3/2019 Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0.0'-1.5'	A ARTIFICIAL FILL, UNDOCUMENTED: Silty SAND; light brown, dry, medium dense, very fine to coarse grained with some gravels, roots, roothairs	Afu	SM	Nuke @ 0.0'	0.2	102.5
1.5'-6.5'	B BAUTISTA FORMATION: SANDSTONE/SILTSTONE; gray to light brown, moist, moderately hard, medium to coarse grained with gravels, weathered granitic clasts, manganese staining, oxidation staining, bedding	Qts		Bulk @ 1.0'-5.0' Nuke @ 6.5'	3.0	107.0

GRAPHICAL REPRESENTATION: SOUTH WALL	SCALE: 1" = 5'	SURFACE SLOPE: LEVEL	TREND: N59E



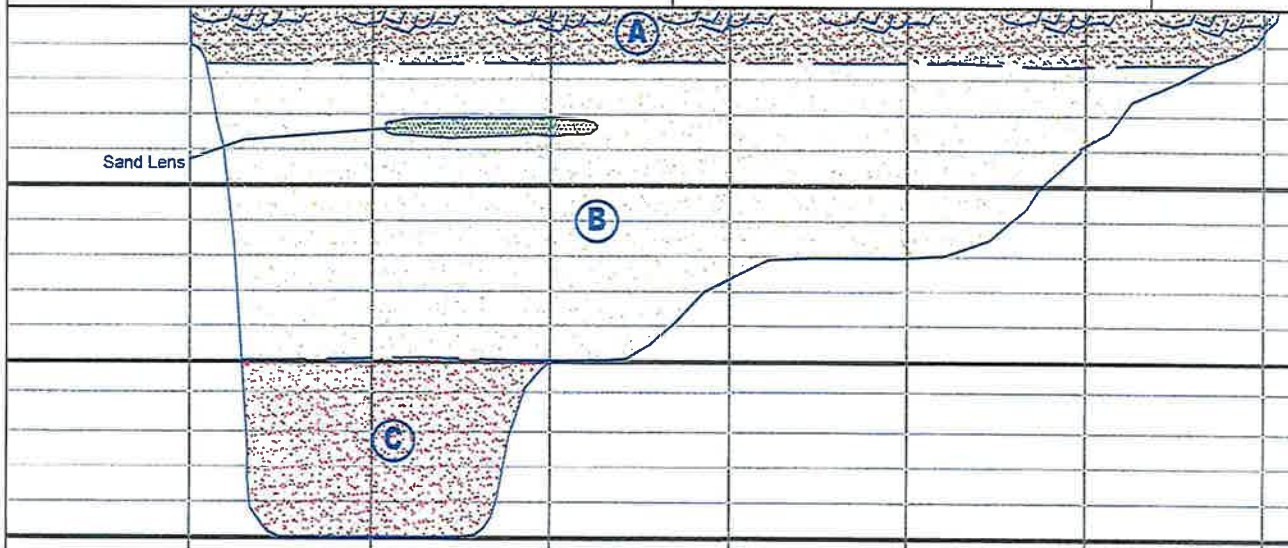
TOTAL DEPTH= 6.5 FEET
NO GROUNDWATER ENCOUNTERED

77

Project Name: Sikand	Logged by: JL	LOG OF TRENCH TR-4
Project Number: G18-1647-10	Elevation: 1629'	Engineering Properties
Equipment: BACKHOE	Location/Grid: SEE GEOTECHNICAL MAP	

Depth	Date: 10/3/2019 / Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0.0'-1.5'	A ARTIFICIAL FILL, UNDOCUMENTED: Silty SAND; light brown, dry, loose to medium dense, fine to medium grained with some coarse grains, roots, roothairs, blocky, desiccated	Afu	SM	Bulk @ 0.0'-3.0' Nuke @0.0'	0.2	94.7
1.5'-10.0'	B ALLUVIUM: Silty SAND; yellowish brown, dry to moist, medium dense, fine to medium grained with occasional coarse grains, roothairs, pinhole pores, trace oxidation staining, caliche nodules, sand lens	Qal		Bulk @ 2.0'-5.0' Nuke @ 6.0'	1.8	103.1
10.0'-15.0'	C Poorly-graded SAND with SILT; orangish brown, moist, medium dense, fine to medium grained with some coarse grains, trace oxidation, micaceous		SP/SM	Bulk @ 10.0'-15.0' Nuke @ 10.0'	2.5	105.3

GRAPHICAL REPRESENTATION: EAST WALL	SCALE: 1" = 5'	SURFACE SLOPE: LEVEL	TREND: N29W

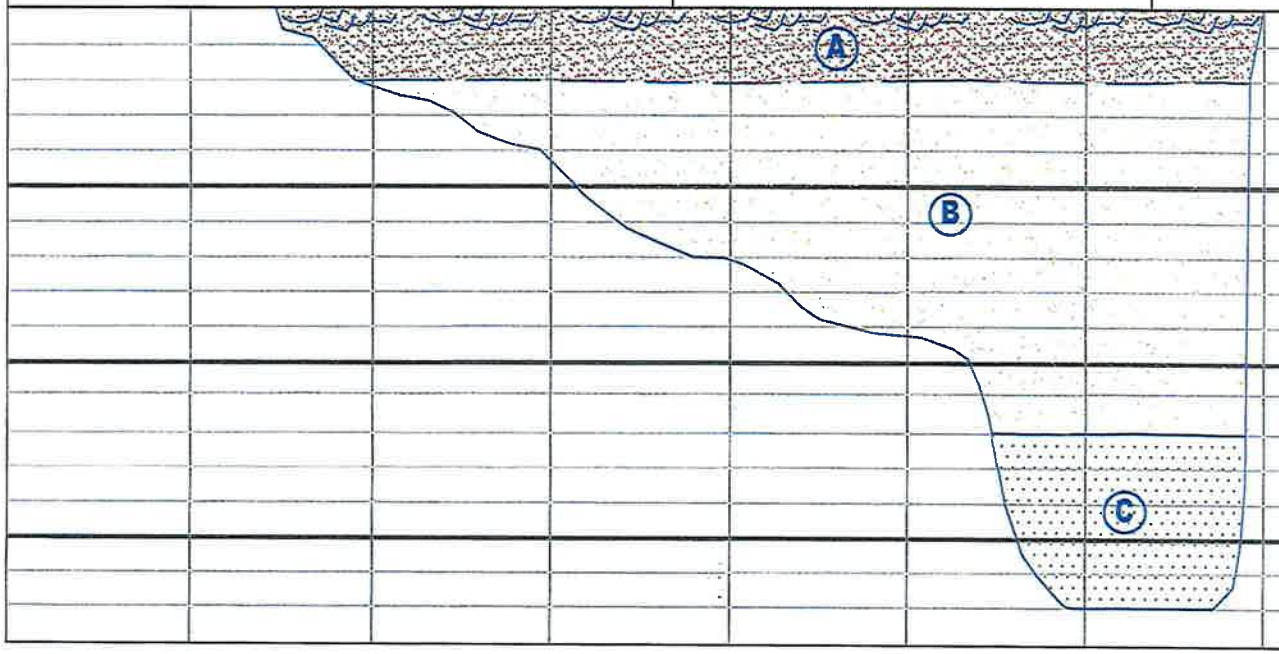


TOTAL DEPTH=15.0 FEET
NO GROUNDWATER ENCOUNTERED

Project Name: Sikand	Logged by: JL	LOG OF TRENCH TR-5
Project Number: G18-1647-10	Elevation: 1617'	Engineering Properties
Equipment: BACKHOE	Location/Grid: SEE GEOTECHNICAL MAP	

Depth	Date: 10/3/2019 Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0.0'-2.0'	A ARTIFICIAL FILL, UNDOCUMENTED: Silty SAND; light brown, dry, loose to medium dense, very fine to fine grained with occasional coarse grains, roots, roothairs, blocky, desiccated	Afu	SM	Bulk @ 0.0'-6.0' Nuke @0.0'	0.3	92.8
2.0'-12.0'	B ALLUVIUM: Silty SAND; yellowish brown, moist, loose to medium dense, very fine to fine grained with occasional coarse grains and gravel, roothairs, caliche nodules, pinhole pores	Qal		Nuke @ 6.0'	7.1	88.2
12.0'-17.0'	C SILT with CLAY; orangish brown to grayish brown, moist, loose to medium dense, very fine, roothairs, micaceous		ML/CL	Bulk @ 12.0'-17.0'		

GRAPHICAL REPRESENTATION: SOUTH WALL	SCALE: 1" = 5'	SURFACE SLOPE: LEVEL	TREND: N79E



TOTAL DEPTH=17.5 FEET
NO GROUNDWATER ENCOUNTERED

Geotechnical Boring Log C-1

Date: 10/3/19	**Project Name:** SIKAND	Page 1 of 1
Project Number: G18-1647-10	**Logged By:** JW/AJR	
Drilling Company:	**Type of Rig:** HAND AUGER	
Drive Weight (lbs.):	**Drop (in.):** **Hole Dia. (in.):** 5"	
Top of Hole Elevation (ft): 1,624'	**Hole Location:** SEE GEOTECHNICAL MAP	

Elevation (MSL) and Depth (ft.)	Blow Count / 6"	Sample No.	Soil Graphic	Geologic / Group Symbol	DESCRIPTION	In-Situ Moist.(%)	Dry Density (pcf)	Standard Penetration Test SPT Depth	SPT N	CURVE 10 30 50	Type of Test
0				Afu SM	**ASPHALT** grayish black A/C **ARTIFICIAL FILL, UNDOCUMENTED** Silty SAND; grayish brown, dry, very fine to medium grained with some coarse grains and occasional very coarse grains, micaceous @4.0'; dark olive brown, dry to damp, very fine to fine grained with some medium grains						
1620 5					Total Depth: '6						
1615 10											
1610 15											
1605 20											
1600 25											
1595 30											

Sample Legend

- SPT
- Ring Sample (CA modified)

LGC GEO-ENVIRONMENTAL, INC.

Geotechnical Boring Log C-2

Date: 10/3/19	**Project Name:** SIKAND	Page 1 of 1
Project Number: G18-1647-10	**Logged By:** JW/AJR	
Drilling Company:	**Type of Rig:** HAND AUGER	
Drive Weight (lbs.):	**Drop (in.):** **Hole Dia. (in.):** 5"	
Top of Hole Elevation (ft):	**Hole Location:** SEE GEOTECHNICAL MAP	

Elevation (MSL) and Depth (ft.)	Blow Count / 6"	Sample No.	Soil Graphic	Geologic / Group Symbol	DESCRIPTION	In-Situ Moist.(%)	Dry Density (pcf)	Standard Penetration Test SPT Depth	SPT N	Standard Penetration Test CURVE 10 30 50	Type of Test
0				Afu SM	**ASPHALT** grayish black A/C **ARTIFICIAL FILL, UNDOCUMENTED** Silty SAND; grayish brown, dry, very fine to medium grained with some coarse grains and occasional very coarse grains, micaceous @4.0'; dark olive brown, dry to damp, very fine to fine grained with some medium grains						
5					Total Depth: '5						
10											
15											
20											
25											
30											

Sample Legend

- SPT
- Ring Sample (CA modified)

LGC Geo-Environmental, Inc.

APPENDIX C

LABORATORY TESTING PROCEDURES AND TEST RESULTS

APPENDIX C

Laboratory Testing Procedures and Test Results

The laboratory testing program was directed towards providing quantitative data relating to the relevant engineering properties of the soil. Samples considered representative of site conditions were tested in general accordance with American Society for Testing and Materials (ASTM) procedure and/or California Test Methods (CTM), where applicable. The following summary is a brief outline of the test type and a table summarizing the test results.

Soil Classification: Soil were classified according the Unified Soil Classification System (USCS) in accordance with ASTM Test Methods D2487 and D2488. The soil classifications (or group symbol) are shown on the laboratory test data, and boring logs.

Maximum Dry Density Tests: The maximum dry density and optimum moisture content of typical materials were determined in accordance with ASTM test method D1557. The test results are presented in the table below:

SAMPLE LOCATION	SAMPLE DESCRIPTION (USCS)	MAXIMUM DRY DENSITY (% by weight)	OPTIMUM MOISTURE CONTENT (%)
TR-4 @ 10'-15'	Poorly Graded SAND (SP)	127.5	8.0
TR-5 @ 0'-6'	Silty SAND (SM)	124.2	11.0

Expansion Index: The expansion potential of a selected sample was evaluated by the Expansion Index Test, U.B.C. Standard No. 18-2 and/or ASTM test method D4829. Specimens are molded under a given compactive energy at or near the optimum moisture content and approximately 50 percent saturation or approximately 90 percent relative compaction. The prepared 1-inch thick by 4-inch diameter specimens are loaded to an equivalent 144 psf surcharge and are inundated with tap water until volumetric equilibrium is reached. The results of these tests are presented in the table below:

SAMPLE LOCATION	*SAMPLE DESCRIPTION (USCS)*	*EXPANSION INDEX*	*EXPANSION POTENTIAL**
TR-5 @ 0'-6'	Silty SAND (SM)	67	Medium

*Per ASTM D4829

Soluble Sulfates: The soluble sulfate content of selected samples was determined by standard geotechnical methods (CTM 417). The soluble sulfate content is used to determine the appropriate cement type and maximum water-cement ratios. The test results are presented in the table below:

SAMPLE LOCATION	*SAMPLE DESCRIPTION (USCS)*	*SULFATE CONTENT (ppm)*	*SULFATE EXPOSURE**
TR-5 @ 0'-6'	Silty SAND (SM)	Non-Detected	Negligible

*Per ACI 318R-05 Table 4.3.1

Chloride Content: Chloride content was tested with CTM 422. The results are presented below:

SAMPLE LOCATION	*SAMPLE DESCRIPTION (USCS)*	*CHLORIDE CONTENT (ppm)*
TR-5 @ 0'-6'	Silty SAND (SM)	21

Minimum Resistivity and pH Tests: Minimum resistivity and pH tests were performed with CTM 643. The results are presented in the table below:

SAMPLE LOCATION	SAMPLE DESCRIPTION (USCS)	pH	MINIMUM RESISTIVITY (ohm-cm)
TR-5 @ 0'-6'	Silty SAND (SM)	8.2	2,100

Direct Shear: Direct shear tests were performed on selected remolded samples, which were soaked for a minimum of 24 hours under a surcharge equal to the applied normal force during testing. After transfer of the sample to the shear box, and reloading the sample, pore pressures set up in the sample due to the transfer were allowed to dissipate for a period of approximately 1 hour prior to application of shearing force. The samples were tested under various normal loads, a motor-driven, strain-controlled, direct-shear testing apparatus at a strain rate of less than 0.001 to 0.5 inch per minute (depending upon the soil type). The graphical test results are presented in the table below:

SAMPLE LOCATION	SAMPLE DESCRIPTION	ANGLE OF INTERNAL FRICTION (degrees)	COHESION (psf)
TR-5 @ 0'-6'	Silty SAND (SM)	28	160

Atterberg Limits: The liquid and plastic limits ("Atterberg Limits") were determined with ASTM D4318 for engineering classification of fine material and presented in the table below:

SAMPLE LOCATION	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	USCS SOIL SYMBOL
TR-5 @ 0'-6'	31	19	12	SM

R-Value: The resistance R-value was determined by the ASTM test method D2844 for base, sub-base, and basement soil. The samples were prepared and exudation pressure and R-value were determined. These results were used for pavement design:

SAMPLE LOCATION	SAMPLE DESCRIPTION (USCS)	R-VALUE
TR-1 @ 0'-3'	Silty SAND (SM)	17
TR-4 @ 0'-3'	Silty SAND (SM)	67
Menlo Ave 0.5'-1.5'	Silty SAND (SM)	30

APPENDIX D

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

APPENDIX D

General Earthwork and Grading Specifications

1.0 General

1.1 ***Intent:*** These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 ***The Geotechnical Consultant of Record:*** Prior to commencement of work, the owner shall employ a qualified Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to confirm that the attained level of compaction is being accomplished as specified. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 ***The Earthwork Contractor:*** The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the project plans and specifications. The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "equipment" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading.

The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate personnel will be available for observation and testing. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory

conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified. It is the contractor's sole responsibility to provide proper fill compaction.

2.0 Preparation of Areas to be Filled

2.1 Clearing and Grubbing: Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 10 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed. The contractor is responsible for all hazardous waste relating to his work. The Geotechnical Consultant does not have expertise in this area. If hazardous waste is a concern, then the Client should acquire the services of a qualified environmental assessor.

2.2 Processing: Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soil are broken down and free of oversize material and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 Overexcavation: In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 Benching: Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 Evaluation/Acceptance of Fill Areas: All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 General: Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soil of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soil to achieve satisfactory fill material.

3.2 Oversize: Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 Import: If importing of fill material is required for grading, proposed import material shall meet the requirements of this Section. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 Fill Layers: Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 Fill Moisture Conditioning: Fill soil shall be watered, dried back, blended, and/or mixed, as necessary to attain relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557-91).

4.3 Compaction of Fill: After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557-91). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 Compaction of Fill Slopes: In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557-91.

4.5 Compaction Testing: Field tests for moisture content and relative compaction of the fill soil shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 Frequency of Compaction Testing: Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soil embankment. In addition, as a

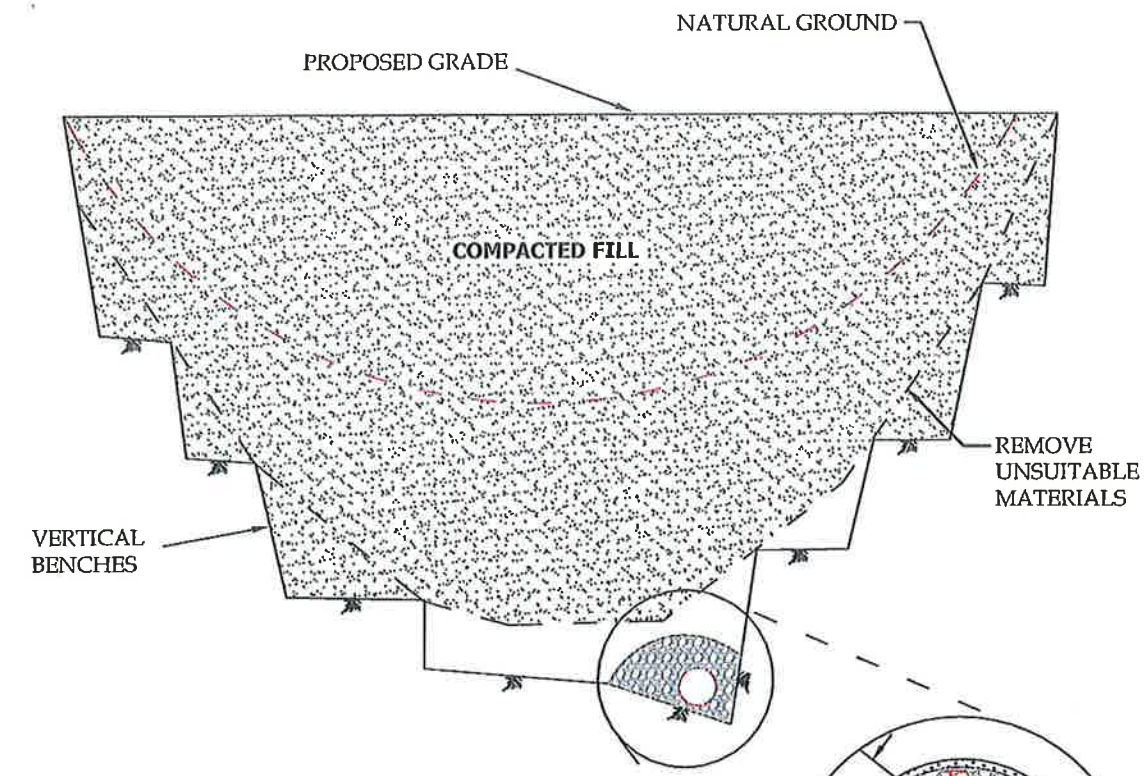
guideline, at least one (1) test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 Compaction Test Locations:

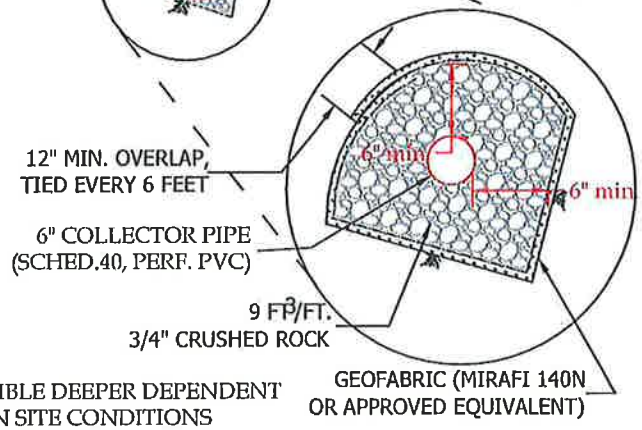
The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two (2) grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

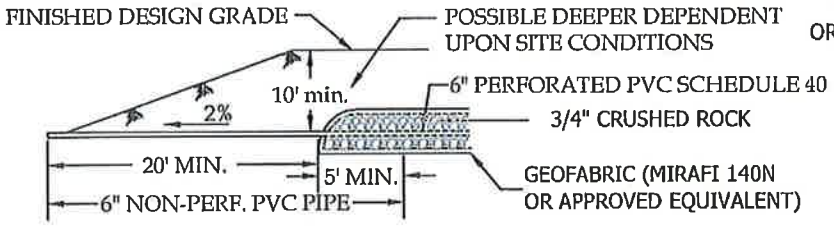
Subdrain systems shall be installed in accordance with the approved geotechnical report(s) and grading plan. The Geotechnical Consultant may recommend additional subdrain and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.



