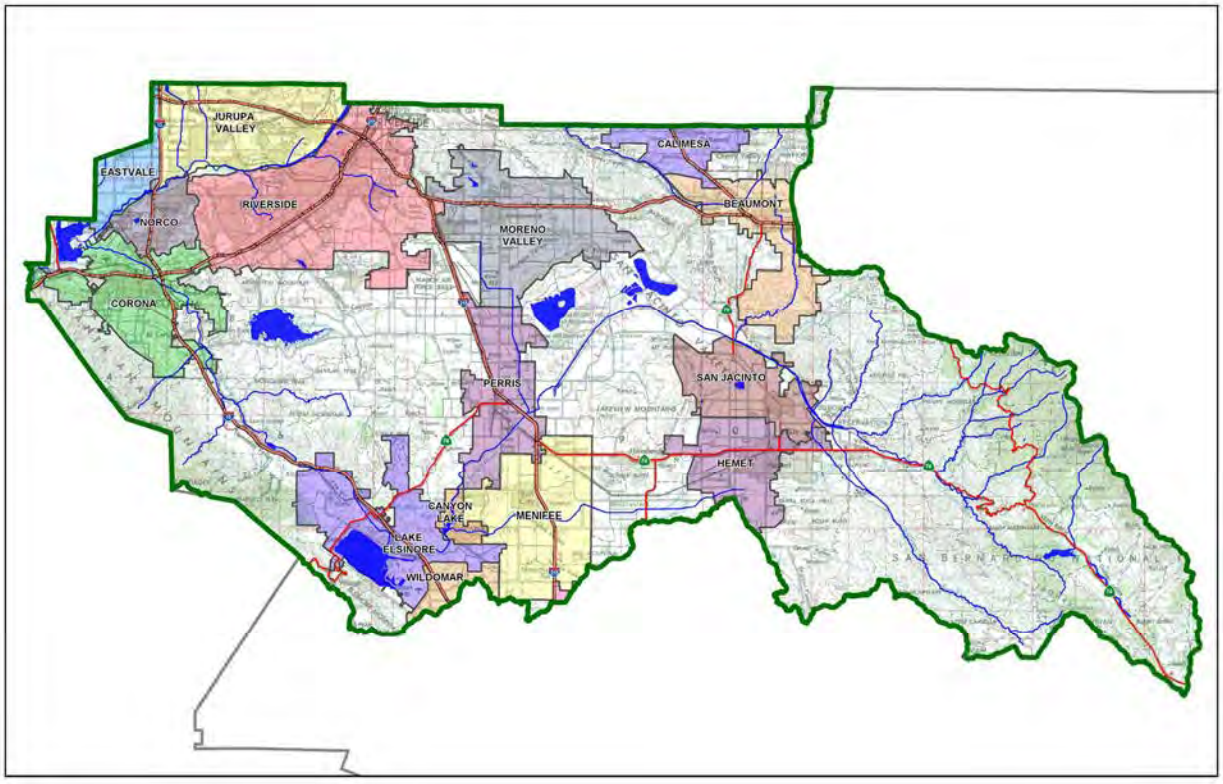
Project Specific Water Quality Management Plan

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

Project Title: Iris Park TTM 37909

Development No: Iris Park TTM 37909

Design Review/Case No:



☒ **Preliminary**
☐ **Final**

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Revision Date(s):

Prepared for Compliance with
Regional Board Order No. **R8-2010-0033**
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OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for Passco Pacifica, LLC by Adkan Engineers for Iris Park Tract 37909 project.

This WQMP is intended to comply with the requirements of City of Moreno Valley which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. In addition, the property owner accepts responsibility for interim operation and maintenance of Stormwater BMPs until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under City of Moreno Valley Water Quality Ordinance (Municipal Code Section 9.10.080).

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

Owner's Signature	Date
Owner's Printed Name	Owner's Title/Position

PREPARER'S CERTIFICATION

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

Preparer's Signature	Date
Michael Brendecke Preparer's Printed Name	Project Manager Preparer's Title/Position

Preparer's Licensure:

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Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	Residential
Planning Area:	Residential
Community Name:	Moreno Valley
Development Name:	Iris Park Tract 37909
PROJECT LOCATION	
Latitude & Longitude (DMS): 33.887903, -117.222970	
Project Watershed and Sub-Watershed: Santa Ana River	
Gross Acres: 10.82	
APN(s): 312-020-025	
Map Book and Page No.: Parcel Map Book 224 Page 79-83	
PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	R5 Suburban Residential
Proposed or Potential SIC Code(s)	1522
Area of Impervious Project Footprint (SF)	332,910 SF
Total Area of proposed Impervious Surfaces within the Project Footprint (SF)/or Replacement	332,910 SF
Does the project consist of offsite road improvements?	☐ Y ☒ N
Does the project propose to construct unpaved roads?	☐ Y ☒ N
Is the project part of a larger common plan of development (phased project)?	☐ Y ☒ N
EXISTING SITE CHARACTERISTICS	
Total area of existing Impervious Surfaces within the Project limits Footprint (SF)	0 sf
Is the project located within any MSHCP Criteria Cell?	☐ Y ☒ N
If so, identify the Cell number:	N/A
Are there any natural hydrologic features on the project site?	☐ Y ☒ N
Is a Geotechnical Report attached?	☒ Y ☐ N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)	B
What is the Water Quality Design Storm Depth for the project?	0.65

The planned development will consist of 82 single-family residences, street improvements, onsite parking, community park and a stormwater treatment area (Bio-retention Basin) in the southeast corner of the site. All onsite runoff will flow to the south as per the existing drainage path.

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.1 Identify Receiving Waters

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

Table A.1 Identification of Receiving Waters

Receiving Waters	EPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
Perris Valley Channel	N/A	N/A	Not a RARE water body
Canyon Lake (Railroad Canyon Reservoir)	Pathogens, Nutrients	MUN, AGR, GWR, REC1, REC2, WARM, WILD	Not a RARE water body
Lake Elsinore	Nutrients, Organic Enrichment/Low Dissolved Oxygen	REC1, REC2, WARM, WILD	Not a RARE water body

A.2 Additional Permits/Approvals required for the Project:

Table A.2 Other Applicable Permits

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

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

Section B: Optimize Site Utilization (LID Principles)

Review of the information collected in Section 'A' will aid in identifying the principal constraints on site design and selection of LID BMPs as well as opportunities to reduce imperviousness and incorporate LID Principles into the site and landscape design. For example, **constraints** might include impermeable soils, high groundwater, groundwater pollution or contaminated soils, steep slopes, geotechnical instability, high-intensity land use, heavy pedestrian or vehicular traffic, utility locations or safety concerns. **Opportunities** might include existing natural areas, low areas, oddly configured or otherwise unbuildable parcels, easements and landscape amenities including open space and buffers (which can double as locations for bioretention BMPs), and differences in elevation (which can provide hydraulic head). Prepare a brief narrative for each of the site optimization strategies described below. This narrative will help you as you proceed with your LID design and explain your design decisions to others.

The 2010 Santa Ana MS4 Permit further requires that LID Retention BMPs (Infiltration Only or Harvest and Use) be used unless it can be shown that those BMPs are infeasible. Therefore, it is important that your narrative identify and justify if there are any constraints that would prevent the use of those categories of LID BMPs. Similarly, you should also note opportunities that exist which will be utilized during project design. Upon completion of identifying Constraints and Opportunities, include these on your WQMP Site plan in Appendix 1.

Consideration of "highest and best use" of the discharge should also be considered. For example, Lake Elsinore is evaporating faster than runoff from natural precipitation can recharge it. Requiring infiltration of 85% of runoff events for projects tributary to Lake Elsinore would only exacerbate current water quality problems associated with Pollutant concentration due to lake water evaporation. In cases where rainfall events have low potential to recharge Lake Elsinore (i.e. no hydraulic connection between groundwater to Lake Elsinore, or other factors), requiring infiltration of Urban Runoff from projects is counterproductive to the overall watershed goals. Project proponents, in these cases, would be allowed to discharge Urban Runoff, provided they used equally effective filtration-based BMPs.

Site Optimization

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

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

Yes, existing drainage patterns on site drain all water from the North to the Southeast corner of the site. The proposed design uses catch basins at the southeast area of the site that are ultimately collected at the bioretention basin at the southeast corner of the property and then will connect to a storm drain line at the intersection of Saddlebrook Lane and Red Maple Lane.

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

No, existing natural vegetation will not be protected. All vegetation will be removed.

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

No, natural infiltration will not be used due to low infiltration rates

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

No site design will be typical for this type of development, but will have open spaces of landscape and a community park

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

Yes, roof runoff from proposed buildings will be directed to yard swales on site for the majority of the site. However, runoff from impervious areas will drain to a proposed storm drain on site, and then into the bioretention basin on site for water quality purposes.

Section C: Delineate Drainage Management Areas (DMAs)

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

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s)[1][2]	Area (Sq. Ft.)	DMA Type
D.1.1	Roofs/Concrete	127,146.00	D
D.1.2	Streets	84,067.00	D
D.1.3	Pad Landscaping	68,466.00	D
D.1.4	Landscaping	53,231.00	D

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

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

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

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

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

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

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

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

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

DMA Name or ID	BMP Name or ID
D.1.1	Bio-Retention Basin
D.1.2	Bio-Retention Basin
D.1.3	Bio-Retention Basin
D.1.4	Bio-Retention 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.

☐None of the above

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

Irrigation Use Feasibility

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

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

Total Area of Irrigated Landscape: **N/A**

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

D.4 Feasibility Assessment Summaries

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

Table D.2 LID Prioritization Summary Matrix

DMA Name/ID	LID BMP Hierarchy				No LID (Alternative Compliance)
	1. Infiltration	2. Harvest and use	3. Bioretention	4. Biotreatment	
D.1.1	☐	☐	☒	☐	☐
D.1.2	☐	☐	☒	☐	☐
D.1.3	☐	☐	☒	☐	☐
D.1.4	☐	☐	☒	☐	☐

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 site does not have proper infiltration rates at the location where the infiltration basin is being proposed.

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]			
D.1.1	*127,146*	*Roofs*	*1.0*	*0.89*	*113,414.20*			
D.1.2	*84,067*	*Concrete/Asphalt*	*1.0*	*0.89*	*74,987.80*			
D.1.3	*68,466*	*Pad Landscaping*	*0.1*	*0.11*	*7,562.60*			
D.1.4	*53,231*	*Landscaping*	*0.1*	*0.11*	*5,879.80*			
						Design Storm Depth (in)	*Design Capture Volume,* V_{BMP} *(cubic feet)*	*Proposed Volume on Plans (cubic feet)*
	332,910				201,844.40	0.65	10,933.20	***10,933.20***

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

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

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

Section E: Alternative Compliance (LID Waiver Program)

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

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

- *Or* -

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

E.1 Identify Pollutants of Concern

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

Table E.1 Potential Pollutants by Land Use Type

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

P = Potential

N = Not Potential

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

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

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

(4) Specifically petroleum hydrocarbons

(5) Specifically solvents

(6) Bacterial indicators are routinely detected in pavement runoff

E.2 Stormwater Credits

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

Table E.2 Water Quality Credits

Qualifying Project Categories	Credit Percentage[2]
Total Credit Percentage[1]	

[1]Cannot Exceed 50%

[2]Obtain corresponding data from Table 3-8 in the WQMP Guidance Document

E.3 Sizing Criteria

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

Table E.3 Treatment Control BMP Sizing

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

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

[E] is for Flow-Based Treatment Control BMPs [E] = .2, for Volume-Based Control Treatment BMPs, [E] obtained from Exhibit A in the WQMP Guidance Document

[G] is for Flow-Based Treatment Control BMPs [G] = 43,560, for Volume-Based Control Treatment BMPs, [G] = 12

[H] is from the Total Credit Percentage as Calculated from Table E.2 above

[I] as obtained from a design procedure sheet from the BMP manufacturer and should be included in Appendix 6

E.4 Treatment Control BMP Selection

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

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

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

Table E.4 Treatment Control BMP Selection

Selected Treatment Control BMP Name or ID[1]	Priority Pollutant(s) of Concern to Mitigate[2]	Removal Efficiency Percentage[3]

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

Section F: Hydromodification

F.1 Hydrologic Conditions of Concern (HCOC) Analysis

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

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

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

If Yes, HCOC criteria do not apply.

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

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

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

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

Table F.1 Hydrologic Conditions of Concern Summary

	2 year – 24 hour		
	Pre-condition	**Post-condition**	**% Difference**
Flow (cubic feet per second)	0.159	1.047	658%
Volume (Cubic Feet)	4,210.70	27,727	658%

[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:

See receiving waters exhibit in Appendix 1 for downstream conveyance to Lake Elsinore.

See Appendix 7 for HCOC Exemption Map.