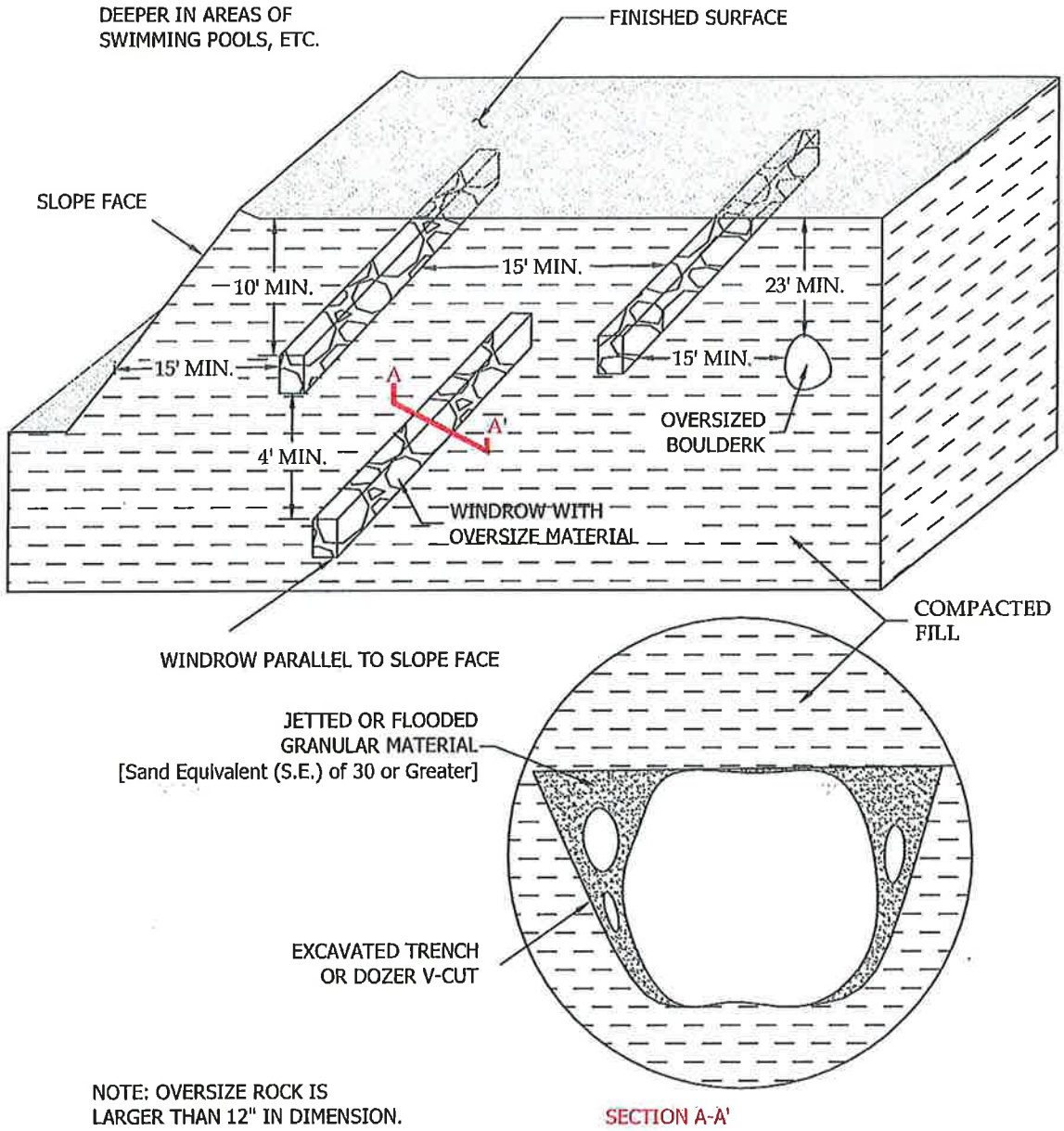
Notes:
1) Continuous runs in excess of 500' shall use 8" diameter pipe.
2) Final 20' of pipe at outlet shall be non-perforated and backfilled with fine-grained material.



OUTLET DETAIL



CANYON & STREET SUBDRAINS

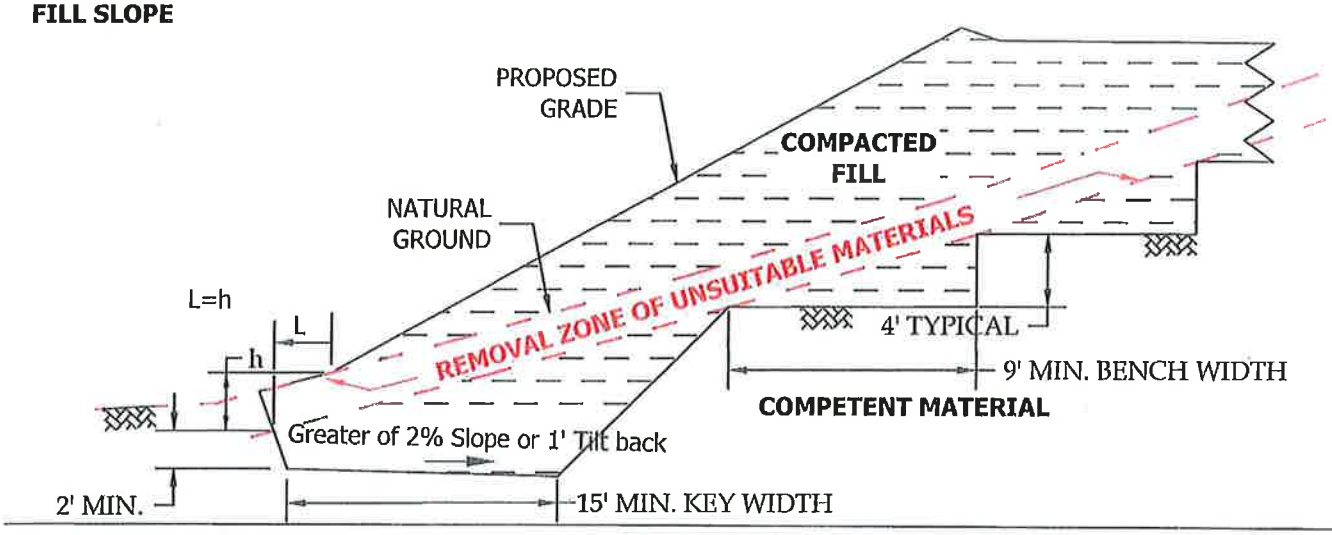


NOTE: OVERSIZE ROCK IS
LARGER THAN 12" IN DIMENSION.

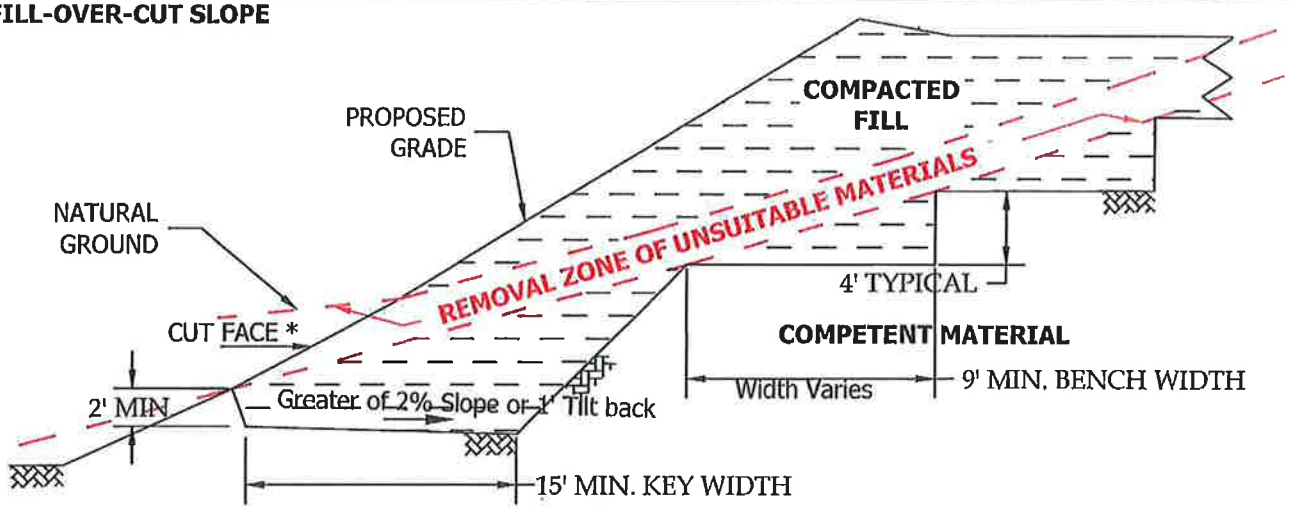
SECTION A-A'

OVERSIZE ROCK DISPOSAL

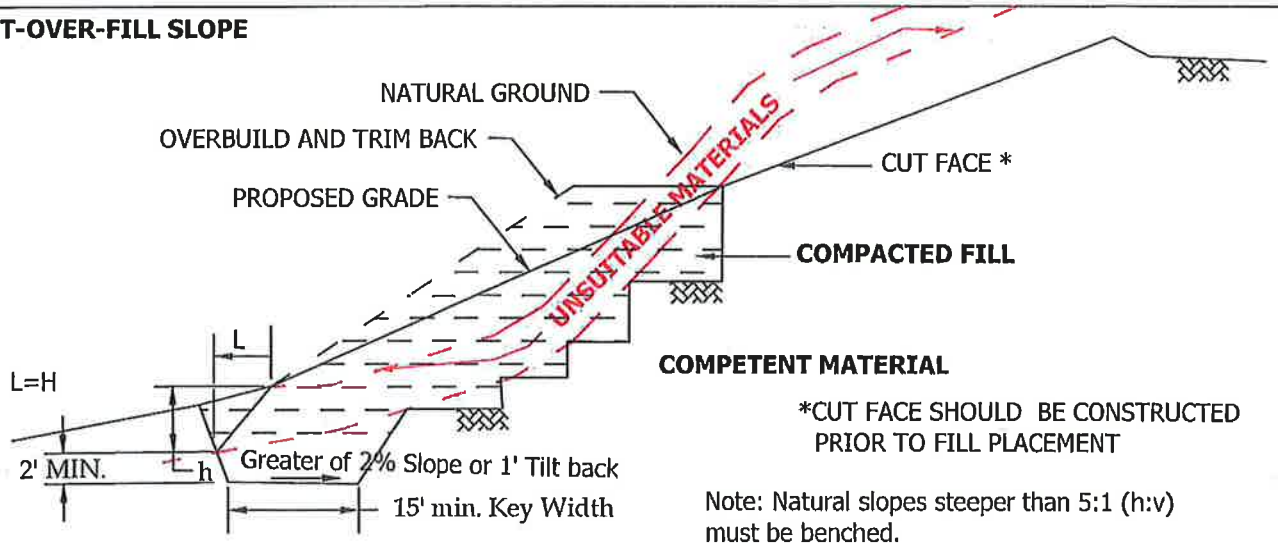
FILL SLOPE



FILL-OVER-CUT SLOPE



CUT-OVER-FILL SLOPE

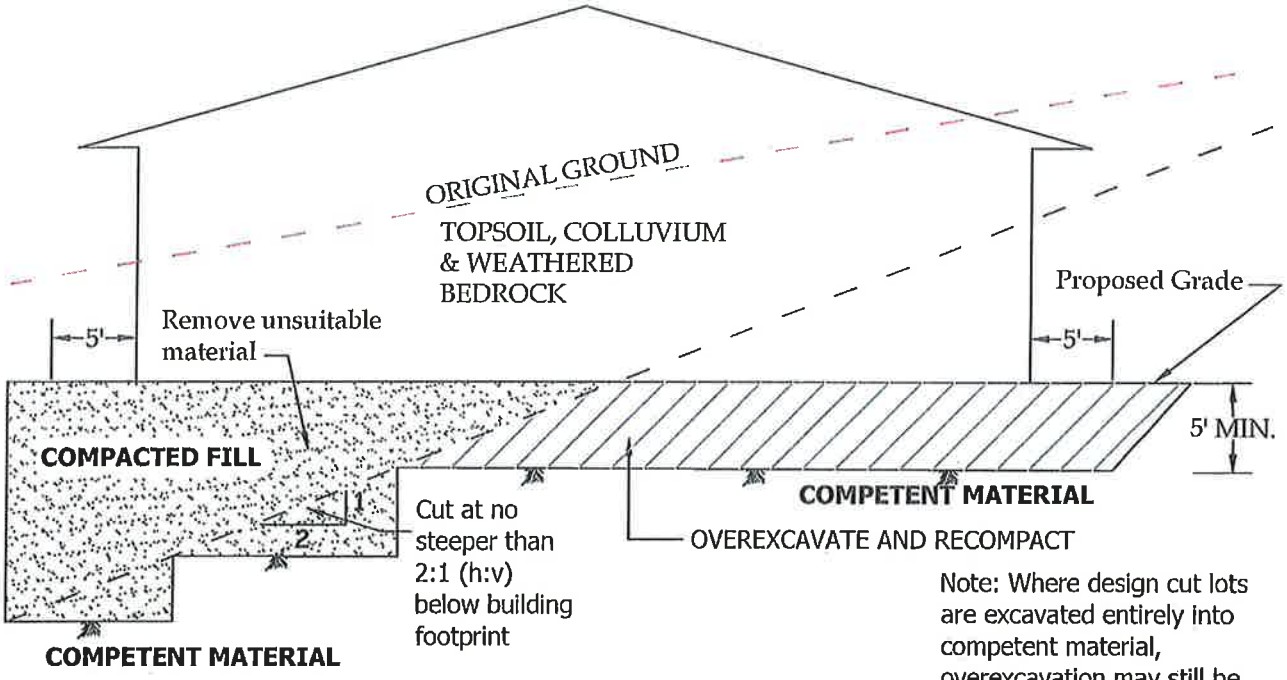


*CUT FACE SHOULD BE CONSTRUCTED PRIOR TO FILL PLACEMENT

Note: Natural slopes steeper than 5:1 (h:v) must be benched.

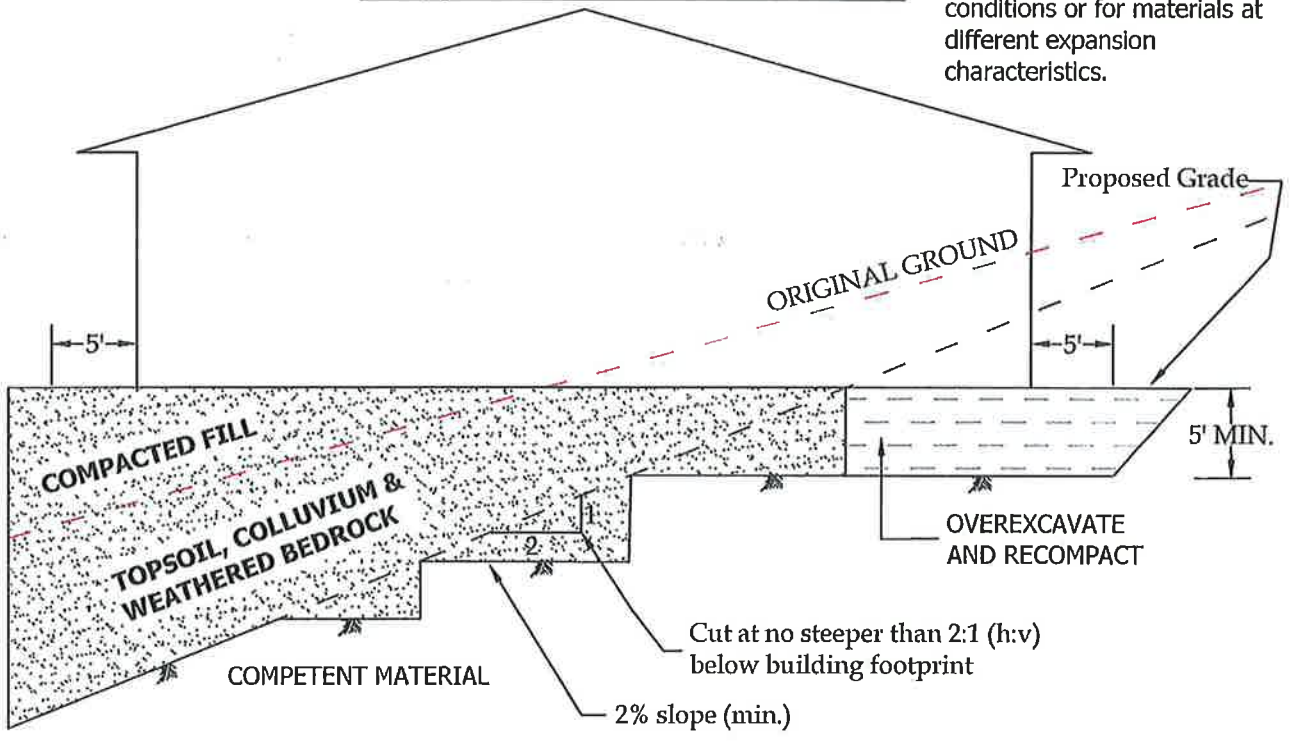
KEYING AND BENCHING

CUT LOT
(Exposing Unsuitable Soils/Bedrock @ Design Grade)

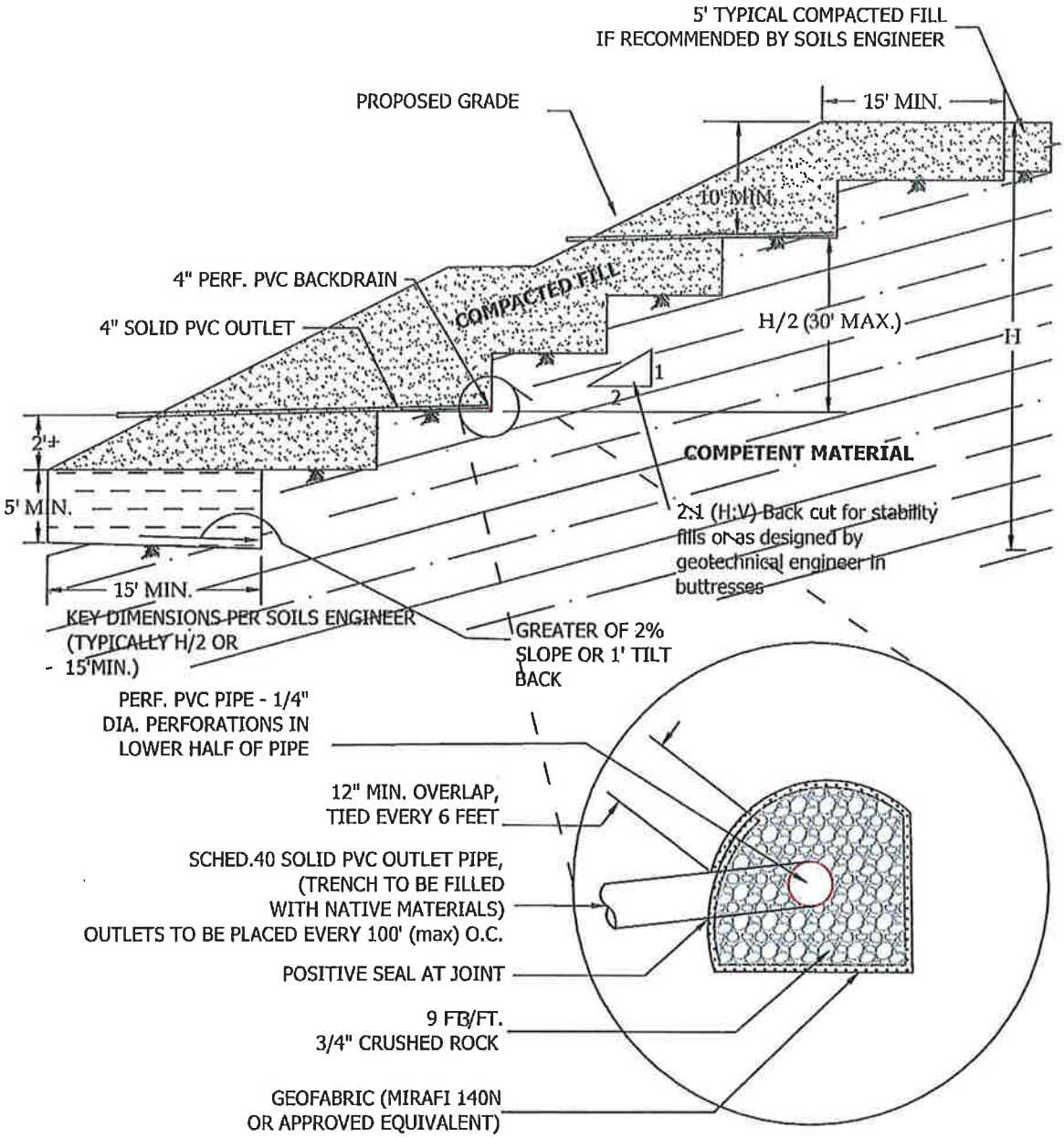


Note: Where design cut lots are excavated entirely into competent material, overexcavation may still be required for hard-rock conditions or for materials at different expansion characteristics.