F.2 HCOC Mitigation

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

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

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

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

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

Section G: Source Control BMPs

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

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

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

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

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

Table G.1 Permanent and Operational Source Control Measures

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
On-site storm drain inlets	Mark all inlets with the words "Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify.	Maintain and periodically repaint or replace inlet markings. Provide stormwater pollution prevention information to new site owners, lessees, or operators. See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance,"
Landscape / Outdoor Pesticide Use	Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution. Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions. Consider using pest-resistant plants, especially adjacent to hardscape. To ensure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	Maintain landscaping using minimum or no pesticides. See applicable operational BMPs in Appendix 10. Provide IPM information to new owners, lessees, and operators.
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," provided in Appendix 10.
Roofing, gutters, and trim	Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.	
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.
Street Sweeping		See applicable operational BMPs in Appendix 10.

Section H: Construction Plan Checklist

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

Table H.1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)	BMP Location (Lat/Long)
D.4	Bio-Retention Basin	Tentative Tract Map	33.886108, -117.222153

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

Section I: Operation, Maintenance and Funding

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

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

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

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

Maintenance Mechanism: HOA

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

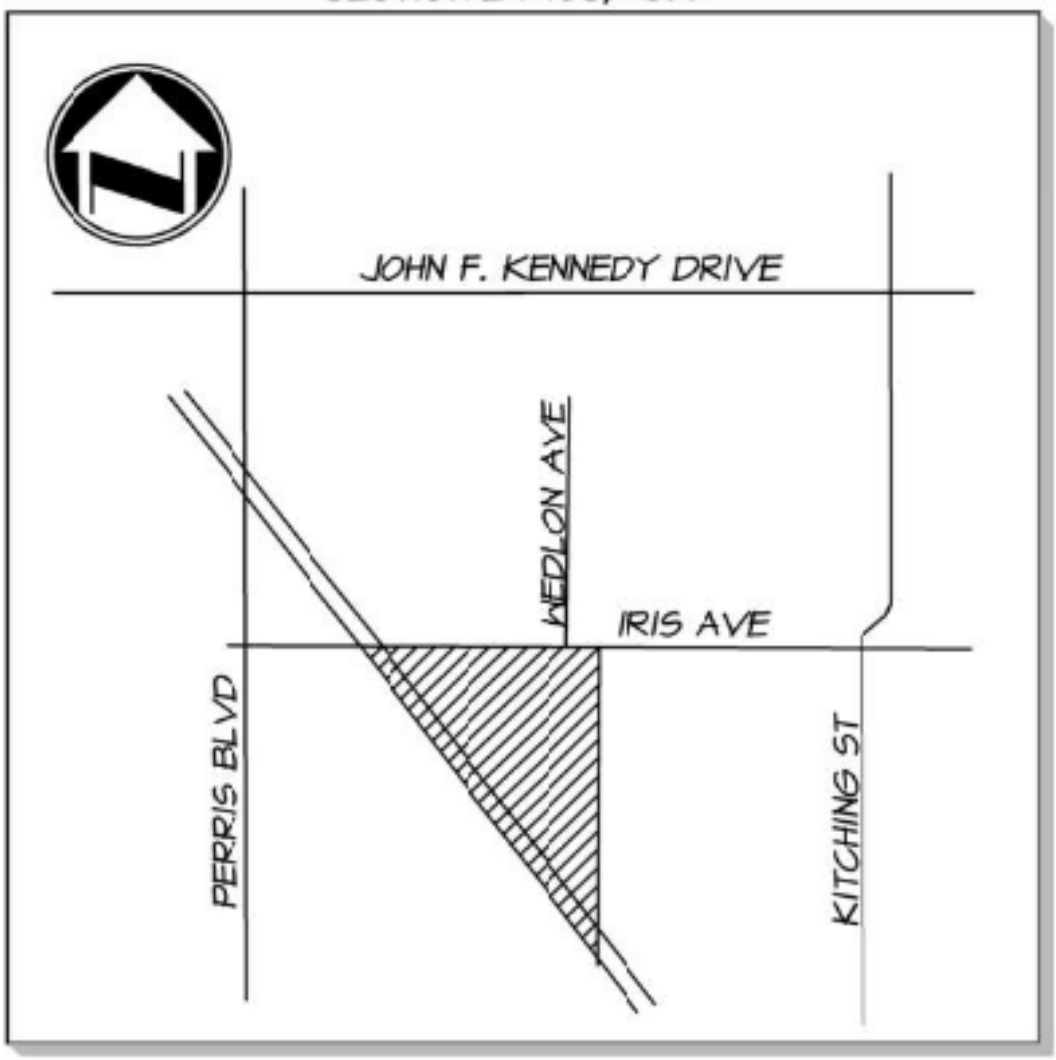
☒ Y ☐ N

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

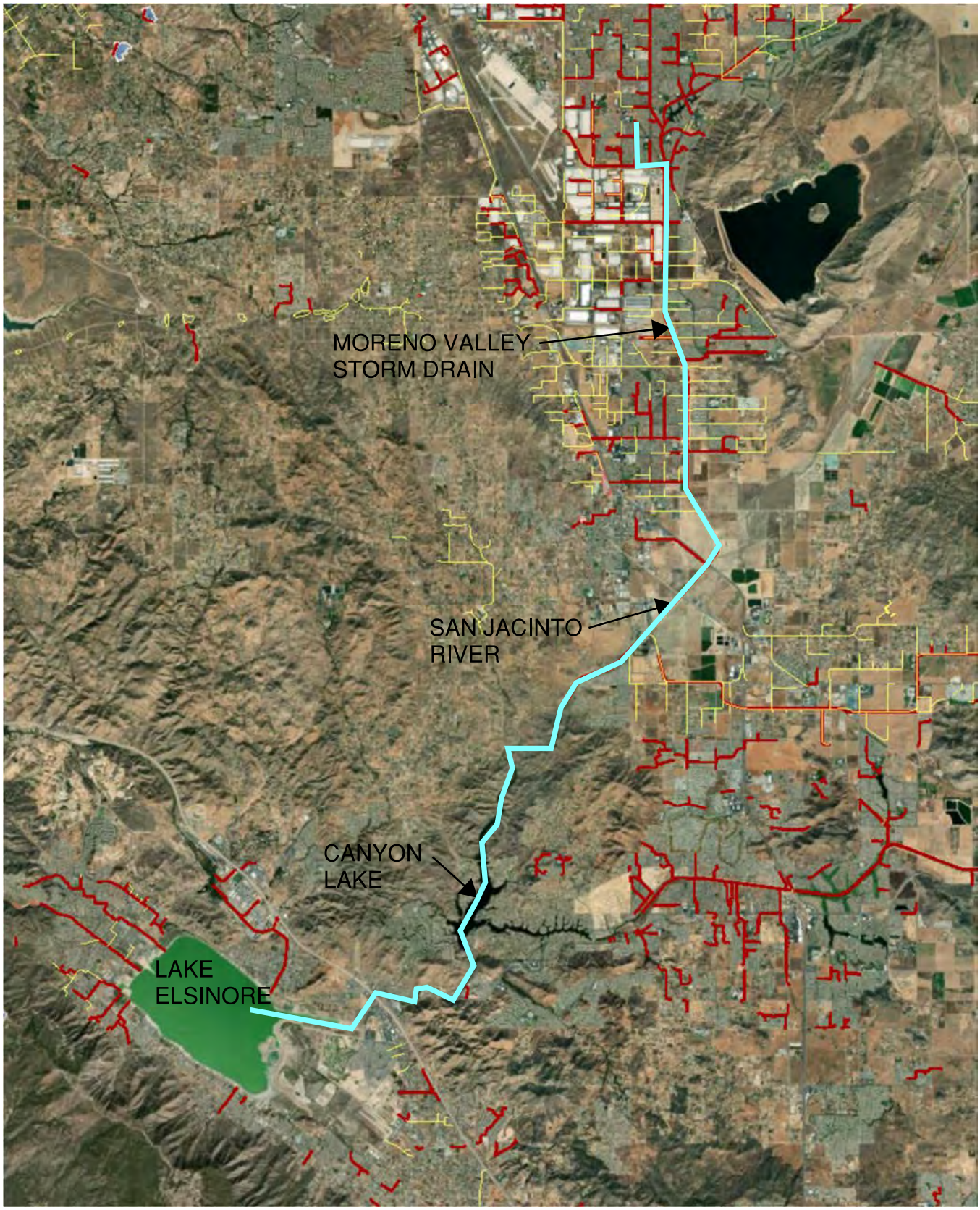
SECTION 29 T3S, R3W

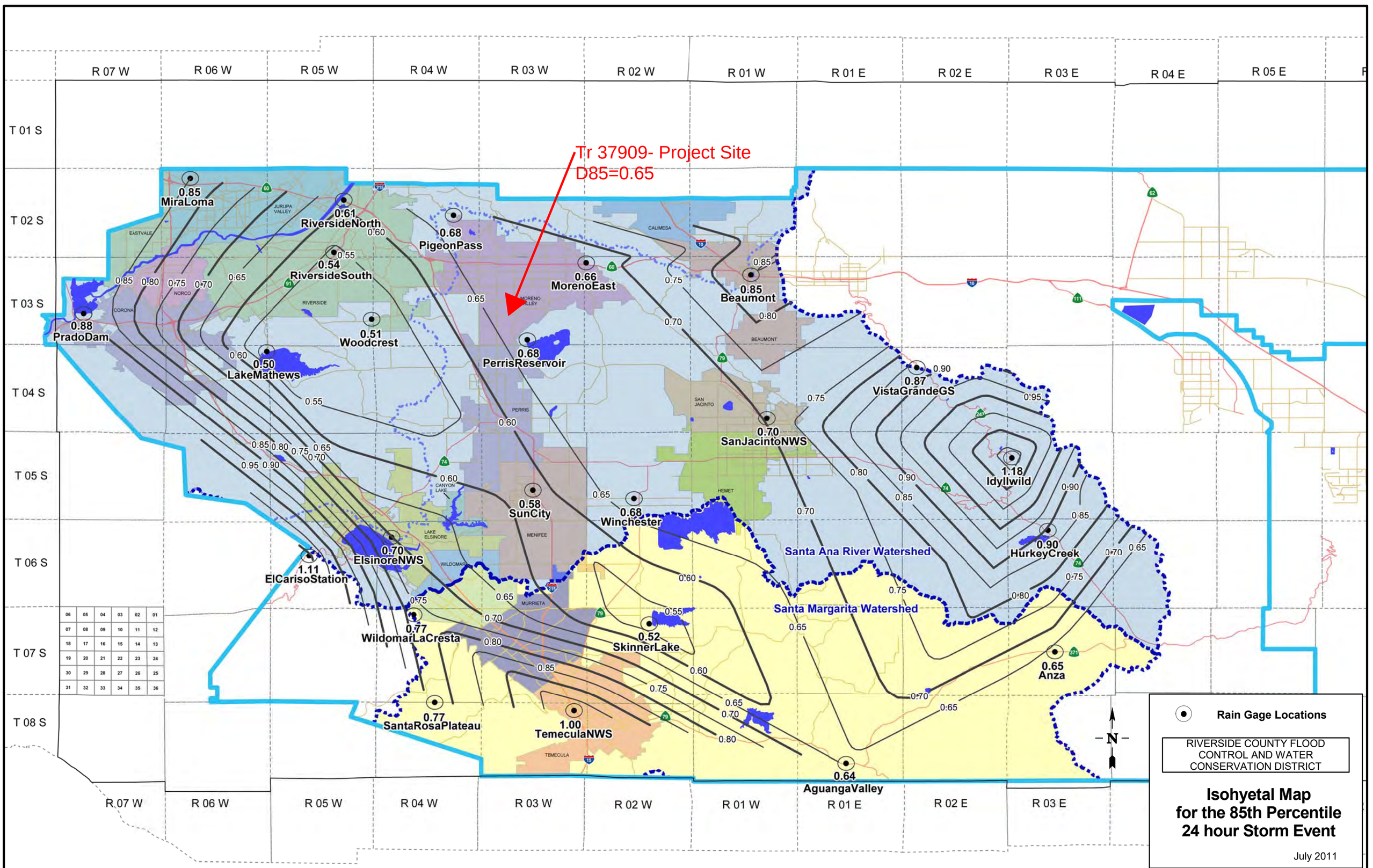


VICINITY MAP

N.T.S.