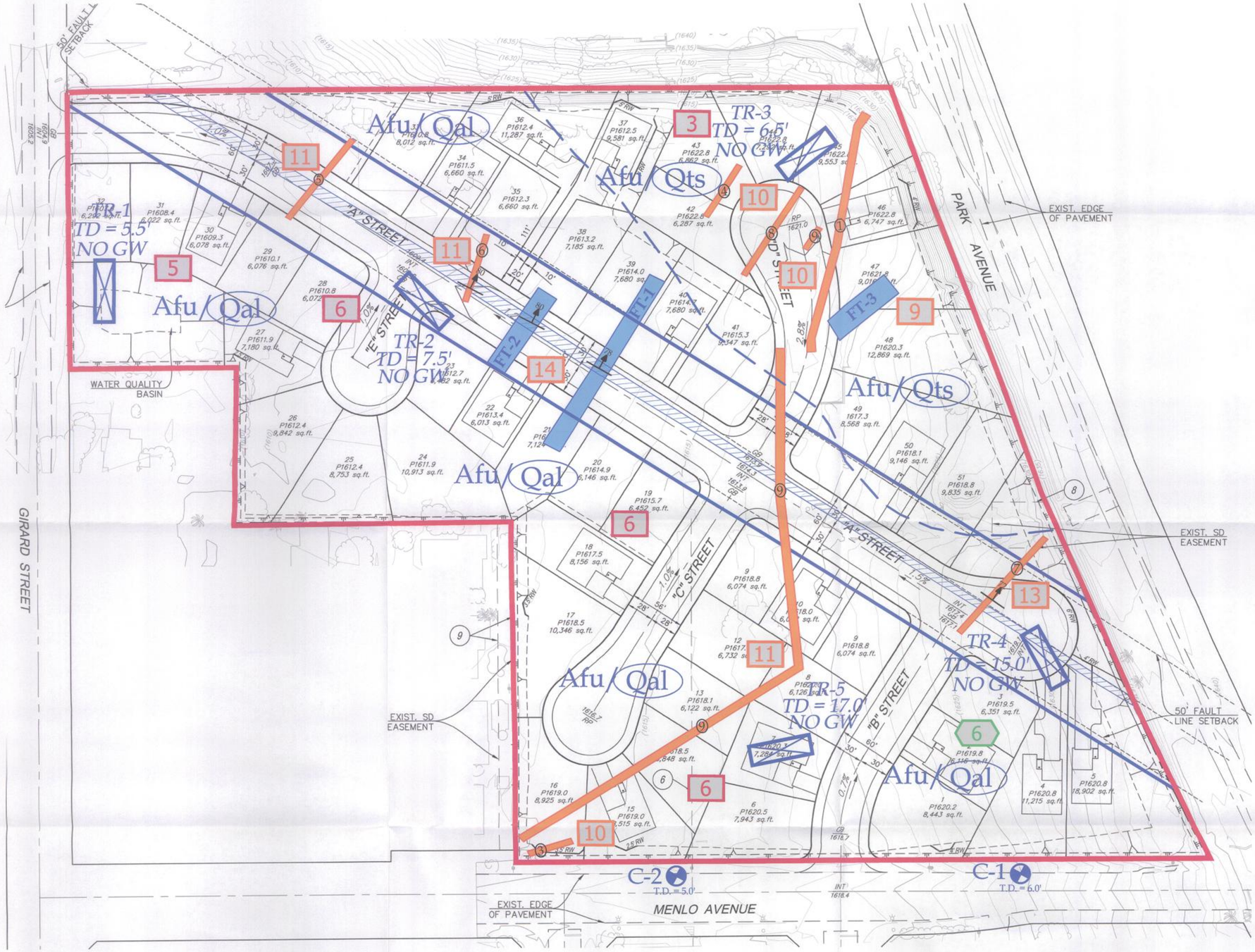
CUT/FILL TRANSITION LOT



TRANSITION LOT OVEREXCAVATION DETAIL



TYPICAL BUTTRESS/ STABILIZATION FILL DETAIL



LEGEND
(Locations are Approximate)

Geologic Earth Units

- Afu - Artificial Fill, Undocumented
- Qal - Alluvium (Circled Where Buried)
- Qts - Bautista Formation (Circled Where Buried)

Symbols

- Limits of This Report
- TR-5 TD=17.0' NO GW — Exploratory Trench Location
- C-2 T.D. = 5.0' NO GW — Exploratory Core Location
- Approximate Geologic Contact
- 6 — Approximate Depths of Overexcavation Below Existing Grade (ft.) in proposed fill areas
- 6 — Approximate Depths of Overexcavation Below Proposed Grade (ft.) in proposed cut areas
- 13 — Approximate Depths of Overexcavation Below Existing Grade (ft.) in fault trench areas
- FT-3 — Fault Trench Location (LGC, 2018)
- (9) — Fault Trench Location (Rasmussen, 1988)
- Limits of Structural Setback Zone Per (LGC, 2018)
- Fault Zone (Casa Loma Fault)
- Fault Attitude (LGC, 2018)

0 50' 100'

LOGICAL GEOTECHNICAL CONSULTANTS
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING • SWPPP
27570 COMMERCE CENTER DR., #128, TEMECULA, CA 92590
PHONE: 951.297.2450 FAX: 951.719.2998
WWW.LGCGEOENV.COM

Mark Bergmann	Larry Cooley
Engineering Geologist	Civil Engineer

GEOTECHNICAL MAP

800 North Girard Street
City of Hemet, County of Riverside, State of California

Name:	Sikand
Project No.	G18-1647-10
Client:	Sikand
Scale:	1" = 50'
Date:	October 2019
Reference:	Sikand Engineering, Preliminary Site Plan, Scale 1"=60' dated 1/14/19
Plate No.	1 OF 1

LGC GEO-ENVIRONMENTAL, INC.

Preliminary Infiltration Testing Investigation for the Proposed Single-Family Residential Development, Located at 800 N. Girard Street, City of Hemet, Riverside County, California

Dated: October 14, 2019
Project No. G18-1647-20

Prepared For:

Mr. Shizao Zheng
1378 West Zhorgshan Road
Ningbo City, Zhejiang Province
China

27570 Commerce Center Drive, Suite. 128, Temecula, California 92590
Phone: 951.297.2450 I Fax: 951.719.2998 I www.lgcgeoenv.com

October 14, 2019 Project No. G18-1647-20

Mr. Shizao Zheng
1378 West Zhorgshan Road
Ningbo City, Zhejiang Province
China

Subject: ***Preliminary Infiltration Testing Investigation for the Proposed Single-Family Residential Development, Located at 800 N. Girard Street, City of Hemet, Riverside County, California.***

1.0 INTRODUCTION

LGC Geo-Environmental, Inc. (LGC) is pleased to present this preliminary infiltration testing investigation for the proposed single-family residential development, located at 800 N. Girard Street, City of Hemet, Riverside County, California. The purpose of our study was to determine the vertical infiltration rates and physical characteristics of the subsurface soils in selected areas of proposed onsite storm water infiltration BMP devices within specific portions of the subject property.

2.0 PROPERTY LOCATION AND DESCRIPTION

The subject site is irregular in shape and is located on the northeast corner of E. Menlo Avenue and Park Avenue in the City of Hemet, Riverside County, California. The site is bounded on the north by residential development, on the west by Girard Street and residential development, on the south by E. Menlo Avenue and residential development, and east by Park Avenue. The general location and configuration of the site is shown on the Site Location Map (Figure 1).

The subject site has been previously graded and filled. Currently, it is a vacant lot with several concrete pads, a roadway, and various small structures. Vegetation growth is present on the subject site.

The topography of the site is slightly inclined with sheet drainage appearing to flow from east to west. The existing site elevations vary from approximately 1,637 feet above mean sea level (msl) near the northeast corner of the site, to approximately 1,607 msl at the northwest corner of the site.

3.0 PROPOSED CONSTRUCTION

The referenced "Preliminary Site Plan", prepared by Sikand Engineering Associates, indicates that the proposed single-family residential development will be comprised of 49 graded pads, associated roadways, one water quality detention basin, and landscape and hardscape areas. The development is proposed to be two family duplex dwelling units at this time.

4.0 SUBSURFACE EXPLORATION: INFILTRATION TESTING

4.1 Subsurface Exploration

Subsurface exploration of the subject site was performed on October 10, 2019 and consisted of advancing two (2) infiltration test borings. The borings were excavated within the proposed infiltration system location utilizing a hollow stem drill rig to a depth of 10 feet below existing grade. A third boring was excavated to a depth of 20 feet, to observe the depth to groundwater. These logs are presented in Appendix A. Earth materials encountered within the locations were classified in general accordance with the visual manual procedures of the Unified Soil Classification System (USCS). Logs of the infiltration borings are presented in Appendix A, and their approximate locations are depicted on the Infiltration Test Location Map (Plate 1).

Prior to the subsurface exploration work, an underground utilities clearance was obtained from Underground Service Alert of Southern California.

4.2 Infiltration Testing

On October 11, 2019, two (2) infiltration tests were conducted within the proposed area of the infiltration system. The infiltration test borings were labeled IB-1 through IB-2; and are depicted on the Infiltration Test Location Map (Plate 1). The tests were performed as per the referenced Riverside County Technical Guidance Manual for Onsite Wastewater Treatment Systems.

Once the required depth of 10 feet below existing surface was obtained, a 2-inch layer of 3/4 inch gravel was placed at the bottom of the borings and polyvinyl chloride pipe (PVC), with a nominal diameter of 3 inches, was inserted into the borings. The PVC pipe installed in the infiltration borings contained 0.375-inch diameter perforations only within the lower 2 feet to 3 feet. The annular space around the 2 feet to 3 feet perforated zone was backfilled with 3/4-inch gravel. The remaining portion annular space with solid pipe was backfilled with native soil. A pre-soak period was then conducted to allow the test holes to presaturate before beginning the infiltration test. At the beginning of the infiltration test, a sandy soils test was performed with two consecutive readings taken within 25 minutes, to measure a water drop of at least 6 inches. Upon completion of the sandy soils test, IB-1 readings were taken at 10-minute intervals for the entirety of the infiltration test and IB-2 readings were taken at 30-minute intervals for the entirety of the infiltration test, with the drop in water level being recorded at the end of each interval. Minor settlement of the backfill soils may occur over time.

To acquire the vertical design infiltration test rates, the field percolation rates, which have vertical and sidewall infiltration, were reduced utilizing a reduction factor per the Porchet Method standard in order to get a vertical design infiltration rate. A reduction factor of 5.16 and 5.58 was applied to the field percolation rates for IB-1 and IB-2, respectively. The results of the percolation method infiltration tests are presented in the following table in section 5.3. The infiltration test data sheets are presented in Appendix A.

5.0 FINDINGS

5.1 Earth Materials

Based on our review of the data from the geotechnical investigation, and our current investigation of the proposed infiltration basin, the materials encountered to the depths explored include artificial fill and alluvium. A description of the earth material and soils encountered is described below:

Artificial Fill, Undocumented (Afu): Artificial fill was encountered on the site during our subsurface exploration and was observed at a depth approximately 1 foot to 5 feet below the surface, in all the borings. The artificial fill generally consists of silty sand and is various shades of brown. The material is damp to moist; and very fine to fine grained with some medium grains.

Alluvium (Qal): Alluvium was encountered below the topsoil, to an observed depth of about 20 feet below the surface. The alluvium is generally silty sand to sandy silt, and is characterized as being various shades of brown; moist; very fine to fine grained, with occasional medium grains; and slightly micaceous.

5.2 Groundwater

Groundwater was not encountered during exploratory drilling. A review of the California Department of Water Resources, Water Data Library online database indicates the presence of groundwater less than a mile away from the general site area as approximately 267 feet below the existing ground surface according to historical records at an elevation of approximately 1,588 above mean sea level (Well ID: Station 337574N1169698W001).

5.3 Infiltration Testing Results

The shallow infiltration testing rates for design considerations for the proposed infiltration system area which was tested are presented in the table below.

Infiltration Design Rates

TEST NO.	TEST LOCATION	TEST DEPTH (Feet)	INFILTRATION RATES		SOIL DESCRIPTION (USCS)
			FIELD PERCOLATION RATE (INCHES/HOUR)	DESIGN INFILTRATION RATE (INCHES/HOUR)	
IB-1	Infiltration Basin	10	40.50	7.85	SM
IB-2	Infiltration Basin	10	6.00	1.21	ML/SM

6.0 CONCLUSIONS AND RECOMMENDATIONS

Shallow infiltration testing for the proposed infiltration system indicates design rates of 7.85 inches/hour and 1.21 inches/hour, for IB-1 and IB-2, respectively, at a depth of 10 feet after applying reduction factors shown in the Table above, per the Porchet Method. The design rates representing the infiltration devices proposed to be installed, should be utilized for the proposed infiltration device location, as indicated on the Infiltration Test Location Map (Plate 1). An average composite design rate of **4.53 inches/hour** for the proposed infiltration basin represented by testing from infiltration test borings IB-1 and IB-2 can be utilized.

The proposed infiltration basin device should be placed at least five (5) feet horizontally away from or beyond a 1:1 (horizontal to vertical) projection from the base of any proposed or existing structures or walls, whichever is greater. Since the proposed infiltration basin device is within and/or adjacent to proposed roadways, parking areas and/or sidewalks (within five (5) feet) and may be up to approximately three (3) feet deep, any gravel backfill should be densified or any soil backfill should be compacted to at least 90% of the maximum dry density during placement. The project geologist or engineer should observe infiltration device excavations during trenching to verify the anticipated soil units and geotechnical conditions as well as observe, probe and/or test any densification or compaction of the infiltration trench and pit gravel and/or soil backfill.

7.0 PLAN REVIEWS AND CONSTRUCTION SERVICES

This report was prepared for the exclusive use of Mr. Shizao Zheng to assist the project civil engineer in the design of the proposed infiltration systems for the proposed development. It is recommended that LGC be engaged to review infiltration device plans, grading plans, foundation plans and the final infiltration design drawings and specifications prior to construction. This is to document that the recommendations contained in this report were properly interpreted and incorporated into the project plans and specifications from a geotechnical standpoint. Plans should be forwarded to the project geotechnical engineer and/or engineering geologist for LGC for review and comments, as deemed necessary. LGC's review of infiltration device plans, grading plans, foundation plans and the final infiltration design drawings and specifications may indicate that additional subsurface exploration, laboratory testing and analysis should be performed to address areas of concern. If LGC is not accorded the opportunity to review these documents, we cannot take responsibility for misinterpretation of our recommendations.
If the project plans change significantly (e.g., location and type of infiltration devices), LGC should be retained to review our original design recommendations and applicability to the revised construction. If conditions are encountered during construction that appears to be different from those indicated in this report, this office should be notified immediately. Design and construction revisions may be required.

The preliminary conclusions and recommendations provided in this report are based on review of previous geotechnical reports, infiltration testing, geologic field mapping, and geotechnical/geologic analyses to date. A representative of LGC should observe the interpolated subsurface conditions in the field during construction

We recommend that LGC be retained to provide geotechnical engineering services during future grading, infiltration device excavations, installation of infiltration materials, backfill of infiltration devices, or when an unusual soil condition is encountered at the site. This is to document compliance with the design, specifications or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

8.0 INVESTIGATION LIMITATIONS

This report is based upon information provided by the client and the project civil engineer, a limited number of subsurface excavations, field observations and percolation/infiltration tests to which we applied various methods of analysis and interpretation. The materials encountered and tested in the field on the project site are believed representative of the project area, and the conclusions and recommendations contained herein are presented on that basis. However, soil materials can vary in characteristics between points of exploration, both laterally and vertically, and those variations could affect the conclusions, recommendations, and performance of the proposed storm water infiltration device BMP systems. Fluctuations in the level of groundwater may occur due to variations in rainfall, irrigation, and the other factors not in evidence at the time measurements were made. If this occurs, the changed conditions must be evaluated by the project geotechnical engineer and engineering geologist and design(s) adjusted as required or alternate design(s) recommended.

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

The conclusions and opinions contained in this report are based on the results of the described geotechnical evaluations and represent our professional judgment. The findings, conclusions and recommendations contained in this report are to be considered tentative only and subject to confirmation by the undersigned during the construction process. Without this confirmation, this report is to be considered incomplete and LGC or the undersigned professionals assume no responsibility for its use.

The conclusions and opinions contained in this report are valid up to a period of 2 years from the date of this report. Changes in the conditions of a property can and do occur with the passage of time, whether they be because of natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate codes or standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, if any of the above mentioned situations occur, an update of this report should be completed.

This report has not been prepared for use by parties or projects other than those named or designed above. It may not contain sufficient information for other parties or other purposes.

The opportunity to be of service is appreciated. Should you have any questions regarding the content of this report, or should you require additional information, please do not hesitate to contact this office at your earliest convenience.
Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by engineers and geologists practicing in this or other localities. The contents of this report are professional opinions and as such, are not to be considered a guarantee or warranty.

The opportunity to be of service is appreciated. Should you have any questions regarding the content of this report, or should you require additional information, please do not hesitate to contact this office at your earliest convenience.

Respectfully submitted,

LGC Geo-Environmental, Inc.

Mark Bergmann CEG 1348
Certified Engineering Geologist/President

JJL/MB

Distribution: (2) Addressee

Attachments: Figure 1 – Site Location Map
Appendix A – Infiltration Boring Logs *(Rear of Text)*
Appendix B – Infiltration Test Results *(Rear of Text)*
Plate 1 – Infiltration Test Location Map *(Pocket Enclosure)*

FIGURE 1
SITE LOCATION MAP

Project Name	SIKAND
Project No.	G18-1647-20
Geol./ Eng.	MB
Scale	NOT TO SCALE
Date	OCTOBER 2019

APPENDIX A

INFILTRATION BORING LOGS

Geotechnical Boring Log IB-1

Date: 10/10/19	**Project Name:** SIKAND	Page 1 of 1
Project Number: G18-1647-20	**Logged By:** JM	
Drilling Company: BAJA	**Type of Rig:** HOLLOW-STEM AUGER	
Drive Weight (lbs.): 140	**Drop (in.):** 30 **Hole Dia. (in.):** 8"	
Top of Hole Elevation (ft): 1,610'	**Hole Location:** SEE INFILTRATION TEST LOCATION MAP	

Elevation (MSL) and Depth (ft.)	Blow Count / 6"	Sample No.	Soil Graphic	Geologic / Group Symbol	DESCRIPTION	In-Situ Moist.(%)	Dry Density (pcf)	Standard Penetration Test SPT Depth	SPT N	CURVE 10 30 50	Type of Test
1610 / 0				Afu SM	**ARTIFICIAL FILL, UNDOCUMENTED** Silty SAND; light brown to brown, dry, very fine to medium grained with some coarse grains, slightly micaceous, roots and roothairs @ 1.0'; yellowish brown, damp to moist, very fine to fine grained with some medium grains						
1605 / 5				Qal SM	**ALLUVIUM** Silty SAND; dark yellow brown to orange brown, moist, very fine to fine grained with occasional medium grains, slightly micaceous						
1600 / 10					Total Depth: 10' No Groundwater						
1595 / 15											
1590 / 20											
1585 / 25											
1580 / 30											

Sample Legend

- SPT
- Ring Sample (CA modified)

LGC GEO-ENVIRONMENTAL, INC.

Geotechnical Boring Log IB-2

Date: 10/10/19	**Project Name:** SIKAND
Project Number: G18-1647-20	**Logged By:** JM
Drilling Company: BAJA	**Type of Rig:** HOLLOW STEM AUGER
Drive Weight (lbs.): 140	**Drop (in.):** 30 **Hole Dia. (in.):** 8"
Top of Hole Elevation (ft): 1,609'	**Hole Location:** SEE INFILTRATION TEST LOCATION MAP

Elevation (MSL) and Depth (ft.)	Blow Count / 6"	Sample No.	Soil Graphic	Geologic / Group Symbol	DESCRIPTION	In-Situ Moist. (%)	Dry Density (pcf)	Standard Penetration Test SPT Depth	SPT N	Standard Penetration Test CURVE 10 30 50	Type of Test
0 / 1605				Afu SM	**ARTIFICIAL FILL, UNDOCUMENTED** Silty SAND; light brown to brown, dry, very fine to medium grained with some coarse grains, slightly micaceous, roots and roothairs @ 1.0'; yellowish brown, damp to moist, very fine to fine grained with some medium grains						
5 / 1600				Qal SM-ML	**ALLUVIUM** Silty SAND/Sandy SILT; dark yellowish brown to orange brown, moist, very fine to fine grained, micaceous						
10 / 1595					Total Depth: '10 No Groundwater						
15 / 1590											
20 / 1585											
25 / 1580											
30											

Sample Legend

- SPT
- Ring Sample (CA modified)

LGC Geo-Environmental, Inc.

Geotechnical Boring Log IB-3

Date: 10/10/19	**Project Name:** SIKAND	Page 1 of 1
Project Number: G18-1647-20	**Logged By:** JM	
Drilling Company: BAJA	**Type of Rig:** HOLLOW STEM AUGER	
Drive Weight (lbs.): 140	**Drop (in.):** 30 **Hole Dia. (in.):** 8"	
Top of Hole Elevation (ft): 1,609.5	**Hole Location:** SEE INFILTRATION TEST LOCATION MAP	

Elevation (MSL) and Depth (ft.)	Blow Count / 6"	Sample No.	Soil Graphic	Geologic / Group Symbol	DESCRIPTION	In-Situ Moist.(%)	Dry Density (pcf)	Standard Penetration Test SPT Depth	SPT N	Standard Penetration Test CURVE 10 30 50	Type of Test
0 / 1605				Afu SM	**ARTIFICIAL FILL, UNDOCUMENTED** Silty SAND; light brown to brown, dry, very fine to medium grained with some coarse grains, slightly micaceous, roots and roothairs @ 1.0'; yellowish brown, damp to moist, very fine to medium grained						
5 / 1600				Qal SM-ML	**ALLUVIUM** Silty SAND/Sandy SILT; orange brown to yellowish brown, moist, very fine to fine grained, micaceous						
10 / 1595											
15 / 1590											
20 / 1585					Total Depth: '20 No Groundwater						
25 / 1580											
30											

Sample Legend

- SPT
- Ring Sample (CA modified)

LGC Geo-Environmental, Inc.

APPENDIX B

INFILTRATION TEST RESULTS

Project:	Sikand	Job No.:	G18-1647-20
Test Hole No.:	IB-1	Date Excavated:	10/10/2019
Depth of Test Hole:	10'	Soil Classification:	SM
Check for Sandy Soil Criteria By: JW		Date of Perc Test:	10/11/2019 Diameter: 8 inches

SANDY SOIL CRITERIA TEST

TIME	Time Interval (Minutes)	Initial Water Level (Inches)	Final Water Level (Inches)	Change In Water Level (Inches)
5:56	9	20	7.8	12.3
6:05				
6:06	8	20	11.8	8.3
6:14				

PRESOAK PERIOD

	Date	Time	Interval	Amount of Water Used
Start	10/10/19	5:45 AM		No Water Remaining
Stop	10/11/19			

TEST PERIOD

Time	Time Interval (min.)	Total Elasped Time (min.)	Initial Water Level (inches)	Final Water Level (inches)	Change In Water Level (Inches)	Field Percolation Rate (minutes/inch)
6:16	10	10	20	11.25	8.75	1.14
6:26						
6:27	10	21	20	11.75	8.25	1.21
6:37						
6:38	10	32	20	12.25	7.75	1.29
6:48						
6:49	10	43	20	13.13	6.88	1.45
6:59						
7:00	10	54	20	13.25	6.75	1.48
7:10						
7:11	10	65	20	13.25	6.75	1.48
7:21						

Reduction Factor:	5.16
Design Infiltration Rate (in/hr):	7.85

Project:	Sikand	Job No.:	G18-1647-20
Test Hole No.:	IB-2	Date Excavated:	10/10/2019
Depth of Test Hole:	10'	Soil Classification:	ML/SM
Check for Sandy Soil Criteria By: JW		Date of Perc Test:	10/11/2019 Diameter: 8 inches

SANDY SOIL CRITERIA TEST

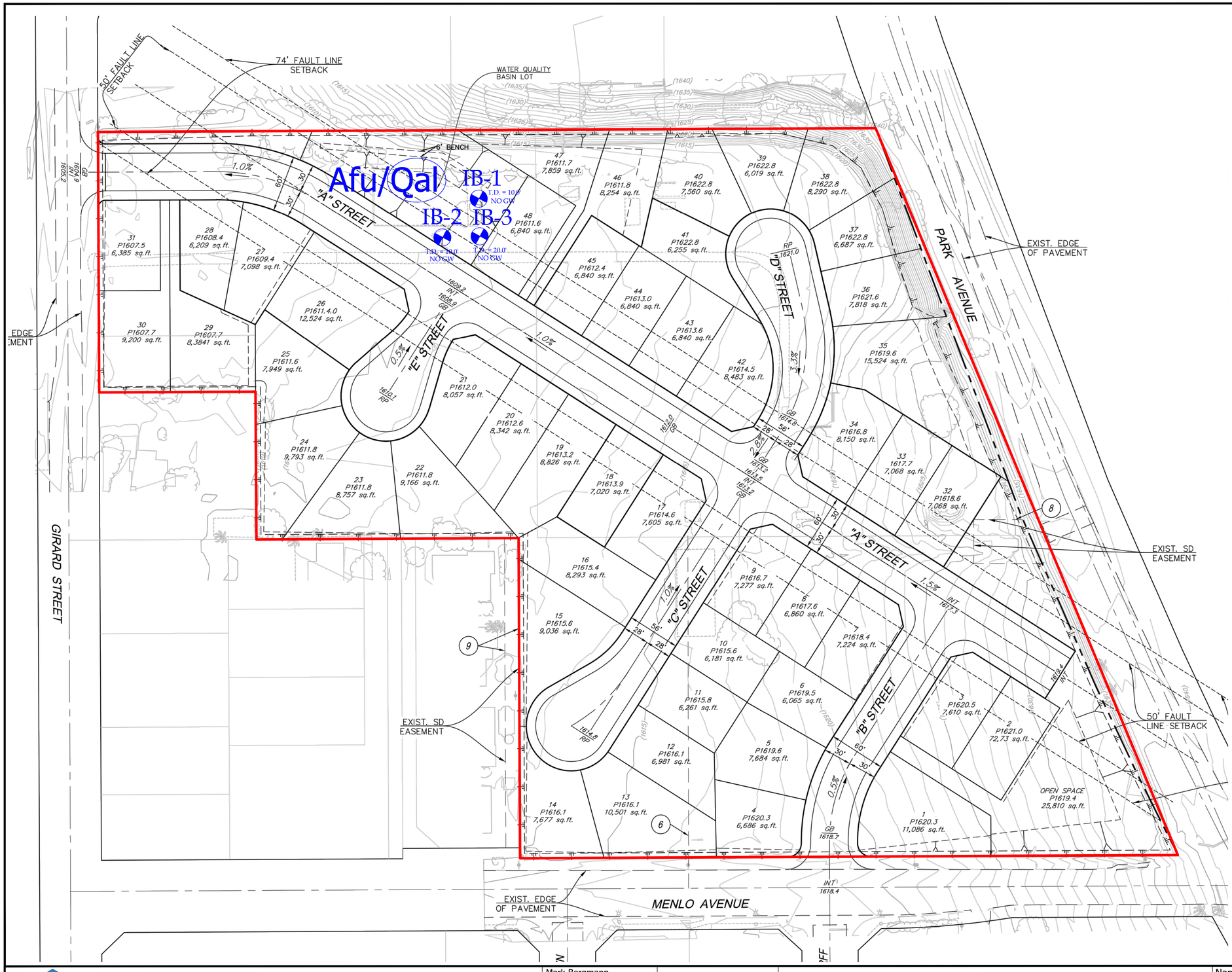
TIME	Time Interval (Minutes)	Initial Water Level (Inches)	Final Water Level (Inches)	Change In Water Level (Inches)
6:00	25	20	15.3	4.8
6:25				

PRESOAK PERIOD

	Date	Time	Interval	Amount of Water Used
Start	10/10/2019	5:40 AM		No Water Remaining
Stop	10/11/2019			

TEST PERIOD

Time	Time Interval (min.)	Total Elasped Time (min.)	Initial Water Level (inches)	Final Water Level (inches)	Change In Water Level (Inches)	Field Percolation Rate (minutes/inch)
6:00	30	30	20	14.25	5.75	5.22
6:30						
6:31	30	61	20	16.13	3.88	7.74
7:01						
7:02	30	92	20	16.00	4.00	7.50
7:32						
7:33	30	123	20	16.25	3.75	8.00
8:03						
8:04	30	154	20	16.50	3.50	8.57
8:34						
8:35	30	185	20	16.63	3.38	8.89
9:05						
9:06	30	216	20	16.75	3.25	9.23
9:36						
9:37	30	247	20	16.88	3.13	9.60
10:07						
10:08	30	278	20	16.88	3.13	9.60
10:38						
10:39	30	309	20	17.00	3.00	10.00
11:09						
11:10	30	340	20	17.00	3.00	10.00
11:40						
11:41	30	371	20	17.00	3.00	10.00
12:11						
					Reduction Factor:	5.58
					Design Infiltration Rate (in/hr):	1.21



LEGEND
(Locations are Approximate)

Geologic Earth Units

Qal - Quaternary Alluvium

Qts - Bautista Formation

Symbols

- Limits of This Report

IB-3 (T.D. = 20.0' NO GW) - Infiltration Boring Location

LOGICAL GEOTECHNICAL CONSULTANTS
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING
27570 COMMERCE CENTER DR., #128, TEMECULA, CA 92590
PHONE: 951.297.2450 FAX: 951.719.2998
WWW.LGCGEOENV.COM

Mark Bergmann
Engineering Geologist

INFILTRATION TEST LOCATION MAP

800 North Girard Street
City of Hemet, County of Riverside, State of California

Name:	Sikand
Project No.	G18-1647-20
Client:	Shizao Zheng
Scale:	1" = 50'
Date:	October 2019
Reference:	Sikand Engineering, Preliminary Site Plan, Scale 1"=60'
Plate No.	1 OF 1

Appendix 4: Historical Site Conditions

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

N/A

Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

NOTE: The project is already proposing the use Infiltration Basin as the BMP. This is the highest BMP based on the prioritization list, and considered the most appropriate for the site. LID infeasibility is not applicable.

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation

Santa Ana Watershed - BMP Design Volume, V_{BMP}

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name	Sikand Engineering Associates	Date	1/28/2020
Designed by	Doug Farmer, PE	Case No	
Company Project Number/Name	5118-007/ Hemet		

BMP Identification

BMP NAME / ID: Basin 1

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

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

D_{85}= 0.70 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)
Basin 1	117504	Roofs	1	0.89	104813.6			
Basin 1	118402	Concrete or Asphalt	1	0.89	105614.6			
Basin 1	378290	Ornamental Landscaping	0.1	0.11	41785.2			
	614196	Total			252213.4	0.70	14712.4	

Proposed Volume must be greater than the Design Capture Volume

Notes:

R 07 W | R 06 W | R 05 W | R 04 W | R 03 W | R 02 W | R 01 W | R 01 E | R 02 E | R 03 E | R 04 E | R 05 E

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

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

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

Santa Ana River Watershed
Santa Margarita Watershed

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

N

Rain Gage Locations

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

Isohyetal Map for the 85th Percentile 24 hour Storm Event

July 2011

Infiltration Basin - Design Procedure (Rev. 03-2012)	BMP ID: Basin 1	Legend:	Required Entries / Calculated Cells
Company Name: Sikand Engineering Associates			Date: 1/28/2020
Designed by: Doug Farmer, PE			County/City Case No.:

Design Volume

a) Tributary area (BMP subarea)	A_T =	14.1	acres
b) Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	14,713	ft^3

Maximum Depth

a) Infiltration rate	I =	4.53	in/hr
b) Factor of Safety (See Table 1, Appendix A: "Infiltration Testing" from this BMP Handbook)	FS =	3	
c) Calculate D_1 $D_1 = \frac{I\ (in/hr) \times 72\ hrs}{12\ (in/ft) \times FS}$	D_1 =	9.1	ft
d) Enter the depth of freeboard (at least 1 ft)		1	ft
e) Enter depth to historic high ground water (measured from **top** of basin)		267	ft
f) Enter depth to top of bedrock or impermeable layer (measured from **top** of basin)		267	ft
g) D_2 is the smaller of: Depth to groundwater - (10 ft + freeboard) and Depth to impermeable layer - (5 ft + freeboard)	D_2 =	256.0	ft
h) D_{MAX} is the smaller value of D_1 and D_2 but shall not exceed 5 feet	D_{MAX} =	9.1	ft

Basin Geometry

a) Basin side slopes (no steeper than 4:1)	z =	4	:1
b) Proposed basin depth (excluding freeboard)	d_B =	5	ft
c) Minimum bottom surface area of basin ($A_S = V_{BMP}/d_B$)	A_S =	2943	ft^2
d) Proposed Design Surface Area	A_D =	3026	ft^2

Forebay

a) Forebay volume (minimum 0.5% V_{BMP})	Volume =	74	ft^3
b) Forebay depth (height of berm/splashwall. 1 foot min.)	Depth =	1	ft
c) Forebay surface area (minimum)	Area =	74	ft^2
d) Full height notch-type weir	Width (W) =	12.0	in

Notes:

WQMP RETENTION (PRIVATE)
BASIN CALCULATION

NORTH

PLAN

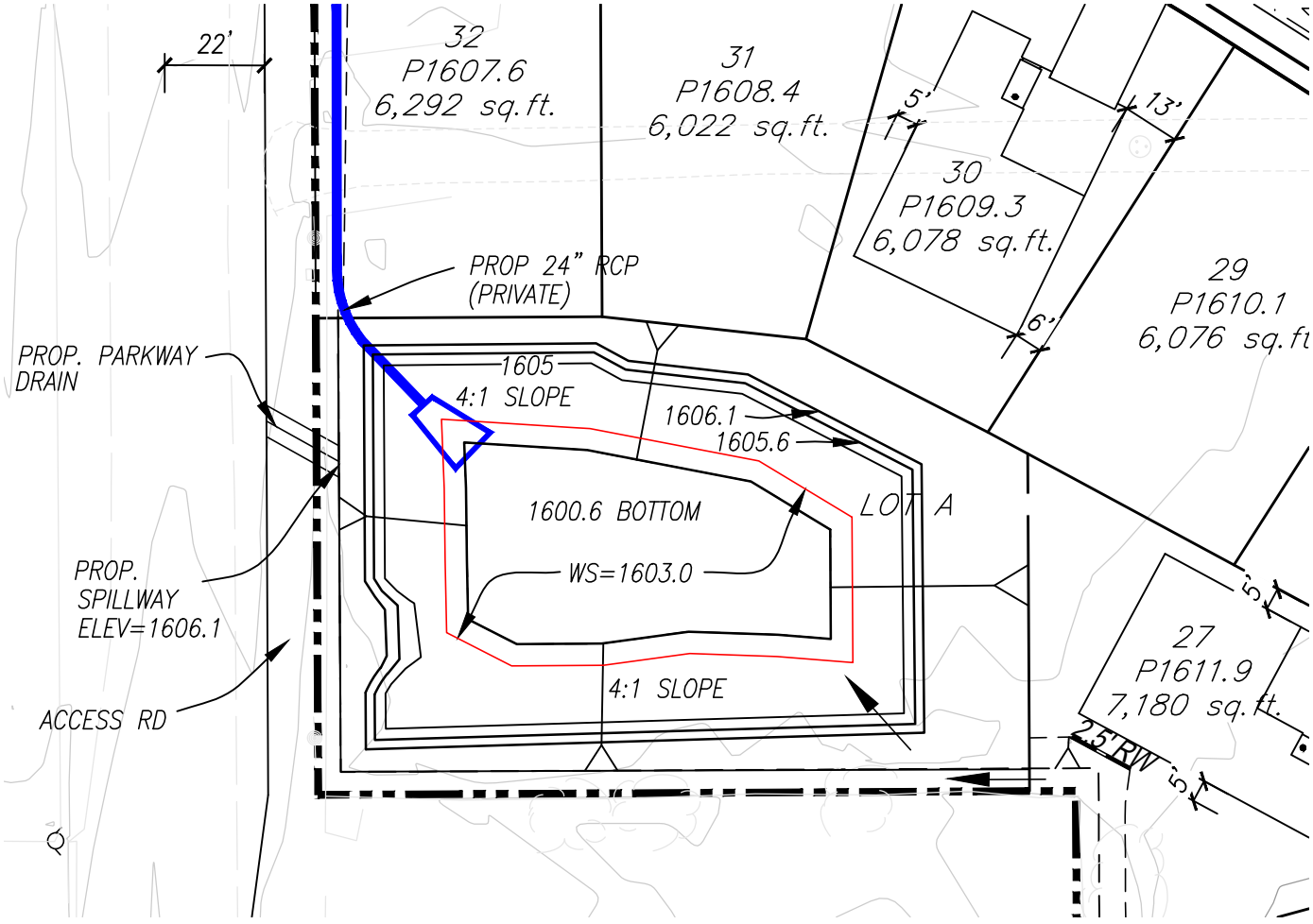
SCALE: 1" = 40'

DEPTH VS CAPACITY

Elevation	Area (ft^2)	Volume (ft^3)	Capacity (ft3)
1,600.60	3,025	-	-
1,605.60	9,085	30,275.00	30,275.00
1,606.10	9,888	4,743.25	35,018.25

V_{BMP} = 14,713 CU-FT

ACTUAL DEPTH = 2.4 FT



SIKAND
Engineering | Planning | Surveying
15230 Burbank Blvd., #100 Van Nuys, CA 91411
Phone: (818) 787-8550; Fax: (818) 901-7451
www.sikand.com; E-mail: info@sikand.com

BY:	E.R.
W.O. NO.:	5118-007
DATE:	01/27/20
SCALE:	

CLIENT: **Mr. Shizao Zheng**
1378 West Zhorgshan Road, Ningbo City
Zhejiang Province, China

PROJECT: **TTM 37558**
City of Hemet, Riverside County

SHT. 1 OF 1

3.1 INFILTRATION BASIN

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

Description

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

Figure 1 – Infiltration Basin

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

Siting Considerations

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

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

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

Setbacks

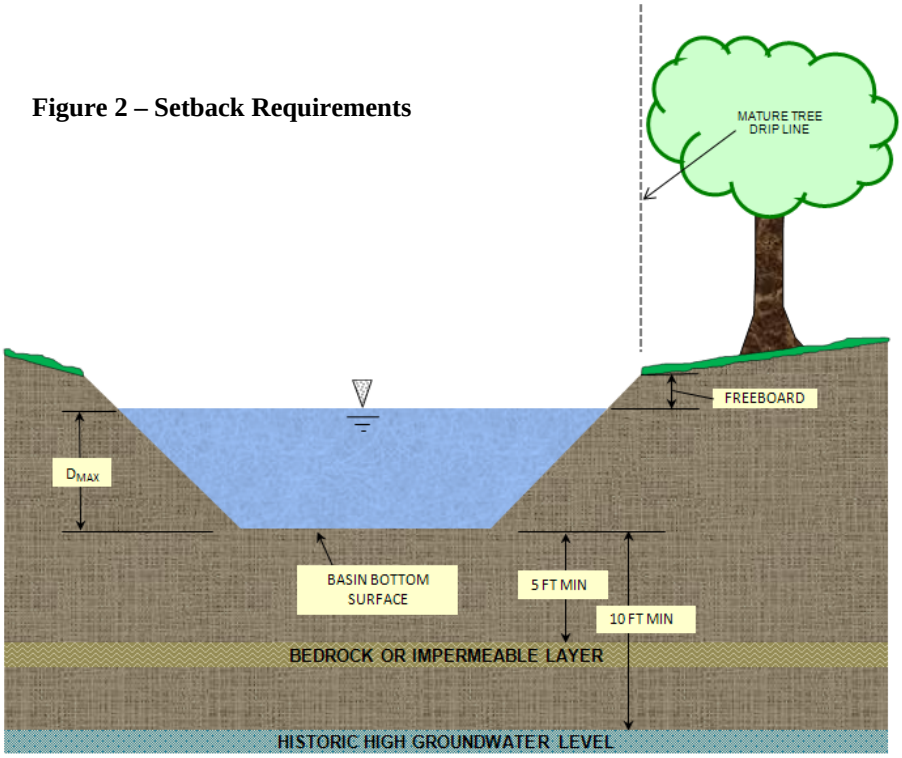
Always consult your geotechnical engineer for site specific recommendations regarding setbacks for infiltration trenches. Recommended setbacks are needed to protect buildings, existing trees, walls, onsite or nearby wells, streams, and tanks. Setbacks should be considered early in the design process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

Infiltration basins typically must be set back:

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

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

Figure 2 – Setback Requirements



Forebay

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

Overflow

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

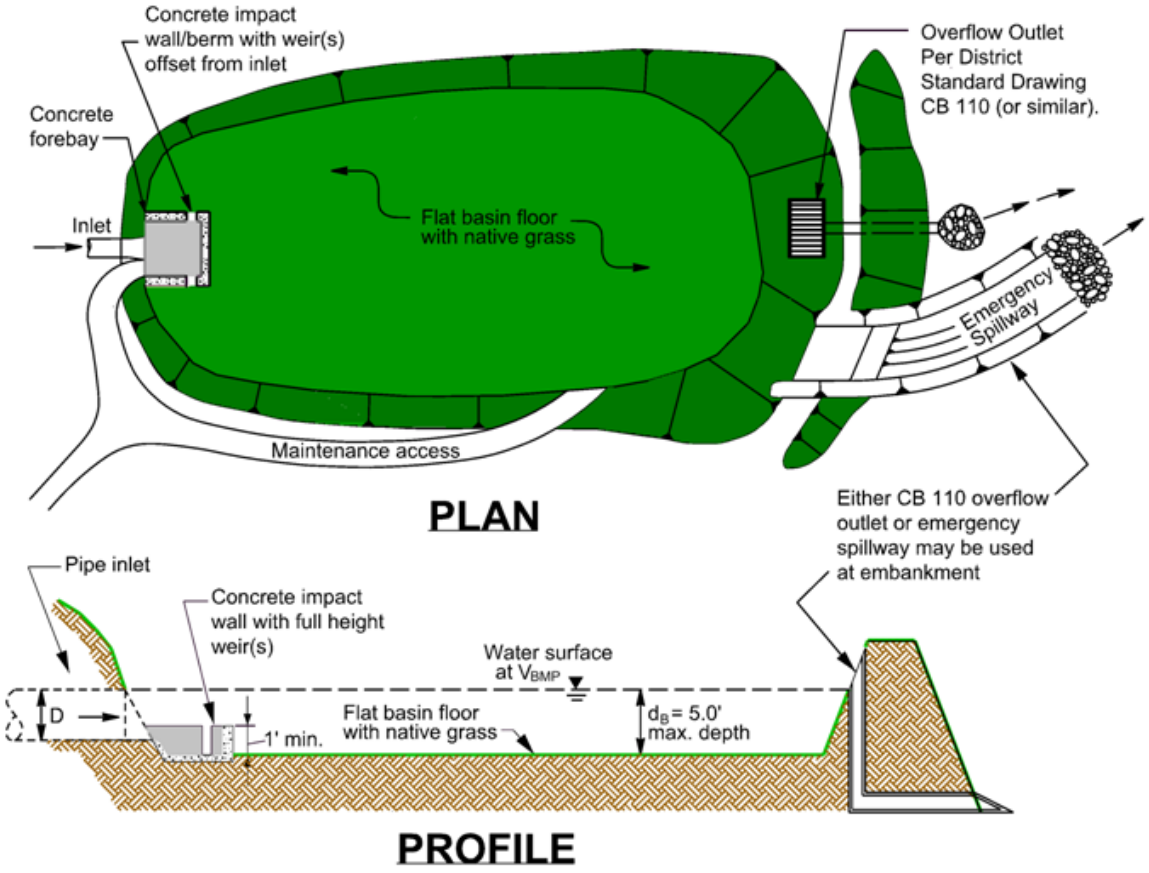


Figure 3 – Infiltration Basin

Landscaping Requirements

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

Maintenance

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

Table 1 - Inspection and Maintenance

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

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

Table 2 - Design and Sizing Criteria for Infiltration Basins

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

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

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

INFILTRATION BASIN SIZING PROCEDURE

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

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

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

d) Enter the depth of freeboard.

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

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

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

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

or

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

Whichever is least.

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

3. Basin Geometry

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

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

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

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

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

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

4. Forebay

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

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

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

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

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

LGC GEO-ENVIRONMENTAL, INC.

Preliminary Infiltration Testing Investigation for the Proposed Single-Family Residential Development, Located at 800 N. Girard Street, City of Hemet, Riverside County, California

Dated: October 14, 2019
Project No. G18-1647-20

Prepared For:

Mr. Shizao Zheng
1378 West Zhorgshan Road
Ningbo City, Zhejiang Province
China

27570 Commerce Center Drive, Suite 128, Temecula, California 92590
Phone: 951.297.2450 I Fax: 951.719.2998 I www.lgcgeoenv.com

Infiltration Design Rates

TEST NO.	TEST LOCATION	TEST DEPTH (Feet)	INFILTRATION RATES		SOIL DESCRIPTION (USCS)
			FIELD PERCOLATION RATE (INCHES/HOUR)	DESIGN INFILTRATION RATE (INCHES/HOUR)	
IB-1	Infiltration Basin	10	40.50	7.85	SM
IB-2	Infiltration Basin	10	6.00	1.21	ML/SM

6.0 CONCLUSIONS AND RECOMMENDATIONS

Shallow infiltration testing for the proposed infiltration system indicates design rates of 7.85 inches/hour and 1.21 inches/hour, for IB-1 and IB-2, respectively, at a depth of 10 feet after applying reduction factors shown in the Table above, per the Porchet Method. The design rates representing the infiltration devices proposed to be installed, should be utilized for the proposed infiltration device location, as indicated on the Infiltration Test Location Map (Plate 1). An average composite design rate of **4.53 inches/hour** for the proposed infiltration basin represented by testing from infiltration test borings IB-1 and IB-2 can be utilized.

The proposed infiltration basin device should be placed at least five (5) feet horizontally away from or beyond a 1:1 (horizontal to vertical) projection from the base of any proposed or existing structures or walls, whichever is greater. Since the proposed infiltration basin device is within and/or adjacent to proposed roadways, parking areas and/or sidewalks (within five (5) feet) and may be up to approximately three (3) feet deep, any gravel backfill should be densified or any soil backfill should be compacted to at least 90% of the maximum dry density during placement. The project geologist or engineer should observe infiltration device excavations during trenching to verify the anticipated soil units and geotechnical conditions as well as observe, probe and/or test any densification or compaction of the infiltration trench and pit gravel and/or soil backfill.

7.0 PLAN REVIEWS AND CONSTRUCTION SERVICES

This report was prepared for the exclusive use of Mr. Shizao Zheng to assist the project civil engineer in the design of the proposed infiltration systems for the proposed development. It is recommended that LGC be engaged to review infiltration device plans, grading plans, foundation plans and the final infiltration design drawings and specifications prior to construction. This is to document that the recommendations contained in this report were properly interpreted and incorporated into the project plans and specifications from a geotechnical standpoint. Plans should be forwarded to the project geotechnical engineer and/or engineering geologist for LGC for review and comments, as deemed necessary. LGC's review of infiltration device plans, grading plans, foundation plans and the final infiltration design drawings and specifications may indicate that additional subsurface exploration, laboratory testing and analysis should be performed to address areas of concern. If LGC is not accorded the opportunity to review these documents, we cannot take responsibility for misinterpretation of our recommendations.
If the project plans change significantly (e.g., location and type of infiltration devices), LGC should be retained to review our original design recommendations and applicability to the revised construction. If conditions are encountered during construction that appears to be different from those indicated in this report, this office should be notified immediately. Design and construction revisions may be required.