Receiving Waters

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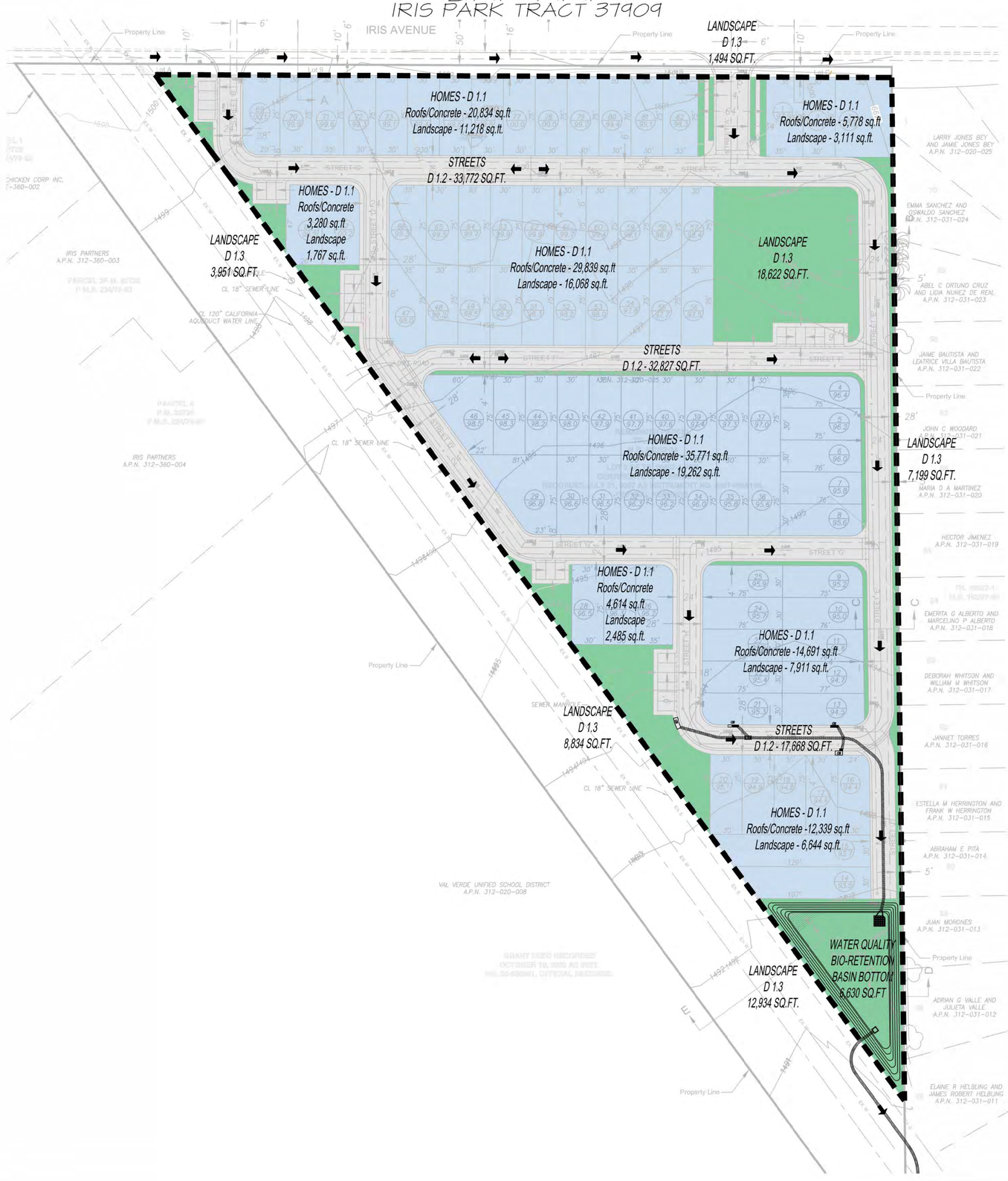
D85=0.65
R 07 W
R 06 W
R 05 W
R 04 W
R 03 W
R 02 W
R 01 W
R 01 E
R 02 E
R 03 E
R 04 E
R 05 E
T 01 S
T 02 S
T 03 S
T 04 S
T 05 S
T 06 S
T 07 S
T 08 S
0.85 MiraLoma
0.61 RiverSideNorth
0.54 RiverSideSouth
0.68 PigeonPass
0.66 MorenoEast
0.85 Beaumont
0.88 PradoDam
0.51 Woodcrest
0.50 LakeMathews
0.68 PerrisReservoir
0.87 VistaGrandeGS
0.70 SanJacintoNWS
1.18 Idyllwild
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
JURUPA VALLEY
EASTVALE
NORCO
CORONA
RIVERSIDE
MORENO VALLEY
CALIMESA
BEAUMONT
SAN JACINTO
PERRIS
HEMET
CANYON LAKE
LAKE ELSINORE
MENIFEE
WILDOMAR
MURRIETA
TEMECULA
Rain Gage Locations
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
Isohyetal Map for the 85th Percentile 24 hour Storm Event
July 2011
N

BMP MAP
IRIS PARK TRACT 37909



OWNER
PASSCO PACIFICA, LLC
333 CITY BOULEVARD WEST, 17TH FLOOR
ORANGE, CA
(714) 609-7251

ENGINEER
adkan ENGINEERS
6879 AIRPORT DRIVE
RIVERSIDE, CA 92504
TEL: 951-688-0241
FAX: 951-688-0599

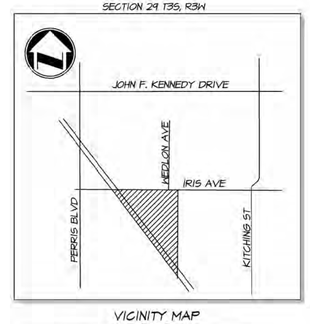
ASSESSORS PARCEL NUMBERS
312-020-025

BMP DATA DMA 1

DMA	DMA CLASSIFICATION	NAME	SURFACE TYPE	AREA (SF)
1.1	D	ROOFS	ROOF	127,146
1.2	D	STREETS	ASPHALT/CONCRETE	84,067
1.3	D	PAD LANDSCAPING	ORNAMENTAL LANDSCAPING	68,466
1.4	D	LANDSCAPING	ORNAMENTAL LANDSCAPING	53,231
TOTAL				332,910

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

SECTION 29 T3S, R3W



VICINITY MAP
N.T.S.
SITE

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

BMP MAP
IRIS PARK TRACT 37909
PREPARATION DATE: APRIL 2020
PLAN PREPARED BY:
adkan ENGINEERS
Civil Engineering · Surveying · Planning
6879 Airport Drive, Riverside, CA 92504
Tel:(951) 688-0241 Fax:(951) 688-0599

PLOT DATE: 4/14/2020 1:54 PM
C:\USERS\JCONTRERAS\DESKTOP\9841 BMP MAP.DWG

Appendix 2: Construction Plans

Grading and Drainage Plans

Tentative Tract Map No. 37909

LEGAL DESCRIPTION:

THE LAND IS SITUATED IN THE CITY OF MORENO VALLEY, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

THE NORTHWEST QUARTER OF THE NORTHWESTQUARTER OF SECTOIN 29, TOWNSHIP 3 SOUTH, RANGE 3 WEST, SAN BERNARDINO MERIDIAN, IN THE CITY OF MORENO VALLEY, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, ACCORDING TO OFFICIAL PLAT THEREOF.

EXCEPTING THEREFROM THAT CONVEYED TO THE CITY OF MORENO VALLEY BY DEED RECORDED AUGUST 28, 1989 AS INSTRUMENT NO. 89-292505, OFFICIAL RECORDS.

ALSO EXCEPTING THEREFROM ALL OIL, WATER, GAS, HYDROCARBONS, PRECIOUS METALS AND MINERALS OF ANY KIND WHETHER DESCRIBED OR NOT. BELOW A DEPTH OF 500 FEET WITHOUT ANY RIGHT OF SURFACE ENTRY AS RESERVED IN A DEED RECORDED JUNE 13, 1991 AS INSTRUMENT NO. 91-199908 OFFICIAL RECORDS.

ALSO EXCEPTING THEREFROM THAT PORTION SAID LAND CONVEYED TO VAL VERDE UNIFIED SCHOOL DISTRICT BY DEED RECORDED OCTOBER 10, 2002 AS INSTRUMENT NO. 02-566961 OFFICIAL RECORDS

ALSO EXCEPTING THEREFROM, LOT 1, LETTERED LOTS A THROUGH C OF TRACT MAP NO. 29857-1, AS SHOWN ON FILE IN BOOK 422 PAGES 23 AND 24 OF MAPS, RECORDS OF RIVERSIDE COUNTY , CALIFORNIA.

APN: 312-020-025

GENERAL PLAN/ZONING/LANDUSE

EXISTING GENERAL PLAN DESIGNATION:
PROPOSED GENERAL PLAN DESIGNATION:

EXISTING ZONING:	*R5 – SUBURBAN RESIDENTIAL*
PROPOSED ZONING:	*R10*
EXISTING LANDUSE:	*Vacant*
PROPOSED LANDUSE:	*DETACHED SFR*

PROJECT NOTES

TOTAL GROSS PROJECT SIZE: 471,228 SF (10.82 Ac.)
NET PROJECT AREA = 7.80 ACRES
DEDUCT 3.02 ACRES EASEMENT/TRAIL AREA
TOPOGRAPHY SOURCE: Aerial Topographic Mapping
NUMBER OF RESIDENTIAL LOTS: 82
MINIMUM LOT AREA: 2,250 S.F.
MINIMUM LOT DEPTH: 75'
MINIMUM LOT WIDTH: 30'
LOT SIZE: AS SHOWN ON MAP
NET DENSITY: 10.5 DU/ACRE
GUEST PARKING 0.25 SPACES PER UNIT REQUIRED = 21
GUEST PARKING PROVIDED = 28
ALL ONSITE STREETS ARE PRIVATE

DEVELOPER

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

OWNER

Maple Lane Group, LLC
A California Limited Liability Company

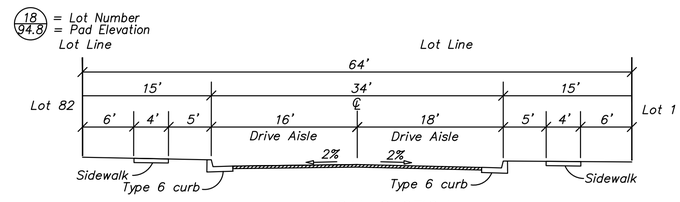
UTILITY PURVEYORS

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

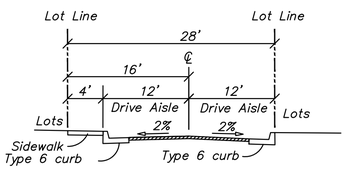
LEGEND

T.C.	*TOP OF CURB*
F.L.	*FLOWLINE*
F.S.	*FINISHED SURFACE*
P.E.	*PAD ELEVATION*
C.B.	*CATCH BASIN*
H.P.	*HIGH POINT*
(XX)	*EXIST. LAND USAGE*
X	*EXIST. ZONING*

(18 / 94.8) = Lot Number / Pad Elevation



TYPICAL SECTION
Private Street 'A'
N.T.S.



TYPICAL SECTION
Private Streets 'B' – 'D' & 'F' – 'I'
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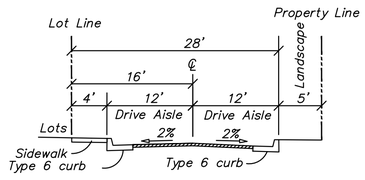

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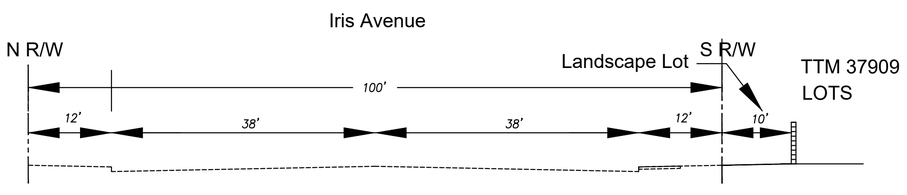

Section A-A
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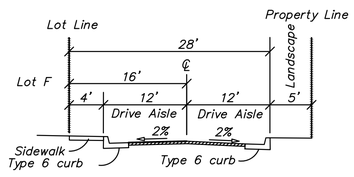

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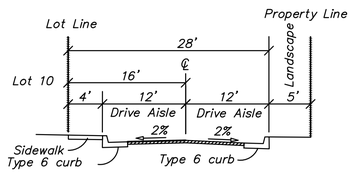

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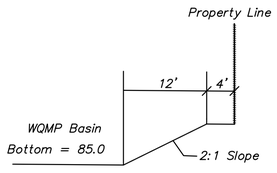

Section D-D
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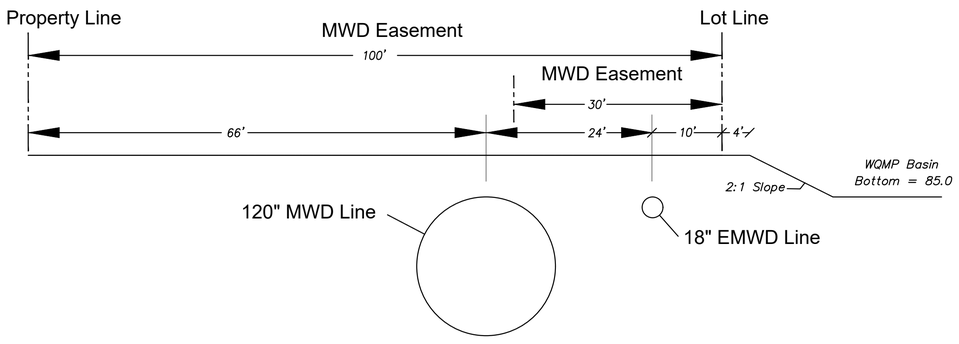


Section E-E
N.T.S.