The preliminary conclusions and recommendations provided in this report are based on review of previous geotechnical reports, infiltration testing, geologic field mapping, and geotechnical/geologic analyses to date. A representative of LGC should observe the interpolated subsurface conditions in the field during construction

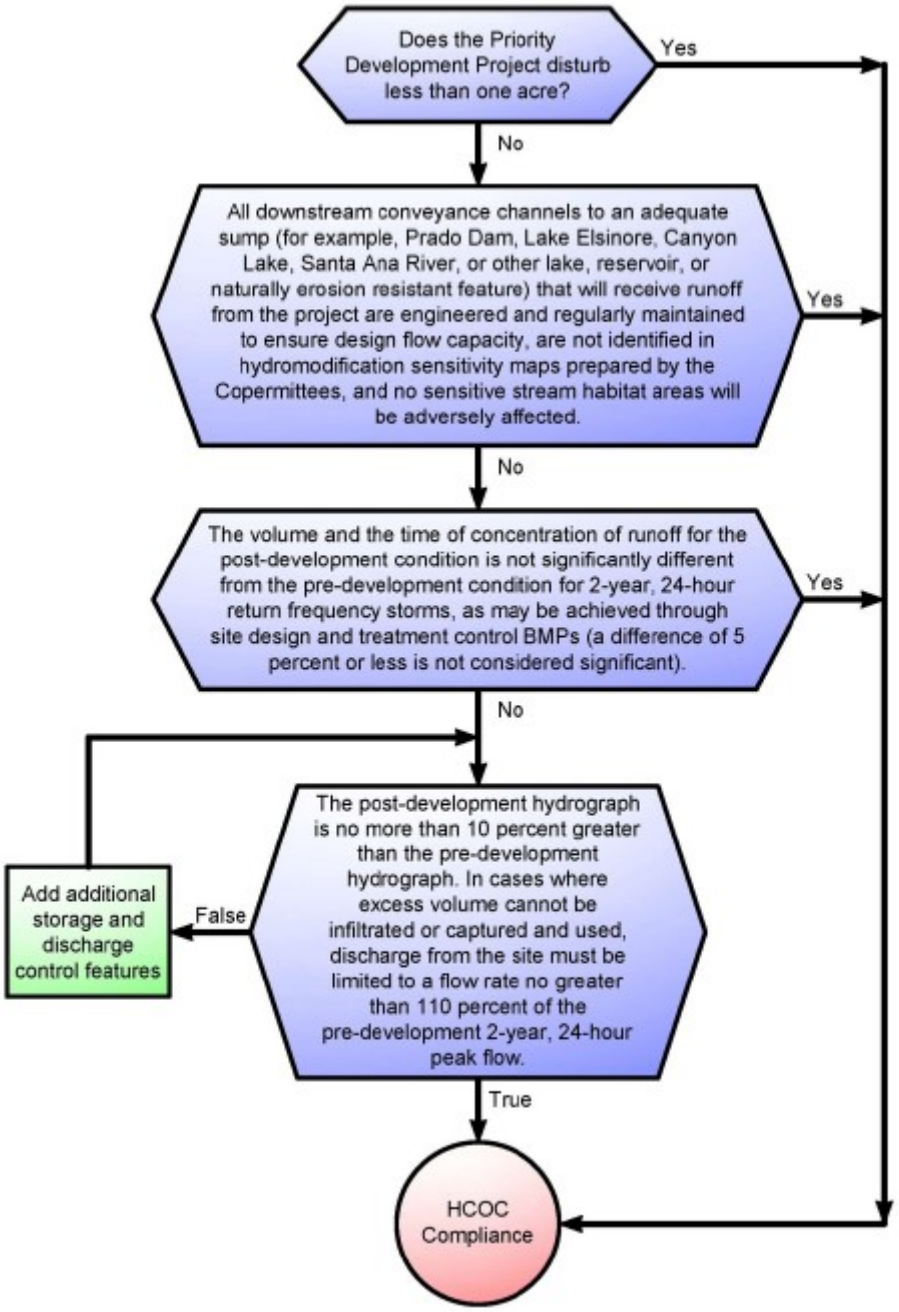
We recommend that LGC be retained to provide geotechnical engineering services during future grading, infiltration device excavations, installation of infiltration materials, backfill of infiltration devices, or when an unusual soil condition is encountered at the site. This is to document compliance with the design, specifications or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

Project Name	SIKAND
Project No.	G18-1647-20
Geol./ Eng.	MB
Scale	NOT TO SCALE
Date	OCTOBER 2019

FIGURE 1
SITE LOCATION MAP

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern


Does the Priority Development Project disturb less than one acre?
Yes
No
All downstream conveyance channels to an adequate sump (for example, Prado Dam, Lake Elsinore, Canyon Lake, Santa Ana River, or other lake, reservoir, or naturally erosion resistant feature) that will receive runoff from the project are engineered and regularly maintained to ensure design flow capacity, are not identified in hydromodification sensitivity maps prepared by the Copermittees, and no sensitive stream habitat areas will be adversely affected.
Yes
No
The volume and the time of concentration of runoff for the post-development condition is not significantly different from the pre-development condition for 2-year, 24-hour return frequency storms, as may be achieved through site design and treatment control BMPs (a difference of 5 percent or less is not considered significant).
Yes
No
The post-development hydrograph is no more than 10 percent greater than the pre-development hydrograph. In cases where excess volume cannot be infiltrated or captured and used, discharge from the site must be limited to a flow rate no greater than 110 percent of the pre-development 2-year, 24-hour peak flow.
False
Add additional storage and discharge control features
True
HCOC Compliance

Santa Ana Watershed - BMP Design Volume, V_{BMP}

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name	Sikand Engineering Associates	Date	1/27/2021
Designed by	Doug Farmer, PE	Case No	
Company Project Number/Name	5118-007/ Hemet		

BMP Identification

BMP NAME / ID: 2yr-24hr Post-Dev't Volume

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

2-year, 24-hour Rainfall Depth, from the Precipitation Map: $D_{2yr, 24hr}$ = 1.80 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
Site	*117504*	*Roofs*	*1*	*0.89*	*104813.6*			
Site	*118402*	*Concrete or Asphalt*	*1*	*0.89*	*105614.6*			
Site	*378290*	*Ornamental Landscaping*	*0.1*	*0.11*	*41785.2*			
	614196	***Total***			**252213.4**	**1.80**	**37832**	

Proposed Volume must be greater than the Design Capture Volume

Notes:

Santa Ana Watershed - BMP Design Volume, V_{BMP}

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name	Sikand Engineering Associates	Date	1/27/2021
Designed by	Doug Farmer, PE	Case No	
Company Project Number/Name	5118-007/ Hemet		

BMP Identification

BMP NAME / ID: 2yr-24hr_Pre-Dev't Volume

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

2-year, 24-hour Rainfall Depth, from the Precipitation Map: $D_{2yr, 24hr}$ = 1.80 inches

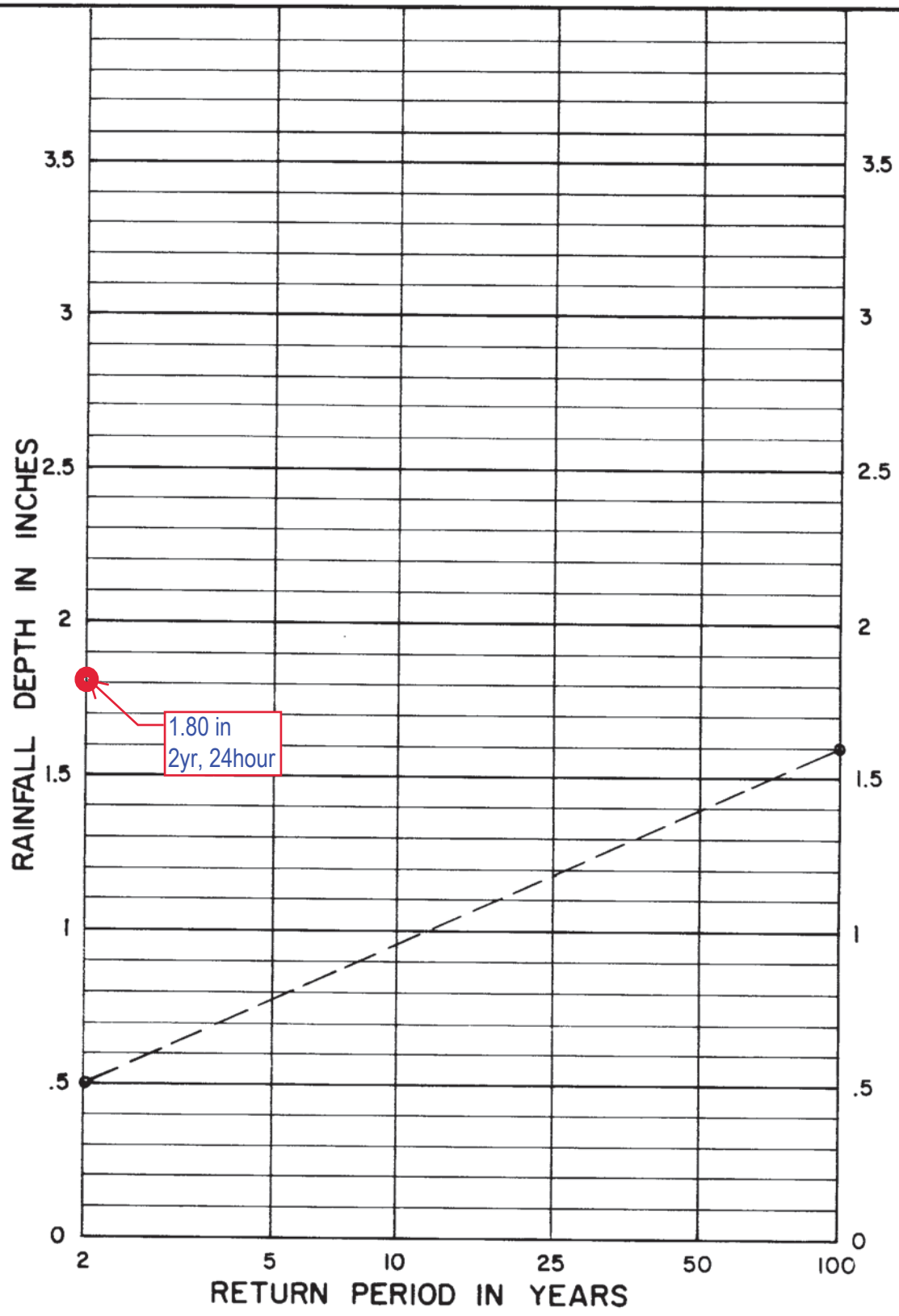
Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
Site	*614916*	*Mixed Surface Types*	*0.15*	*0.14*	*86977.3*			
	614916		***Total***		**86977.3**	**1.80**	***13046.6***	

Proposed Volume must be greater than the Design Capture Volume

Notes:



NOTE:

1. For intermediate return periods plot 2-year and 100-year one hour values from maps, then connect points and read value for desired return period. For example given 2-year one hour = .50" and 100-year one hour = 1.60", 25-year one hour = 1.18"

Reference: NOAA Atlas 2, Volume XI - California, 1973.

RCFC & WCD

HYDROLOGY MANUAL

RAINFALL DEPTH VERSUS RETURN PERIOD FOR PARTIAL DURATION SERIES

PLATE D-4.5


PROJECT SITE
NOTES:
1. Isohyetals from NOAA Atlas 2, Volume XI - California, 1973.
RCFC & WCD
HYDROLOGY MANUAL
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
2-YEAR — 24-HOUR PRECIPITATION
DRAWN BY: R.A.S.
PLATE E-5.5
SHEET NO.
DR. NO.
APPROVED: CHIEF ENGINEER R.E. NO. 8822
DATE
REVISED:

RETENTION/DETENTION (PRIVATE) BASIN CALCULATION

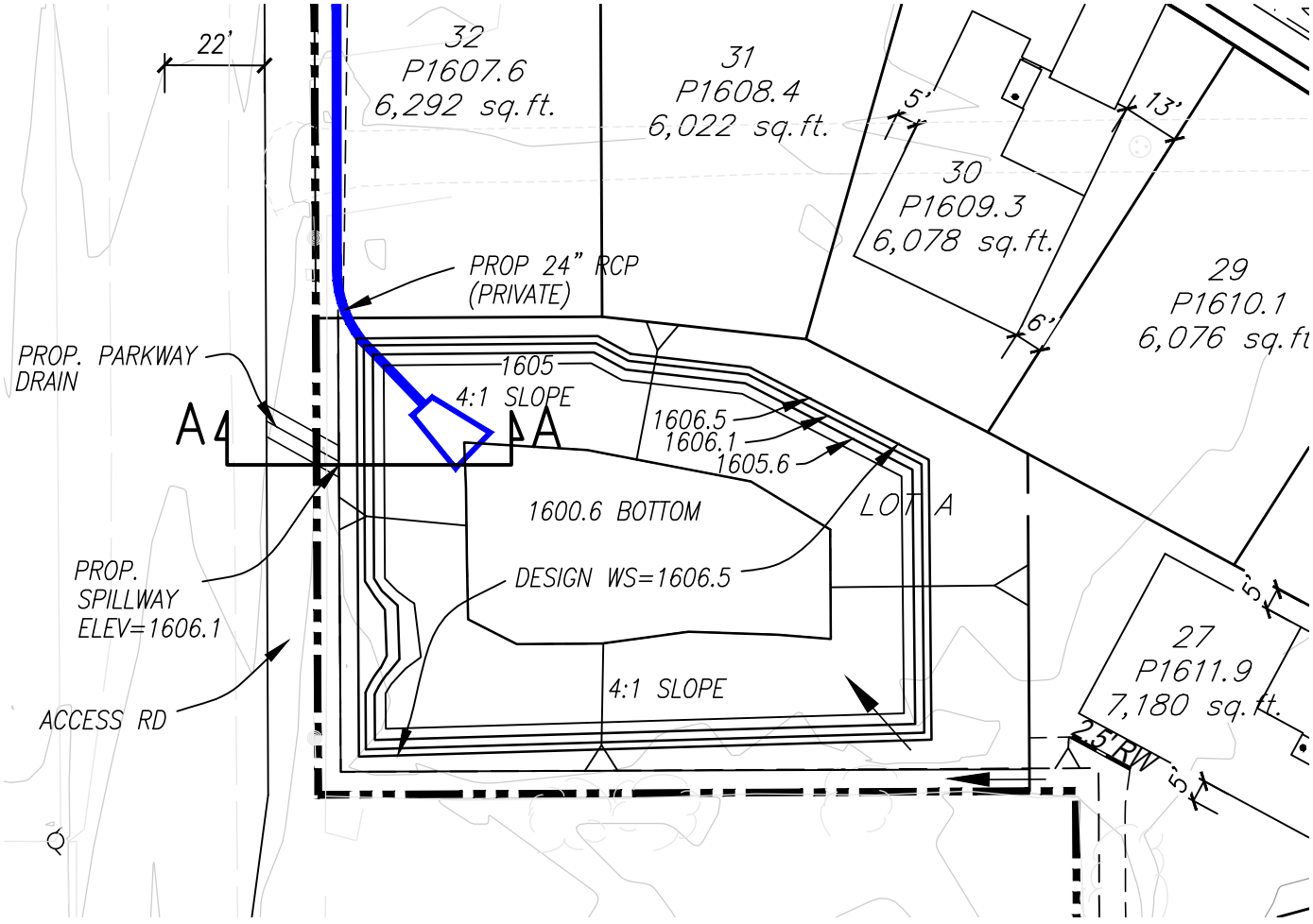
NORTH

PLAN

SCALE: 1" = 40'

DEPTH VS CAPACITY

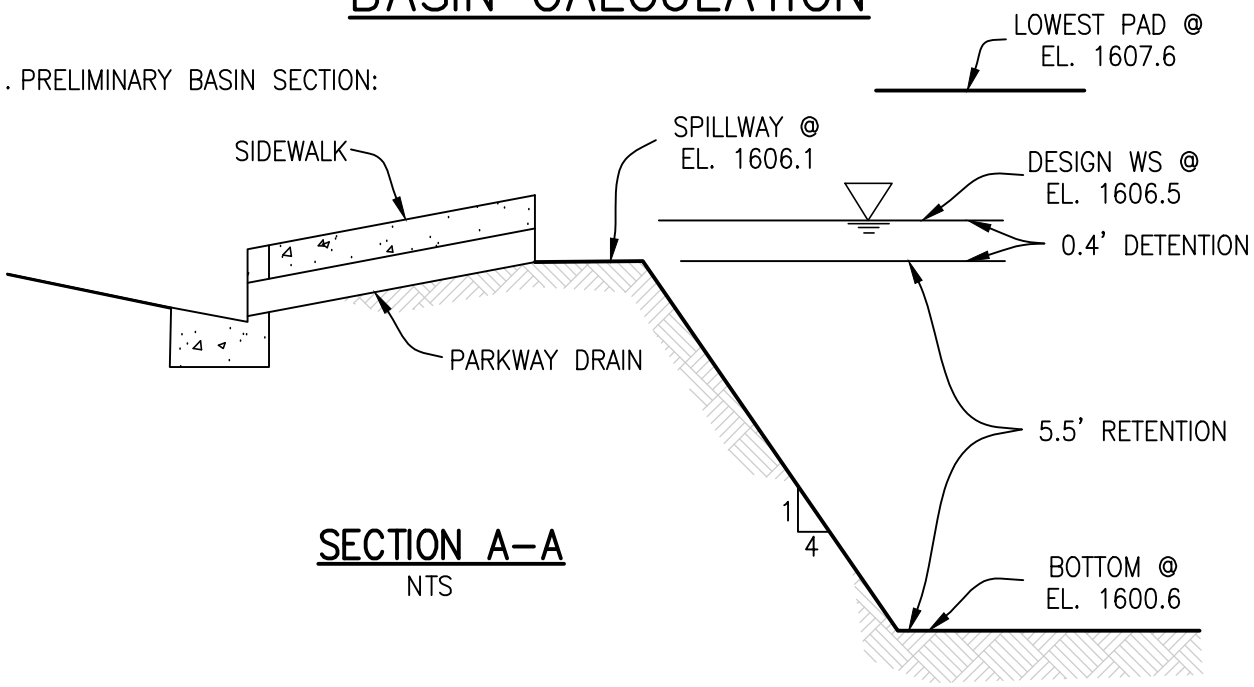
Elevation	Area (ft^2)	Volume (ft^3)	Capacity (ft3)	
1,600.60	3,025	-	-	
1,605.60	9,085	30,275.00	30,275.00	
1,606.10	9,888	4,743.25	35,018.25	← RETENTION LEVEL
1,606.50	10,617	4,101.00	39,119.25	← DETENTION LEVEL



SIKAND Engineering | Planning | Surveying 15230 Burbank Blvd., #100 Van Nuys, CA 91411 Phone: (818) 787-8550; Fax: (818) 901-7451 www.sikand.com; E-mail: info@sikand.com	BY: E.R. W.O. NO.: 5118-007 DATE: 01/27/20 SCALE:	CLIENT: **Mr. Shizao Zheng** 1378 West Zhorgshan Road, Ningbo City Zhejiang Province, China PROJECT: **TTM 37558** City of Hemet, Riverside County	SHT. 1 OF 2

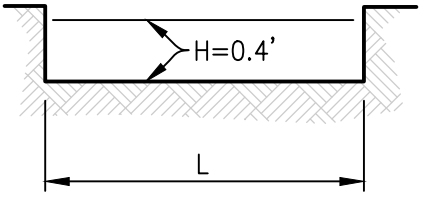
RETENTION/DETENTION (PRIVATE) BASIN CALCULATION

1. PRELIMINARY BASIN SECTION:



SECTION A–A
NTS

2. BROAD–CRESTED WEIR:



$Q = CLH^{3/2}$

$C = 2.80$

$Q = 2.7$ CFS

SOLVING FOR $L = \frac{Q}{CH^{3/2}} = 3.81'$

USE L = 4'

3. DRAWDOWN:

RETENTION DEPTH = 5.5 FT

INFILTRATION RATE = 4.53 INCH/HR (SEE PRELIM. INFILTRATION TEST REPORT)

FACTOR OF SAFETY = 3

DESIGN INFILTRATION RATE = $\frac{4.53 \text{ INCH/HR}}{3} = 1.51$ INCH/HR

TIME TO DRAIN = $\frac{5.5 \text{ FT}}{(1.51 \text{ INCH/HR}) \times (1 \text{ FT}/12 \text{ INCHES})} =$ 43.7 HOURS

LESS THAN 72 HRS MAX, THEREFORE OKAY!