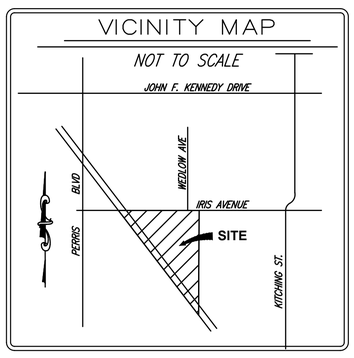
Lot Statistics Table

Residential Lots				Residential Lots				Residential Lots			
Lot Number	Width (ft)	Depth (ft)	Area (sf)	Lot Number	Width (ft)	Depth (ft)	Area (sf)	Lot Number	Width (ft)	Depth (ft)	Area (sf)
1	35	75	2,625	28	30	75	2,250	55	30	107	2,250
2	30	75	2,250	29	81	75	4,068	56	30	129	2,250
3	52	75	4,293	30	30	75	2,250	57	30	75	2,250
4	30	75	2,227	31	30	75	2,250	58	30	75	2,250
5	30	75	2,266	32	30	75	2,250	59	30	75	2,250
6	30	76	2,280	33	30	75	2,250	60	30	75	2,250
7	30	76	2,295	34	30	75	2,250	61	30	75	2,250
8	30	76	2,292	35	30	75	2,250	62	30	75	2,250
9	30	75	2,237	36	30	75	2,250	63	30	75	2,250
10	30	76	2,277	37	30	75	2,250	64	30	75	2,250
11	30	76	2,291	38	30	75	2,250	65	30	75	2,250
12	30	77	2,306	39	30	75	2,250	66	35	75	2,606
13	30	77	2,303	40	30	75	2,250	67	35	75	2,600
14	30	107	3,547	41	30	75	2,250	68	34	75	2,447
15	30	129	4,188	42	30	75	2,250	69	35	75	2,576
16	30	75	2,237	43	30	75	2,250	70	30	75	2,250
17	30	75	2,250	44	30	75	2,250	71	30	75	2,250
18	30	75	2,250	45	30	75	2,250	72	30	75	2,250
19	30	75	2,250	46	60	75	3,606	73	30	75	2,250
20	30	75	2,250	47	35	77	2,788	74	30	75	2,250
21	30	75	2,201	48	30	75	2,258	75	30	75	2,250
22	30	75	2,250	49	30	75	2,250	76	30	75	2,250
23	30	75	2,250	50	30	75	2,250	77	30	75	2,250
24	30	75	2,250	51	30	75	2,250	78	30	75	2,250
25	30	75	2,233	52	30	75	2,250	79	30	75	2,250
26	35	75	2,599	53	30	75	2,250	80	30	75	2,250
27	30	75	2,250	54	30	75	2,250	81	30	75	2,250
subtotal Residential Lot Area			66,947	subtotal Residential Lot Area			64,470	82	33	75	2,474
								subtotal Residential Lot Area			64,453
								Total Residential Lot Area			195,870
								Average Lot Size			2,389

Lettered Lots	
Lot Number	Area (sf)
A	619
B	4,399
C	1,313
D	1,216
E	1,057
F	18,623
G	1,701
H	1,502
I	7,238
J	12,934
subtotal	50,602

Streets	
A	5,076
B	4,010
C	16,600
D	12,367
E	19,195
F	12,596
G	9,338
H	5,864
I	3,570
J	4,368
subtotal	92,984

VICINITY MAP
NOT TO SCALE



REGISTERED PROFESSIONAL ENGINEER
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City of Moreno Valley
CALIFORNIA

DATE April 14, 2020
JOB NO.
DRAWN BY R.A.H.
CHECKED BY R.M.B.
SHEET 1 OF 1

Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data

LOR GEOTECHNICAL GROUP, INC.
Soil Engineering ▲ Geology ▲ Environmental

PRELIMINARY GEOTECHNICAL AND INFILTRATION FEASIBILITY INVESTIGATION PROPOSED IRIS PARK RESIDENTIAL DEVELOPMENT MORENO VALLEY, CALIFORNIA

PROJECT NO. 33591.1
NOVEMBER 25, 2019

Prepared For:

Passco Pacifica, LLC
333 City Boulevard, Suite 1700
Orange, California 92868

Attention: Mr. Oscar Graham

6121 Quail Valley Court ▲ Riverside, CA 92507 ▲ (951) 653-1760 ▲ (951) 653-1741 (Fax) ▲ www.lorgeo.com

LOR GEOTECHNICAL GROUP, INC.
Soil Engineering ▲ Geology ▲ Environmental

November 25, 2019

Passco Pacifica, LLC
333 City Boulevard, Suite 1700
Orange, California 92868

Project No. 33591.1

Attention: Mr. Oscar Graham

Subject: Preliminary Geotechnical and Infiltration Feasibility Investigation, Proposed Iris Park Residential Development, APN 312-020-025, Moreno Valley, California.

LOR Geotechnical Group, Inc., is pleased to present this report summarizing our geotechnical investigation for the above referenced project. In summary, it is our opinion that the proposed development is feasible from a geotechnical perspective, provided the recommendations presented in the attached report are incorporated into design and construction.

To provide adequate support for the proposed residential structures, we recommend that a compacted fill mat be constructed beneath footings and slabs. The compacted fill mat will provide a dense, high-strength soil layer to uniformly distribute the anticipated foundation loads over the underlying soils. All undocumented fill material and any loose alluvial materials should be removed from structural areas and areas to receive engineered compacted fill. The data developed during this investigation indicates that removals on the order of approximately 5 to 7 feet will be required within the currently planned development areas. The given removal depths are preliminary. The actual depths of the removals should be determined during the grading operation by observation and/or in-place density testing.

Very low expansion potential, fair R-value quality, poor infiltration characteristics, and a negligible soluble sulfate content generally characterize the onsite soil materials tested.

LOR Geotechnical Group, Inc.