SIKAND
Engineering | Planning | Surveying
15230 Burbank Blvd., #100 Van Nuys, CA 91411
Phone: (818) 787–8550; Fax: (818) 901–7451
www.sikand.com; E–mail: info@sikand.com

BY: E.R.	CLIENT: **Mr. Shizao Zheng** 1378 West Zhorgshan Road, Ningbo City Zhejiang Province, China	SHT. 2
W.O. NO.: 5118–007		
DATE: 01/27/20	PROJECT: **TTM 37558** City of Hemet, Riverside County	OF 2
SCALE:		

Existing Condition 2yr storm

```
                Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
        Rational Hydrology Study        Date: 01/29/21  File:EX2.out
------------------------------------------------------------------------
Tentative Tract 37558
Drainage Study - Existing Condition
City of Hemet, County of Riverside
By Sikand Engineering Associates
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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

------------------------------------------------------------------------


Program License Serial Number 6057

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

Storm event (year) =    2.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [ Hemet ] area used.
10 year storm 10 minute intensity =  1.960(In/Hr)
10 year storm 60 minute intensity =  0.760(In/Hr)
100 year storm 10 minute intensity =  3.050(In/Hr)
100 year storm 60 minute intensity =  1.180(In/Hr)

Storm event year =   2.0
Calculated rainfall intensity data:
1 hour intensity =  0.466(In/Hr)
Slope of intensity duration curve = 0.5300




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        2.000
**** INITIAL AREA EVALUATION ****
____________________________________________________________________________
Initial area flow distance =   210.800(Ft.)
Top (of initial area) elevation =  1640.200(Ft.)
Bottom (of initial area) elevation =  1625.000(Ft.)
Difference in elevation =    15.200(Ft.)
Slope =    0.07211  s(percent)=       7.21
TC = k(0.710)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.214 min.
Rainfall intensity =      1.192(In/Hr) for a     2.0 year storm
UNDEVELOPED (fair cover) subarea
Runoff Coefficient = 0.599
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      0.214(CFS)
Total initial stream area =        0.300(Ac.)
Pervious area fraction = 1.000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        3.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
____________________________________________________________________________
Top of natural channel elevation =   1625.000(Ft.)
End of natural channel elevation =   1612.700(Ft.)
Length of natural channel  =   783.700(Ft.)
Estimated mean flow rate at midpoint of channel =      1.785(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   2.11(Ft/s)
```

```
Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
        Normal channel slope =  0.0157
Corrected/adjusted channel slope =  0.0157
Travel time =    6.20 min.     TC =   16.42  min.


 Adding area flow to channel
UNDEVELOPED (fair cover) subarea
Runoff Coefficient = 0.547
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      0.927(In/Hr) for a     2.0 year storm
Subarea runoff =      2.230(CFS) for      4.400(Ac.)
Total runoff =      2.444(CFS)  Total area =       4.700(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        4.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________________
Top of natural channel elevation =   1612.700(Ft.)
End of natural channel elevation =   1608.700(Ft.)
Length of natural channel  =   378.700(Ft.)
Estimated mean flow rate at midpoint of channel =      2.912(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   1.92(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
        Normal channel slope =  0.0106
Corrected/adjusted channel slope =  0.0106
Travel time =    3.29 min.     TC =   19.71  min.


 Adding area flow to channel
UNDEVELOPED (fair cover) subarea
Runoff Coefficient = 0.526
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      0.841(In/Hr) for a     2.0 year storm
Subarea runoff =      0.796(CFS) for      1.800(Ac.)
Total runoff =      3.241(CFS)  Total area =       6.500(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        5.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________________
Top of natural channel elevation =   1608.700(Ft.)
End of natural channel elevation =   1606.600(Ft.)
Length of natural channel  =   166.000(Ft.)
Estimated mean flow rate at midpoint of channel =      4.562(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   2.32(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
        Normal channel slope =  0.0127
Corrected/adjusted channel slope =  0.0127
Travel time =    1.19 min.     TC =   20.90  min.


 Adding area flow to channel
UNDEVELOPED (fair cover) subarea
Runoff Coefficient = 0.519
```

```
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      0.816(In/Hr) for a     2.0 year storm
Subarea runoff =      2.243(CFS) for      5.300(Ac.)
Total runoff =      5.484(CFS)  Total area =      11.800(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station        6.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________________
Top of natural channel elevation =   1606.600(Ft.)
End of natural channel elevation =   1605.500(Ft.)
Length of natural channel  =   159.400(Ft.)
Estimated mean flow rate at midpoint of channel =      6.065(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   1.83(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
        Normal channel slope =  0.0069
Corrected/adjusted channel slope =  0.0069
Travel time =    1.45 min.     TC =   22.35  min.


 Adding area flow to channel
UNDEVELOPED (fair cover) subarea
Runoff Coefficient = 0.511
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      0.787(In/Hr) for a     2.0 year storm
Subarea runoff =      1.006(CFS) for      2.500(Ac.)
Total runoff =      6.490(CFS)  Total area =      14.300(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station        6.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     14.300(Ac.)
Runoff from this stream =      6.490(CFS)
Time of concentration =   22.35 min.
Rainfall intensity =     0.787(In/Hr)
Summary of stream data:

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


1        6.490     22.35                 0.787
Largest stream flow has longer time of concentration
Qp =      6.490 + sum of
Qp =      6.490

Total of 1 streams to confluence:
Flow rates before confluence point:
       6.490
Area of streams before confluence:
      14.300
Results of confluence:
Total flow rate =      6.490(CFS)
Time of concentration =    22.348 min.
Effective stream area after confluence =     14.300(Ac.)
End of computations, total study area =           14.30 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged RI index number =  69.0
```

Proposed Condition 2yr storm

```
                Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
        Rational Hydrology Study        Date: 01/29/21  File:pr2.out
------------------------------------------------------------------------
Tentative Tract 37558
Drainage Study
City of Hemet, County of RIverside
By Sikand Engineering Associates
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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

------------------------------------------------------------------------


Program License Serial Number 6057

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

Storm event (year) =    2.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [ Hemet ] area used.
10 year storm 10 minute intensity =  1.960(In/Hr)
10 year storm 60 minute intensity =  0.760(In/Hr)
100 year storm 10 minute intensity =  3.050(In/Hr)
100 year storm 60 minute intensity =  1.180(In/Hr)

Storm event year =   2.0
Calculated rainfall intensity data:
1 hour intensity =  0.466(In/Hr)
Slope of intensity duration curve = 0.5300




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Initial area flow distance =   183.200(Ft.)
Top (of initial area) elevation =  1621.000(Ft.)
Bottom (of initial area) elevation =  1619.200(Ft.)
Difference in elevation =     1.800(Ft.)
Slope =    0.00983  s(percent)=       0.98
TC = k(0.390)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.903 min.
Rainfall intensity =      1.366(In/Hr) for a     2.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.705
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
Initial subarea runoff =      0.481(CFS)
Total initial stream area =        0.500(Ac.)
Pervious area fraction = 0.500


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        3.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________________
Top of street segment elevation =  1619.200(Ft.)
End of street segment elevation =  1617.100(Ft.)
Length of street segment  =   162.600(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
```

```
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      1.444(CFS)
Depth of flow =   0.226(Ft.), Average velocity =   1.943(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   4.948(Ft.)
Flow velocity =   1.94(Ft/s)
Travel time =    1.39 min.     TC =    9.30  min.
 Adding area flow to street
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.695
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
Rainfall intensity =      1.253(In/Hr) for a     2.0 year storm
Subarea runoff =      1.742(CFS) for      2.000(Ac.)
Total runoff =      2.223(CFS)  Total area =       2.500(Ac.)
Street flow at end of street =      2.223(CFS)
Half street flow at end of street =      1.112(CFS)
Depth of flow =   0.254(Ft.), Average velocity =   2.094(Ft/s)
Flow width (from curb towards crown)=   6.358(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        4.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =  1617.100(Ft.)
End of street segment elevation =  1613.700(Ft.)
Length of street segment  =   253.200(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      4.250(CFS)
Depth of flow =   0.299(Ft.), Average velocity =   2.433(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   8.640(Ft.)
Flow velocity =   2.43(Ft/s)
Travel time =    1.73 min.     TC =   11.03  min.
 Adding area flow to street
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.685
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
Rainfall intensity =      1.144(In/Hr) for a     2.0 year storm
Subarea runoff =      3.920(CFS) for      5.000(Ac.)
Total runoff =      6.143(CFS)  Total area =       7.500(Ac.)
Street flow at end of street =      6.143(CFS)
Half street flow at end of street =      3.071(CFS)
Depth of flow =   0.330(Ft.), Average velocity =   2.644(Ft/s)
Flow width (from curb towards crown)=  10.174(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        5.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =  1613.700(Ft.)
End of street segment elevation =  1608.800(Ft.)
```

```
Length of street segment  =   395.100(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      7.665(CFS)
Depth of flow =   0.354(Ft.), Average velocity =   2.699(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  11.372(Ft.)
Flow velocity =   2.70(Ft/s)
Travel time =    2.44 min.     TC =   13.47  min.
 Adding area flow to street
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.673
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
Rainfall intensity =      1.029(In/Hr) for a     2.0 year storm
Subarea runoff =      2.910(CFS) for      4.200(Ac.)
Total runoff =      9.053(CFS)  Total area =      11.700(Ac.)
Street flow at end of street =      9.053(CFS)
Half street flow at end of street =      4.526(CFS)
Depth of flow =   0.370(Ft.), Average velocity =   2.807(Ft/s)
Flow width (from curb towards crown)=  12.191(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station        6.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________________
Top of street segment elevation =  1608.800(Ft.)
End of street segment elevation =  1606.500(Ft.)
Length of street segment  =   320.100(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      9.719(CFS)
Depth of flow =   0.407(Ft.), Average velocity =   2.318(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  14.034(Ft.)
Flow velocity =   2.32(Ft/s)
Travel time =    2.30 min.     TC =   15.77  min.
 Adding area flow to street
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.664
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
Rainfall intensity =      0.947(In/Hr) for a     2.0 year storm
Subarea runoff =      1.194(CFS) for      1.900(Ac.)
Total runoff =     10.247(CFS)  Total area =      13.600(Ac.)
Street flow at end of street =     10.247(CFS)
Half street flow at end of street =      5.123(CFS)
Depth of flow =   0.413(Ft.), Average velocity =   2.348(Ft/s)
Flow width (from curb towards crown)=  14.337(Ft.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station        7.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =  1603.500(Ft.)
Downstream point/station elevation =  1600.000(Ft.)
Pipe length  =   139.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    10.247(CFS)
Given pipe size =     24.00(In.)
Calculated individual pipe flow  =    10.247(CFS)
Normal flow depth in pipe =    8.78(In.)
Flow top width inside pipe =   23.12(In.)
Critical Depth =   13.74(In.)
Pipe flow velocity =      9.85(Ft/s)
Travel time through pipe =    0.24 min.
Time of concentration (TC) =    16.01 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station        7.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
UNDEVELOPED (good cover) subarea
Runoff Coefficient = 0.472
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  61.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Time of concentration =    16.01 min.
Rainfall intensity =      0.940(In/Hr) for a     2.0 year storm
Subarea runoff =      0.222(CFS) for      0.500(Ac.)
Total runoff =     10.469(CFS)  Total area =      14.100(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station        7.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     14.100(Ac.)
Runoff from this stream =     10.469(CFS)
Time of concentration =   16.01 min.
Rainfall intensity =     0.940(In/Hr)
Summary of stream data:

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


1       10.469     16.01                 0.940
Largest stream flow has longer time of concentration
Qp =     10.469 + sum of
Qp =     10.469

Total of 1 streams to confluence:
Flow rates before confluence point:
      10.469
Area of streams before confluence:
       14.100
Results of confluence:
Total flow rate =     10.469(CFS)
Time of concentration =    16.008 min.
Effective stream area after confluence =     14.100(Ac.)
End of computations, total study area =           14.10 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.518
Area averaged RI index number =  56.2
```

Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

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

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

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

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

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

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

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

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

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

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

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

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

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ P. **Plazas, sidewalks, and parking lots.**			❑ **Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.**

Appendix 9: O&M

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

NOTE: The proposed Infiltration Basin BMP will be maintained by the HOA. The O&M Plan and Documentation will be provided on the Final WQMP. The page below is a sample inspection checklist that will be part of the implementation.

[EXAMPLE]

Infiltration Basin Maintenance Plan

INFILTRATION BASIN INFORMATION

Infiltration basins are designed to remove pollutants from stormwater runoff and reduce runoff volume through infiltration. **Maintenance is required** and is extremely important. Sediment and debris must be removed regularly to maintain correct function.

This document serves as guidance to developing an inspection and maintenance plan.

SITE LOCATION: _____

Physical address of infiltration basin

INFILTRATION BASIN INSPECTION/MAINTENANCE

The CURRENT OWNER or their designee is responsible for completing inspections and conducting maintenance.

WHEN WILL THE INFILTRATION BASIN BE INSPECTED AND MAINTAINED?

At a minimum, Infiltration Basins must be inspected in the **spring** and **fall** of each year. Personnel should be aware of the maintenance plan. It is recommended to consult with the designer and builder to understand the inspection and maintenance needs.

MAINTENANCE PLAN INFORMATION

This Maintenance Plan for the location listed above is submitted by the CURRENT OWNER on _____ to comply with the City's Land Development Code Requirements. Inspection and maintenance records are required to be kept on file for five (5) years and submitted to the City as requested. This plan will be attached to the required recorded maintenance agreement.

INSPECTION & MAINTENANCE CHECKLIST (must be completed in the Spring & Fall):

	Clean basin. Remove any sediment, trash and debris.
	Remove any dead vegetation, trim live vegetation if needed and remove weeds.
	Inspect and clean pre-treatment area(s) (e.g. forebay, sump, filter strip, rock).
	Repair inlet erosion/damage. Inspect bottom of the basin and remove any sediment.
	Loosen, aerate or replace soils to ensure water infiltrates – must infiltrate within 48 hours.
	Paved surfaces draining to basin swept and kept free of sediment and debris.
	Wood mulch replaced or added to keep 3" depth. (Include if applicable).
	Replace dead plants/vegetation. Manage native vegetation (if applicable) through mowing, spot spraying for weeds and/or prescribed burning. Water as needed.
	Erosion will be repaired.
	Photos taken.
	Other:

Appendix 10: Educational Materials

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

3.1 INFILTRATION BASIN

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

Description

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

Figure 1 – Infiltration Basin

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

Siting Considerations

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

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

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

Setbacks

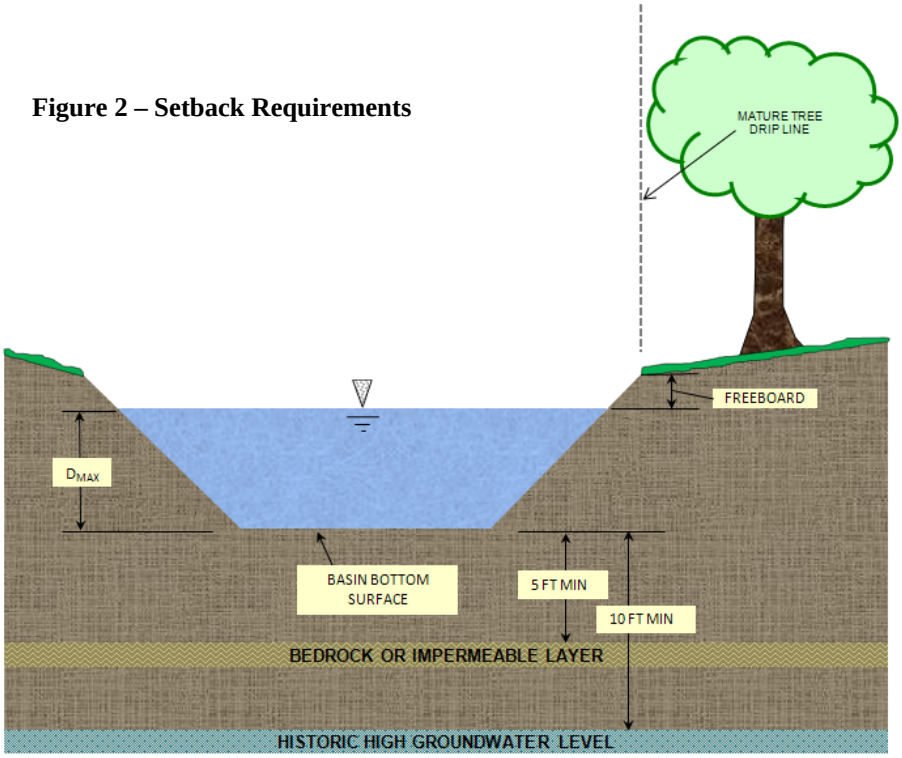
Always consult your geotechnical engineer for site specific recommendations regarding setbacks for infiltration trenches. Recommended setbacks are needed to protect buildings, existing trees, walls, onsite or nearby wells, streams, and tanks. Setbacks should be considered early in the design process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

Infiltration basins typically must be set back:

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

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

Figure 2 – Setback Requirements



Forebay

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

Overflow

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

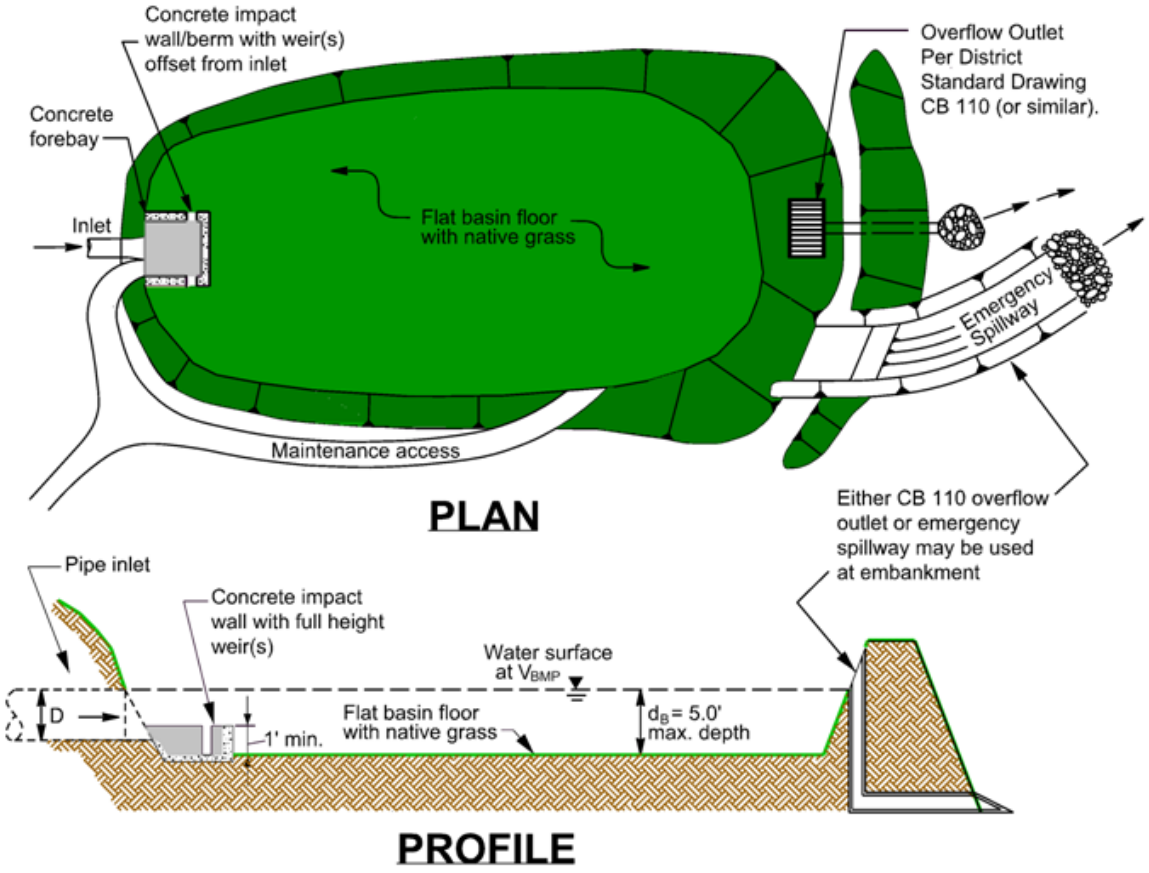


Figure 3 – Infiltration Basin

Landscaping Requirements

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

Maintenance

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

Table 1 - Inspection and Maintenance

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

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

Table 2 - Design and Sizing Criteria for Infiltration Basins

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

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

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

INFILTRATION BASIN SIZING PROCEDURE

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

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

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

d) Enter the depth of freeboard.

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

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

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

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

or

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

Whichever is least.

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

3. Basin Geometry

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

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

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

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

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

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

4. Forebay

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

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

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

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

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

Infiltration Basin - Design Procedure (Rev. 03-2012)	BMP ID	Legend:	Required Entries / Calculated Cells

Company Name: _____ Date: _____

Designed by: _____ County/City Case No.: _____

Design Volume

a) Tributary area (BMP subarea) — A_T = _____ acres

b) Enter V_{BMP} determined from Section 2.1 of this Handbook — V_{BMP} = _____ ft^3

Maximum Depth

a) Infiltration rate — I = _____ in/hr

b) Factor of Safety (See Table 1, Appendix A: "Infiltration Testing" from this BMP Handbook) — FS = _____

c) Calculate D_1 — $D_1 = \frac{I\ (in/hr) \times 72\ hrs}{12\ (in/ft) \times FS}$ — D_1 = _____ ft

d) Enter the depth of freeboard (at least 1 ft) — _____ ft

e) Enter depth to historic high ground water (measured from **top** of basin) — _____ ft

f) Enter depth to top of bedrock or impermeable layer (measured from **top** of basin) — _____ ft

g) D_2 is the smaller of:

Depth to groundwater - (10 ft + freeboard) and
Depth to impermeable layer - (5 ft + freeboard)

D_2 = _____ ft

h) D_{MAX} is the smaller value of D_1 and D_2 but shall not exceed 5 feet — D_{MAX} = _____ ft

Basin Geometry

a) Basin side slopes (no steeper than 4:1) — z = _____ :1

b) Proposed basin depth (excluding freeboard) — d_B = _____ ft

c) Minimum bottom surface area of basin ($A_S = V_{BMP}/d_B$) — A_S = _____ ft^2

d) Proposed Design Surface Area — A_D = _____ ft^2

Forebay

a) Forebay volume (minimum 0.5% V_{BMP}) — Volume = _____ ft^3

b) Forebay depth (height of berm/splashwall. 1 foot min.) — Depth = _____ ft

c) Forebay surface area (minimum) — Area = _____ ft^2

d) Full height notch-type weir — Width (W) = _____ in

Notes: _____

Site Design & Landscape Planning SD-10

Design Objectives

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

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

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

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

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

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

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

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

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

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

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

Roof Runoff Controls SD-11

Rain Garden

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

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

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

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

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

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

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

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

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

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

Pop-up Drainage Emitter

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

Foundation Planting

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

Redeveloping Existing Installations

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

Supplemental Information

Examples

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

Other Resources

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

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

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

Storm Drain Signage SD-13

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

Designing New Installations

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

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

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

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

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Placement

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

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

Supplemental Information

Examples

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

Other Resources

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

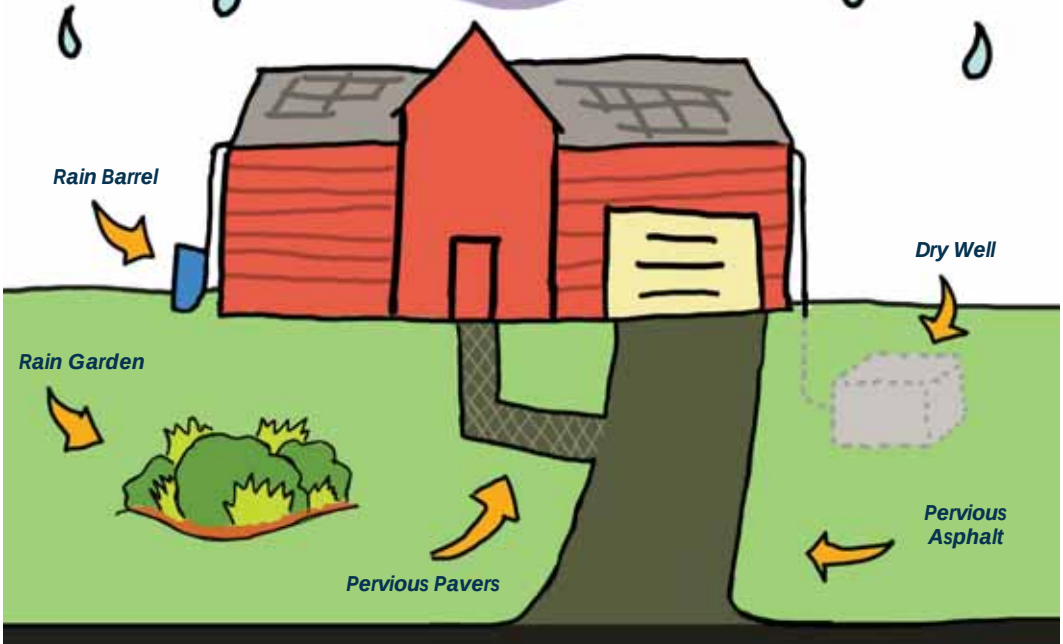
Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

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

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

Homeowners Guide to Stormwater BMP Maintenance

What You Need to Know to Take Care of Your Property

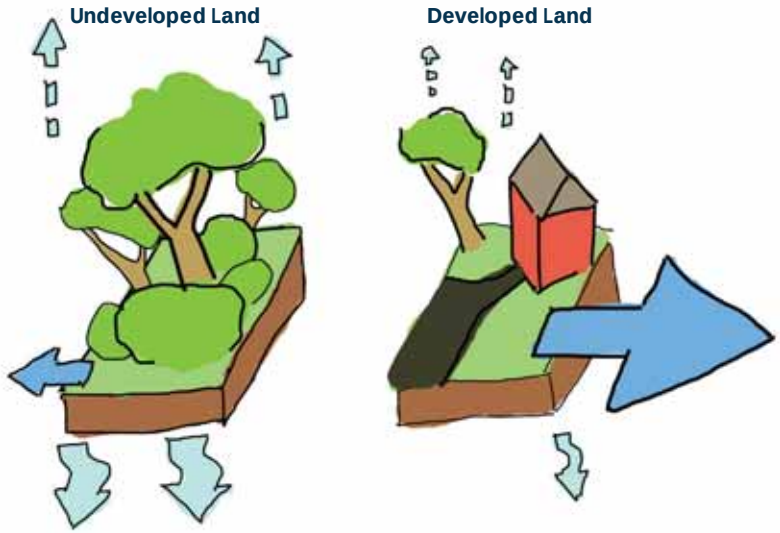


What is Stormwater?

Stormwater is the water that runs off the land after precipitation, either rain or snowmelt. Rain or snow can drain down into the soil (called infiltration), evaporate back into the atmosphere, be used by plants, or flow into streams or water bodies. The water that runs off the land to streams or lakes is referred to as stormwater runoff.

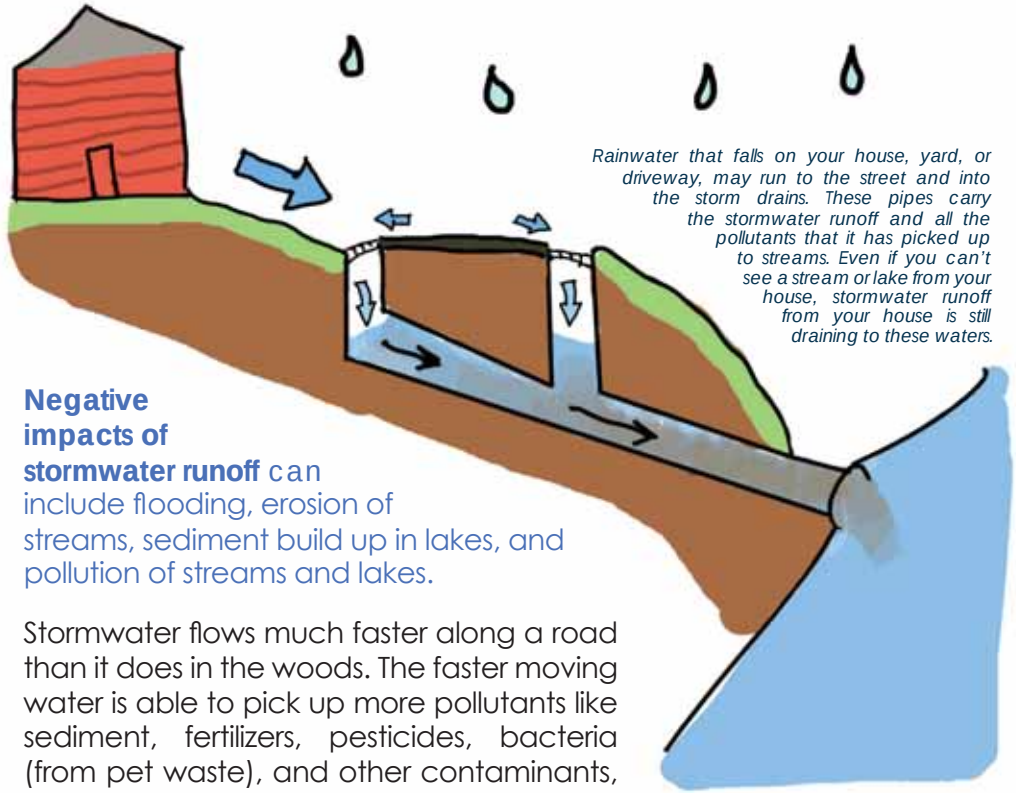
Stormwater runoff happens in natural, undeveloped areas, but typically only for larger storms. For most areas in Pennsylvania that are wooded or natural meadows, it takes about an inch or more of rain to produce runoff.

After development, the natural wooded or meadow areas are replaced with roofs, driveways, sidewalks, and streets. These hard surfaces are called impervious surfaces, and they do not allow water to drain through them, unlike how rain can drain into soil (which is called a pervious surface). When rain falls on impervious surfaces, it runs off rather than infiltrating into the soil or being taken up by vegetation.



When it rains on an undeveloped piece of property, much of the rainwater infiltrates into the soil or is evapotranspired back into the atmosphere. When vegetation is replaced with streets, driveways, sidewalks, houses, and lawns, less rainwater is able to infiltrate or return to the atmosphere, and more of the rain turns into runoff.

Why should you care about Stormwater Management?



Rainwater that falls on your house, yard, or driveway, may run to the street and into the storm drains. These pipes carry the stormwater runoff and all the pollutants that it has picked up to streams. Even if you can't see a stream or lake from your house, stormwater runoff from your house is still draining to these waters.

Negative impacts of stormwater runoff can include flooding, erosion of streams, sediment build up in lakes, and pollution of streams and lakes.

Stormwater flows much faster along a road than it does in the woods. The faster moving water is able to pick up more pollutants like sediment, fertilizers, pesticides, bacteria (from pet waste), and other contaminants, and carry the pollutants to streams and lakes.

An increase in the amount of water that runs off after development and how quickly it runs off can cause erosion and instability in streams. Stormwater runoff can cause streams to become wider, deeper, and straighter, losing their natural bends (or meanders) and decreasing habitat for fish and other animals that live in streams. Stormwater from developed areas can also be hotter than natural stream sources. Warmer water holds less dissolved oxygen so stormwater can be harmful to fish like trout that need more oxygen.

It's easy to notice the flooding impacts of large rain storms, but over time, smaller storms can have an impact on streams, too. Across the state, about 95% of the rainfall volume occurs in small events (less than 2.4 to 3.2 inches depending on your location.)

BMPs: what are they, & what do they do?

BMP stands for Best Management Practice, and includes designed "things" like detention basins, as well as non-engineered approaches like protecting open space to manage stormwater. SCMs are Stormwater Control Measures, which are engineered facilities that are designed and constructed to manage stormwater. For the most part, the terms BMP and SCM can be used interchangeably.

The goal of BMPs or SCMs is to reduce the impact of development on downstream streams and lakes by:

- **minimizing the amount of runoff,**
- **slowing down the runoff,**
- **infiltrating runoff,**
- **evapotranspiring runoff,** or
- **filtering runoff.**

Many BMPs or SCMs will use vegetation for their ability to use water, put water back into the atmosphere, or help it infiltrate into the ground, rather than allow it to become runoff.

If you've ever walked through a meadow or shaken a tree branch after a rain, you got wet with intercepted water. When it rains, some of the water is trapped on plants. This "intercepted" water never even makes it to the ground where it could be infiltrated. Plants also use water as part of the photosynthesis process where they use the sun's energy to create their own food. This water used by plants is called evapotranspiration. Larger plants with broader leaves and deeper roots like trees, shrubs, or decorative grasses will intercept and evapotranspire more water than a grass lawn.

All of the homes in your community drain to a stream or lake. All homeowners need to do their part to maintain stormwater BMPs in their own yard to protect streams and lakes for everyone.

Your whole community has been designed with stormwater management in mind. There are many different BMPs spread throughout the development. Stormwater flows downstream, and the homeowners must do their part on their own property to protect the streams for everyone. You and all of your neighbors each play an important role in the health of downstream waters.

Some BMPs/SCMs are landscaped and others are buried so you might not see anything at the surface. Even though it might just look like some plants or gravel, the BMP is still performing a very important function. Disturbing the vegetation or compacting the soil can ruin that BMP and have a negative impact downstream.

Native vegetation is the best choice for BMPs because they're naturally adapted to the soils and climate. They require less fertilizer, pesticides, watering, and overall less maintenance.

Stormwater Regulations

When a property is developed, the developer must incorporate stormwater management facilities. He/she must design **Erosion and Sediment Control (E&S) BMPs** that are used during construction to prevent soil from running off the site and polluting downstream waters. When the construction period is over, **Post-Construction Stormwater Management (PCSM) BMPs** will have been constructed, and the developer must provide a way for these BMPs to be properly maintained over time.

When the developer finished the project, they will have turned over the maintenance responsibilities for the BMPs to someone else, which could be the property owner, a nonprofit organization, the local municipality, an authority, a private corporation, or another person. The developer will also have produced a plan that must include drawings, which show the location and dimensions of each PCSM BMP. Accompanying this PCSM Plan will be a long-term operation and maintenance schedule, which provides for inspection of PCSM BMPs, including the repair, replacement, or other routine maintenance of the PCSM BMPs to ensure proper function and operation. This maintenance program must describe how access to the PCSM BMPs will be achieved.

The developer will be following the rules of **PA Code, Title 25, Chapter 102**, which defines rules for both Erosion and Sediment Control, and Post Construction Stormwater Management. These regulations can be found by going to PA Code online at www.pacode.com and then browsing to Title 25, Chapter 102.

What's the Homeowner's Legal Responsibility?

If your home was constructed after 2010, and your property contains any Post Construction Stormwater Management (PCSM) BMPs, the developer will have recorded details about them with your property's deed. State regulation requires that the information recorded with the deed identifies the PCSM BMP, provides for access to the BMPs for maintenance and inspection purposes, and provides notice that the responsibility for long-term operation and maintenance of the PCSM BMP is a legal requirement that runs with the property. You can view your property records at the Recorder of Deeds office at your county courthouse to determine if you are responsible for the maintenance of any BMPs.

If you are the person designated as the responsible-party for operation and maintenance, you must ensure that the BMPs continue to function properly and follow the maintenance schedule provided by the developer and recorded with your deed. The responsibility to maintain the BMPs includes the cost of plants or material for upkeep or replacement. You should have been provided a maintenance plan by the developer if you're the first owner of the home. If your home was constructed after 2010, you may need to check the property records for information if you're not the first owner and didn't receive the maintenance plan at the time of purchase.

If you're not doing the necessary maintenance and required documentation, you may be billed by your municipality for the cost of having someone else do the work, or you could face a summary offense and daily fine until the maintenance work is complete.

If responsibility has been transferred to someone else, you need to provide access for maintenance and inspection. You also must leave any BMPs in place. For example, you can't remove the vegetation of a rain garden, level it, and plant lawn grass.

Downspout Disconnection

What is it?

Traditionally, roof gutter downspouts were connected directly to underground storm drain pipes. Disconnecting the downspout allows the roof runoff to be managed right on your property, not allowing it to pick up any pollutants to carry downstream. Roof runoff can be directed to grassy lawn areas, to rain barrels and cisterns for reuse, or to an underground sump for infiltration.

Rain barrels and sumps are discussed separately. This section describes maintenance of roof runoff to a lawn area.

How does it work?

When the gutter downspout is turned and allowed to drain into the yard, the stormwater can be filtered by the grass and infiltrated into the soil. Downspout disconnection reduces stormwater volume by allowing it to be used by plants (evapotranspiration) or infiltrated into the soil.

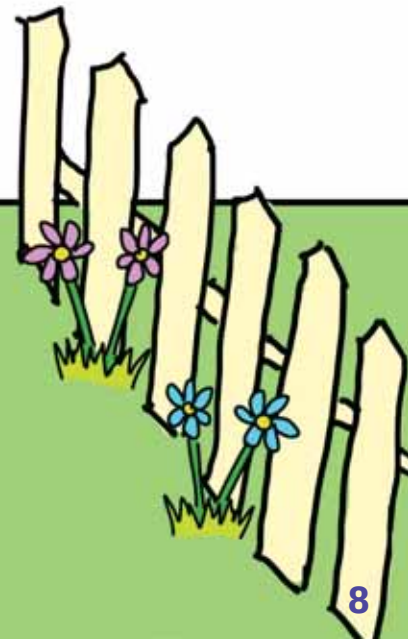
How does a Homeowner maintain it?

Regularly:

- Maintenance for a downspout draining to a lawn area is generally part of the typical yard maintenance.
- Mow the lawn in this area at the same time interval that the rest of the yard is mowed.
- Check for bare spots and reseed if needed.

Additional Information:

- A splash guard or small pile of rocks may be needed at the location where the water leaves the drain to slow the water down and prevent erosion.
- The downspout could be directed to a rain garden rather than the lawn, in which case the Rain Garden maintenance (page 9) should be followed.



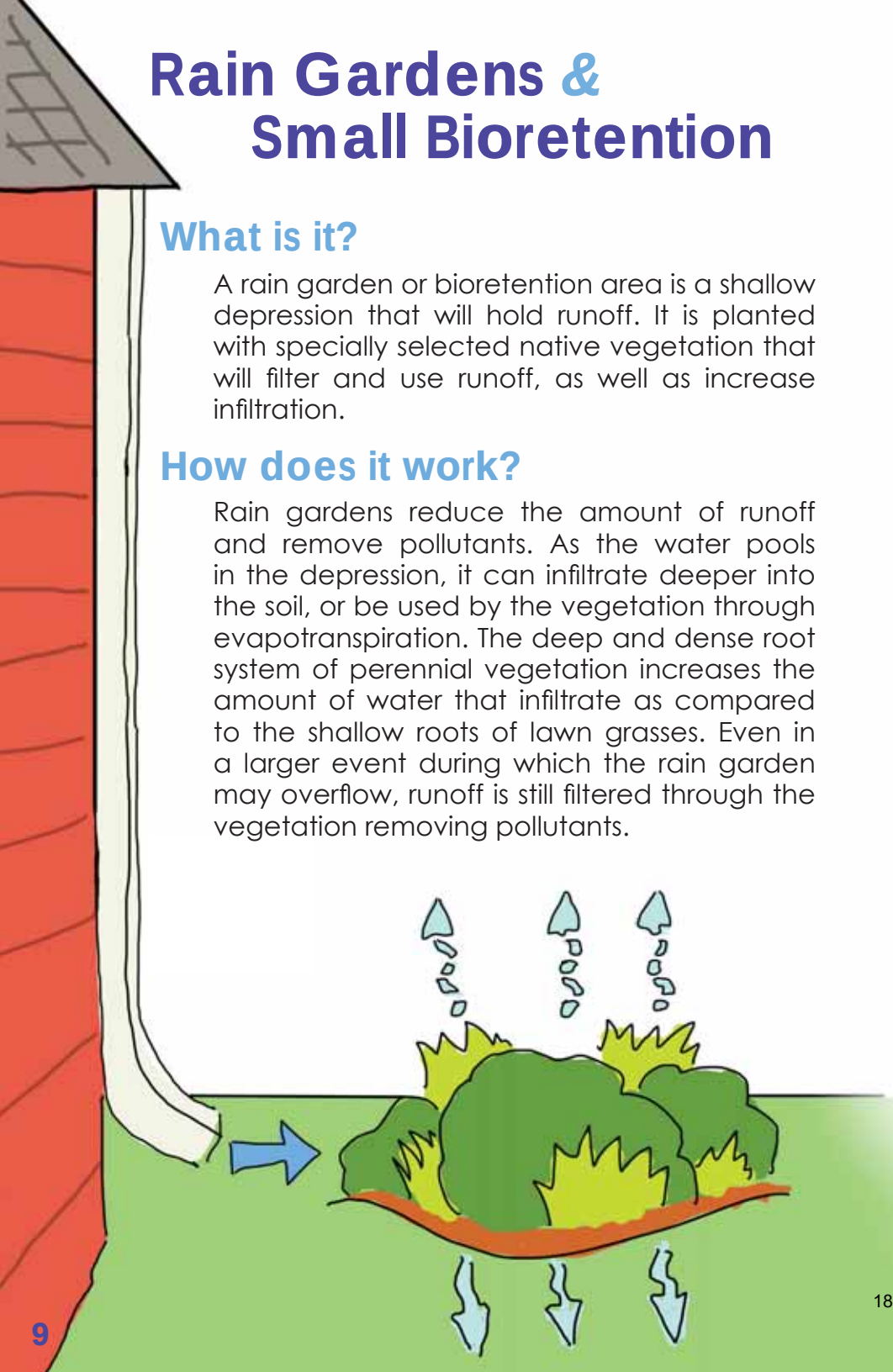
Rain Gardens & Small Bioretention

What is it?

A rain garden or bioretention area is a shallow depression that will hold runoff. It is planted with specially selected native vegetation that will filter and use runoff, as well as increase infiltration.

How does it work?

Rain gardens reduce the amount of runoff and remove pollutants. As the water pools in the depression, it can infiltrate deeper into the soil, or be used by the vegetation through evapotranspiration. The deep and dense root system of perennial vegetation increases the amount of water that infiltrate as compared to the shallow roots of lawn grasses. Even in a larger event during which the rain garden may overflow, runoff is still filtered through the vegetation removing pollutants.



How does a Homeowner maintain it?

Twice a year:

- Vegetation needs to be checked to make sure that it's healthy. Any bare spots need to be replanted.
- Check the inflow area to make sure that there isn't any sediment building up. Remove any accumulated sediment.
- Mulch should be re-spread when erosion is evident and be replenished as needed.

Annually:

- Perennial plants should be cut back if needed by species type and any dead vegetation should be removed at the end of the growing season.

Every Three Years:

- Apply mulch in the spring as needed to cover soil. Mulch should be 1-3 inches deep. Do not use mulch to "fill-in" the depression of the rain garden. That depression area is needed for stormwater management.

Additional Information:

- While vegetation is being established in the first few years, weeding may be required.
- If any plants die, they need to be replaced. Refer to the Post-Construction Stormwater Management Plan for what types of plants to use.
- During periods of extended drought, bioretention areas may require watering.
- Rain gardens should be checked after large rain storms to make sure that they are draining within 72 hours. If water remains in the rain garden longer than 72 hours, you could have mosquito problems, and should contact your county conservation district for guidance on fixing or replacing your rain garden.

Rain Barrels & Cisterns

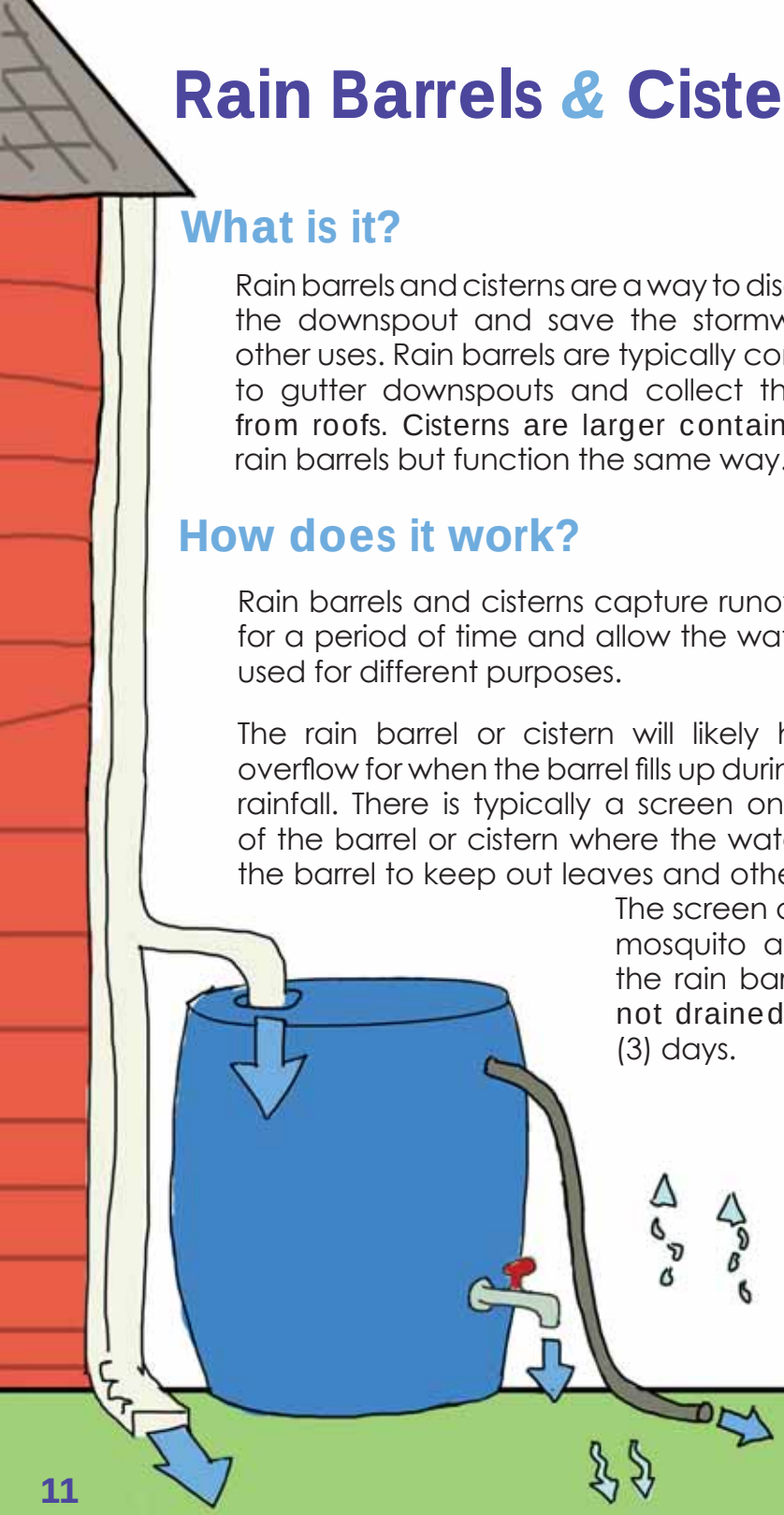
What is it?

Rain barrels and cisterns are a way to disconnect the downspout and save the stormwater for other uses. Rain barrels are typically connected to gutter downspouts and collect the runoff from roofs. Cisterns are larger containers than rain barrels but function the same way.

How does it work?

Rain barrels and cisterns capture runoff, hold it for a period of time and allow the water to be used for different purposes.

The rain barrel or cistern will likely have an overflow for when the barrel fills up during heavy rainfall. There is typically a screen on the top of the barrel or cistern where the water enters the barrel to keep out leaves and other debris. The screen also limits mosquito activity in the rain barrel if it is not drained in three (3) days.



How does a Homeowner maintain it?

After Rain Events:

- Clean the screen by removing any leaves that could block the flow of water into the barrel/cistern.
- Use the water in the barrel/cistern so that it's empty and ready to collect runoff from the next rain.

Annually:

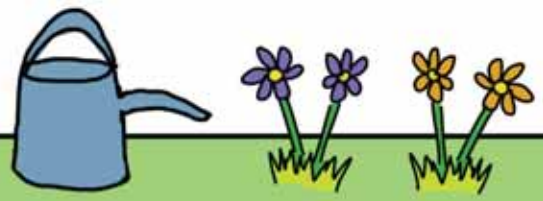
- Clean gutters to remove leaf debris that could clog the barrel/cistern.

❄ Special Winter Needs:

- In the fall, empty the rain barrel/cistern before the water could freeze.
- Rinse out the barrel/cistern to remove any accumulated sediment.
- Do not reconnect the barrel/cistern until spring. During the winter months, connect a piece of flexible gutter to the end of the downspout and direct the outlet to a grassy area of the yard.

Additional Information:

- **Rain barrels and cisterns are great (and economical!) water sources for watering plants.** The spigot can fill a watering can or be connected to a standard garden or irrigation hose.
- **Safety note!** The water in a rain barrel or cistern is **not safe for consumption** without prior treatment.



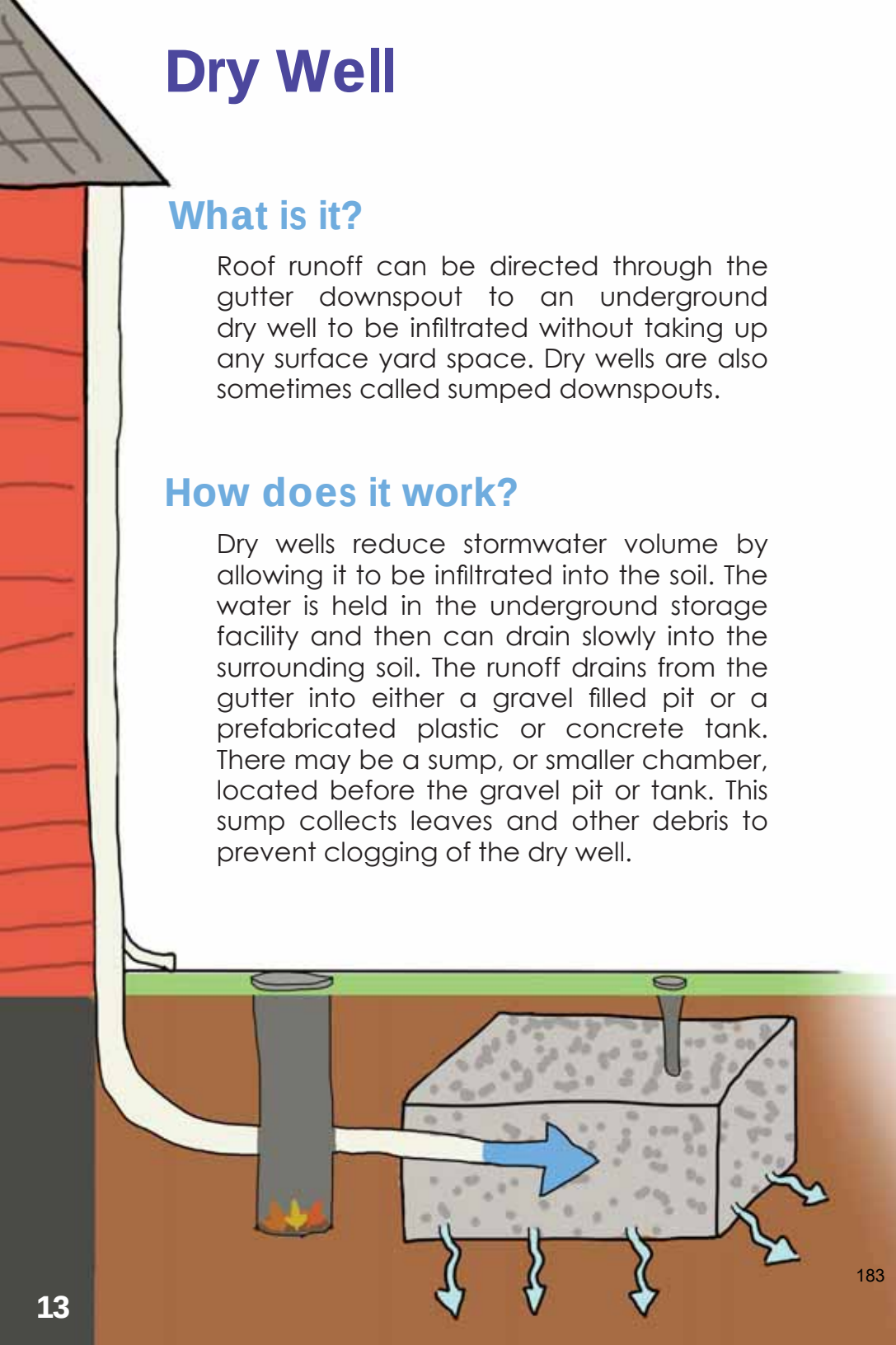
Dry Well

What is it?

Roof runoff can be directed through the gutter downspout to an underground dry well to be infiltrated without taking up any surface yard space. Dry wells are also sometimes called sumped downspouts.

How does it work?

Dry wells reduce stormwater volume by allowing it to be infiltrated into the soil. The water is held in the underground storage facility and then can drain slowly into the surrounding soil. The runoff drains from the gutter into either a gravel filled pit or a prefabricated plastic or concrete tank. There may be a sump, or smaller chamber, located before the gravel pit or tank. This sump collects leaves and other debris to prevent clogging of the dry well.



183

How does a Homeowner maintain it?

After storms with larger than 1 inch of rain:

- There is typically a screen where the downspout enters the dry well. Clean the screen by removing any leaves that could block the flow of water into the dry well.
- Inspect the sump for accumulation of sediment, trash, or any other material. Remove any material that is in the sump to prevent it from clogging the dry well.

Quarterly:

- There should be an above ground cap that allows access to the dry well. Four times a year, view down the access pipe to make sure that the dry well is not accumulating sediment, trash, or other material. Over time the accumulation of sediment or trash may be vacuumed or may require excavation. Contact your county conservation district for guidance on cleaning out your dry well.

Annually:

- Clean gutters to keep leave debris out of the sump and dry well.

Additional Information:

- After large rain events, check the access pipe to ensure that the dry well is draining within 72 hours. If the drain times are more than 72 hours, the dry well may need to be cleaned out or replaced. Contact your county conservation district for guidance on fixing or replacing your dry well.

Infiltration Trench

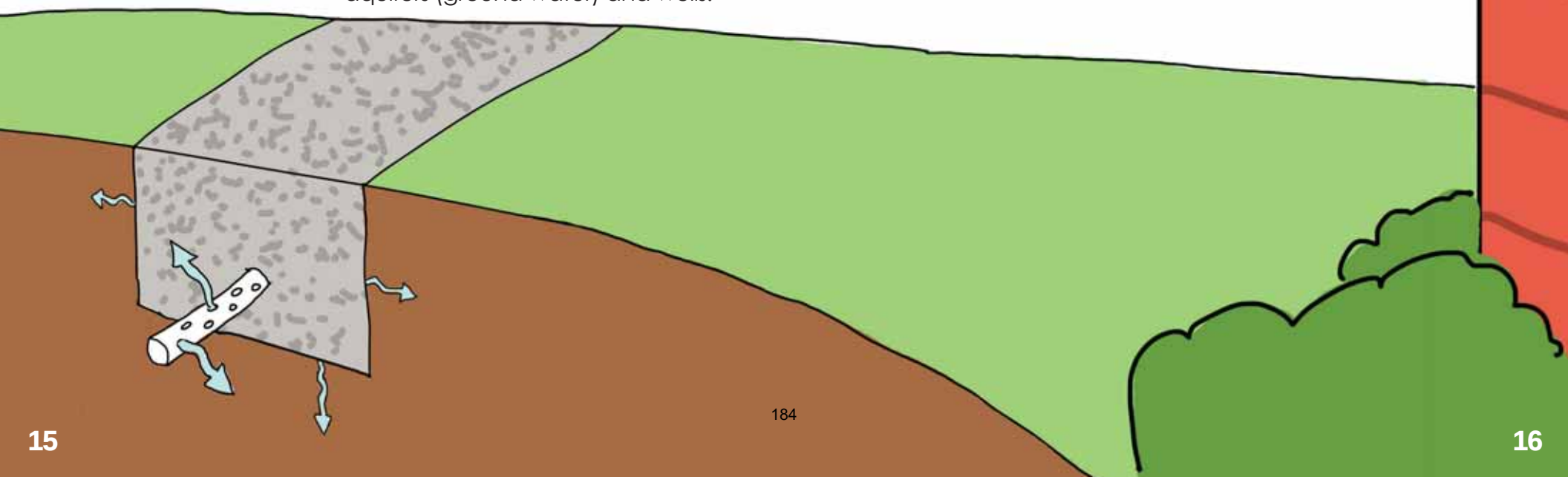
What is it?

Infiltration trenches are essentially leaky pipes in a stone-filled trench. Surface runoff or gutter downspouts can be directed to infiltration trenches.

How does it work?

An infiltration trench contains a perforated pipe in a stone trench. It can be thought of as the opposite of a French drain. In a French drain, water flows from the soil into a perforated pipe and away from the wet spot. For an infiltration trench, stormwater runoff is directed into a perforated pipe that is surrounded by gravel. The water then drains out of the perforated pipe into the trench.

During small rain events with a small amount of runoff, stormwater flows out of the pipe through the perforations into the gravel and then into the soil. During larger storms that produce more runoff, some stormwater will be stored in the stone trench, but water will also flow through the pipe to a larger BMP or SCM. Runoff that moves into the soil can help recharge aquifers (ground water) and wells.



How does a Homeowner maintain it?

Protection:

- You should be careful to not regularly drive over an infiltration trench so as to not cause compaction or crush the perforated pipe.

Annually:

- If the trench has an access pipe, it should be checked annually to make sure that the trench isn't clogged.

Additional Information:

- Ponding of water on the surface over the trench indicates that there is a problem with the trench and you should contact your county conservation district for guidance on fixing or replacing the infiltration trench.

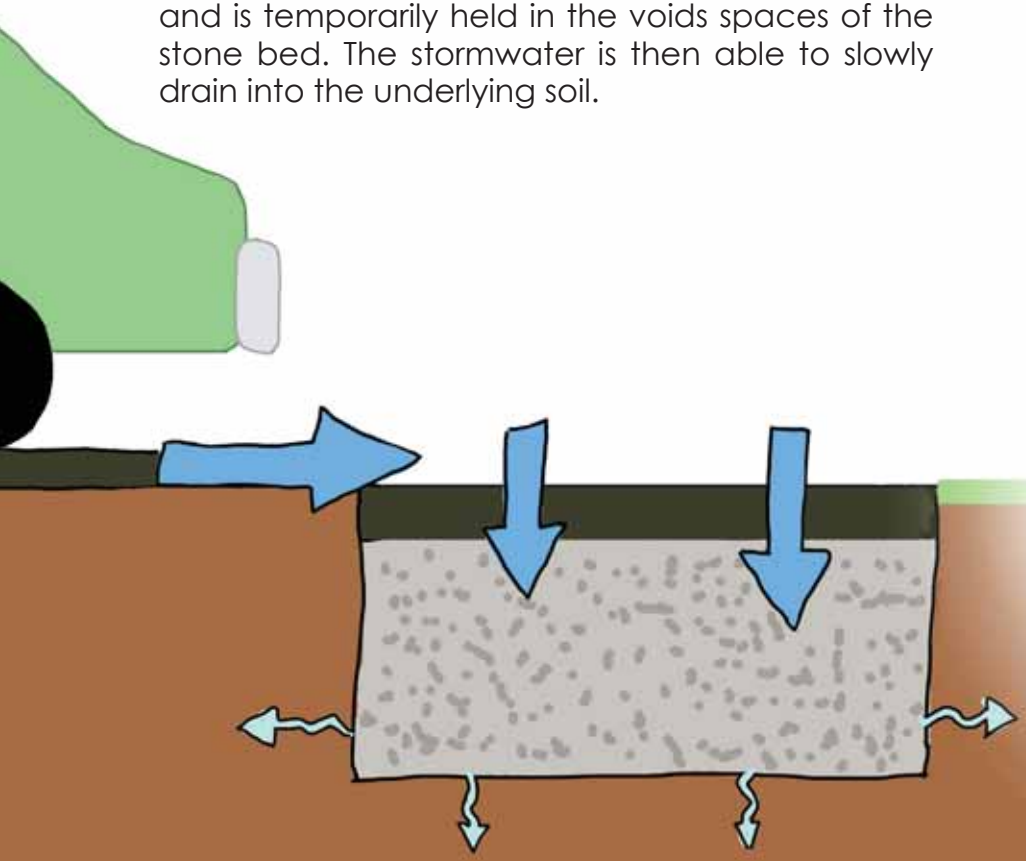
Pervious Pavements

What is it?

Pervious pavements are a modification to typical pavement that allow water to drain through the surface rather than run off it. Pervious pavements include porous asphalt or porous concrete which are poured over a gravel bed, or porous pavers on uncompacted soil.

How does it work?

Stormwater drains through the pervious surface and is temporarily held in the voids spaces of the stone bed. The stormwater is then able to slowly drain into the underlying soil.



How does a Homeowner maintain it?

Protection:

- The key to maintaining pervious pavements is to prevent the surface from getting clogged.
- Planted areas near the pervious pavement should be well maintained to prevent soil from washing into the pavement. If you see a bare spot or eroded area, it should be replanted to prevent soil wash off.
- If soil does wash onto the pavement, it should be immediately cleaned off before it gets ground into the surface.
- It is very important to never apply a sealing coat. A sealing coat over a pervious asphalt driveway or walkway will clog all the openings and prevent water from draining through it.

Biannually:

- The surface needs to be vacuumed twice a year with a commercial cleaning unit to remove fine particles from the surface.

❄ Special Winter Needs:

- Sand or cinders should not be used with pervious pavement because the small particles will clog the surface.
- Snow shoveling and plowing is fine, but be careful not to scrape the surface.
- Salt can be used on pervious pavements, but nontoxic, organic deicers or magnesium chloride-based products are better than sodium chloride.

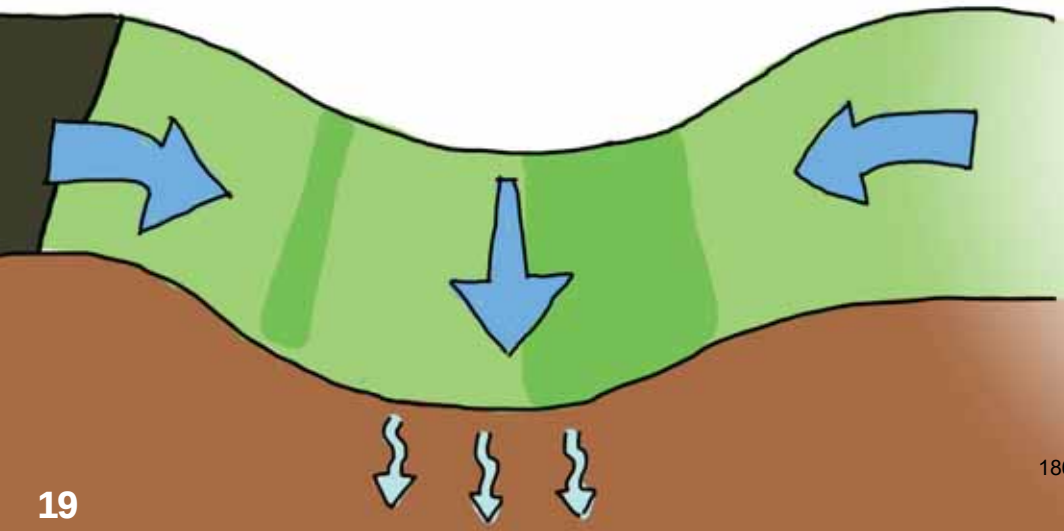
Vegetated Swale

What is it?

A vegetated swale is a wide, shallow channel, planted with grass or shrubs. A swale conveys runoff like a ditch, but a swale is much shallower and wider than a typical drainage ditch. If the swale is located on a steeper slope, rocks may be used to prevent erosion.

How does it work?

The wide, shallow design of swales allows runoff to flow more slowly than it would in a narrow, deep ditch or in a pipe. Vegetated swales slow runoff, promote infiltration, and filter pollutants and sediment in the process of conveying runoff. They can be used instead of conventional curb and gutter.



How does a Homeowner maintain it?

Regularly:

- If the vegetation in the swale is turf grass, mow the swale when mowing the rest of the yard. Mow only when swale is dry to avoid rutting.
- After rain events look for erosion, damage to vegetation, or sediment accumulation. Reseed bare areas and remove sediment.

Twice a Year:

- If the vegetation in the swale is larger perennial shrubs and bushes, check to make sure that it's healthy. Any bare spots need to be replanted.
- Look for any sediment build-up. Remove any accumulated sediment.

Annually:

- Perennial plants should be cut back if needed by species type, and any dead vegetation should be removed at the end of the growing season.

Additional Information:

- While vegetation is being established in the first few years, weeding may be required.
- Watering may be necessary during dry periods.

❄ Special Winter Needs:

- After the spring melt, remove any accumulated antiskid material like sand. Replace any damaged vegetation.
- If driveway or sidewalk runoff is directed to the swale, use nontoxic, organic deicing agents or magnesium chloride-based liquid products (rather than sodium chloride-based salts).

Amended Soils

What is it?

Much of the management of stormwater relies on soil that can infiltrate runoff. Disturbed soils that have been compacted through construction activities or soils with poor organic content can be restored and amended through loosening the soil and adding material like compost.

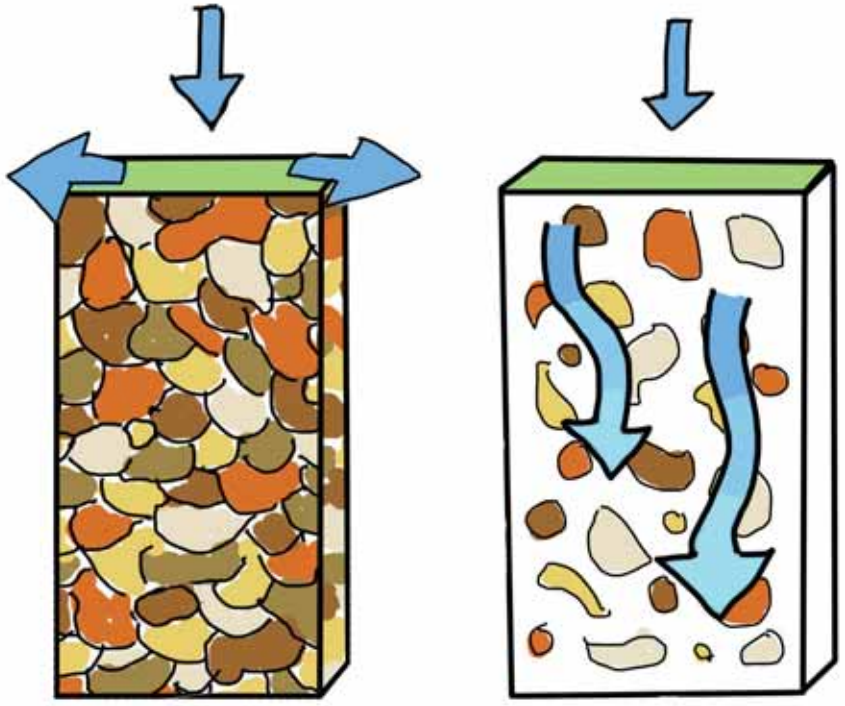
How does it work?

Little spaces between soil particles called pores or voids allow water to both be stored in the soil and move through the soil as infiltration. When the soil is compacted through the process of development, the pores or void spaces are reduced. Compaction of soil prevents water from infiltrating. Loosening the soil or tilling can reduce compaction and increase the soils ability to infiltrate runoff. Adding organic material like compost, sand, or manufactured soil media to the soil increases the pore spaces in the soil, which increases its ability to hold water.

How does a Homeowner maintain it?

Protection:

- The key to maintaining amended soils is to protect and preserve them.
- Compaction of the soil should be avoided. Don't use as an extra parking area or storage for a recreational vehicle.
- Amended soils that are a BMP can't be removed. For example, the area cannot to be converted to a patio or other use that would prevent stormwater infiltration.



Regular Soil **Amended Soil**

There needs to be air spaces in between soil particles for water to be infiltrated. Amended soils have increased air space, but these air spaces are lost if the soil is compacted by heavy equipment or vehicle parking.

Funding Acknowledgements

This publication was developed under Assistance Agreement No. CB-96317101-5 awarded by the U.S. Environmental Protection Agency. The views expressed in this document are solely those of the PaDEP and EPA does not endorse any products or commercial services mentioned in this publication.

Contact Information

Department of Environmental Protection Headquarters
Rachel Carson State Office Building
400 Market Street, Harrisburg, PA 17101
Phone: (717) 783-2300

Northeast Regional Office
2 Public Square, Wilkes-Barre, PA 18711-0790
24 Hour Emergency Number: (570) 826-2511

North-central Regional Office
208 West Third Street, Suite 10, Williamsport, PA 17701-6448
Main Number & 24 Hour Emergency Number: (570) 327-3636

Northwest Regional Office
230 Chestnut Street, Meadville, PA 16335
Business Hours: (814) 332-6945
After Hours: (800) 373-3398

Southeast Regional Office
2 East Main Street, Norristown, PA 19401
Main and 24 Hour Emergency Number: (484) 250-5900

South-central Regional Office
909 Elmerton Avenue, Harrisburg, PA 17110
Business Hours: (717) 705-4700
24 Hour Emergency Number: (866) 825-0208

Southwest Regional Office
400 Waterfront Drive, Pittsburgh, PA 15222-4745
24 Hour Emergency Number: (412) 442-4000

Additional Resources

- **Landscaping with Native Plants.**
  www.dcnr.state.pa.us/forestry/plants/nativeplants/
- **PA Stormwater Best Practices Manual (2006).**
  www.elibrary.dep.state.pa.us/dsweb/View/Collection-8305