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INTRODUCTION

During November of 2019, a Preliminary Geotechnical and Infiltration Feasibility Investigation was performed by LOR Geotechnical Group, Inc., for proposed Iris Park residential development of APN 312-020-025 in the City of Moreno Valley, California. The purpose of this investigation was to conduct a technical evaluation of the geologic setting of the site and to provide geotechnical design recommendations for the proposed improvements. The scope of our services included:

- Review of available pertinent geotechnical literature, reports, maps, and agency information pertinent to the study area;
- Interpretation of aerial photographs of the site and surrounding regions dated 1966 through 2018;
- Geologic field reconnaissance mapping to verify the areal distribution of earth units and significance of surficial features as compiled from documents, literature, and reports reviewed;
- A subsurface field investigation to determine the physical soil conditions pertinent to the proposed development;
- Infiltration testing via the constant head test method at two locations within the approximate area proposed for the infiltration of onsite runoff waters;
- Laboratory testing of selected soil samples obtained during the field investigation;
- Development of geotechnical recommendations for site grading and foundation design; and
- Preparation of this report summarizing our findings, and providing conclusions and recommendations for site development.

The approximate location of the site is shown on the attached Index Map, Enclosure A-1, within Appendix A.

To orient our investigation at the site, you provided us with Site Plan, prepared by IDE Arc Architecture & Planning, undated, that showed the proposed development. As noted on that map, the site will be developed with 84 residential lots and the associated interior streets. An infiltration basin is also proposed. The Site Plan was utilized as a base map for our field investigation and is presented as Enclosure A-2, within Appendix A.

PROJECT CONSIDERATIONS

Information furnished to this firm indicates that the proposed project will consist of the construction of 84 single-family residences.

These will likely be one or two stories in height and are anticipated to be of wood frame construction with an exterior plaster veneer. Light to moderate foundation loads are anticipated with such structures. Cuts and fills on the order of a few feet are anticipated to create the planar building pads.

EXISTING SITE CONDITIONS

The subject site consists of a triangular shaped, relatively flat, vacant area of land that is approximately 10 acres in size. At the time of our investigation, vegetation on the site consisted of a light moderate growth of weeds. The topography of the site is planar, with a very gentle fall towards the southeast.

Iris Avenue, a fully improved roadway, bounds the site on the north followed by a tract of single family residences. A tract of single family residences bounds the site on the east. The California Aqueduct easement comprises the western 100 feet of the site with a shopping center and school beyond. South of the site is a tract of single family homes.

AERIAL PHOTOGRAPH ANALYSIS

The aerial photographs reviewed consisted of vertical aerial stereoscopic photographs of varying scales. We reviewed imagery available from Google Earth (2018) and from Historic Aerials (2019).

The site consisted of vacant land which appeared to be dry land farmed with surrounding properties from 1966, the earliest photograph available, to 1978. The 1997 photograph shows the site as vacant land with some stockpiles of fill material in the northeast corner. Numerous dirt paths are visible in this area. The 2006 photograph shows additional smoothed out fill to the west of the previously noted fill. An earthen berm is present on the north and west side of this area. A minor amount of additional end dumped fill is visible in the 2009 photograph.

Our review of the aerial photographs did not reveal any adverse geologic conditions, such as possible faults or landslides, as being present at or within close proximity to the site.

FIELD EXPLORATION PROGRAM

Our subsurface field exploration program was conducted on November 7, 2019 and consisted of drilling 5 exploratory borings with a truck-mounted Mobile B-61 drill rig equipped with 8-inch diameter hollow stem augers. The borings were drilled to depths of approximately 21 to 51.5 feet below the existing ground surface. The approximate locations of our exploratory borings are presented on the attached Site Plan, Enclosure A-2 within Appendix A.

The subsurface conditions encountered in the exploratory borings were logged by a geologist from this firm. Relatively undisturbed and bulk samples were obtained at a maximum depth interval of 5 feet and returned to our geotechnical laboratory in sealed containers for further testing and evaluation. A detailed description of the field exploration program and the boring logs are presented in Appendix B.

LABORATORY TESTING PROGRAM

Selected soil samples obtained during the field investigation were subjected to laboratory testing to evaluate their physical and engineering properties. Laboratory testing included in-place moisture content and dry density, laboratory compaction characteristics, direct shear, sieve analysis, sand equivalent, R-value, consolidation, expansion index, Atterberg limits, and soluble sulfate content. A detailed description of the laboratory testing program and the test results are presented in Appendix C.

GEOLOGIC CONDITIONS

Regional Geologic Setting

The site is located within the south-central portion of Moreno Valley which lies within the northern end of Perris Valley. This area is located on the Perris block, within the northern Peninsular Ranges geologic province of southern California. While the Perris block is considered to be a relatively stable structural block, it is bounded by active faults. The Perris block is underlain predominately by a very large mass of crystalline igneous rocks of Cretaceous age and older metasedimentary and metavolcanic rocks.

The Perris block has a series of erosional surfaces, marked by low topographic relief and capped with unconsolidated alluvial sediments stripped from the surrounding highlands, such as the Box Spring Mountains and the hills around Lake Perris located east of the site.

These were mapped by the California Division of Mines and Geology as being underlain by deposits of relatively unconsolidated, but weakly to moderately indurated younger to older alluvium (Morton and Matti, 2001 and Morton, 2003).

The nearest known active fault zone is the San Jacinto fault zone located approximately 9.8 kilometers (6.1 miles) to the northeast. Other major faults within the region include the Elsinore fault zone located approximately 26 kilometers (16.2 miles) to the southwest, and San Andreas fault zone located approximately 27 kilometers (17 miles) to the northeast. The site and the regional geologic setting are shown on Enclosure A-3 within Appendix A.

Site Geologic Conditions

Fill/Topsoil: As encountered within the majority of our exploratory borings, fill/topsoil materials on the order of 2 feet thick are present across much of the site. The fill materials were noted to be light brown, dry, and loose silty sand. These materials are most likely the result of weed abatement practices (discing).

Fill: As encountered within our exploratory boring placed in the northeast portion of the site, fill materials on the order of 5 feet are present. These materials consisted of dry, loose, silty sand with some debris and are believed to be end dumped fills noted in our review of aerial photographs.

Older Alluvium: Underlying the fill materials at the site, older alluvial materials were encountered within all of our exploratory borings to the maximum depths explored. These units were noted to consist of silty sand and sandy silt, and lessor amounts unit of well graded sand, clayey sand and lean clay with sand. The older alluvial materials were in a relatively loose to medium dense/stiff state upon first encounter, becoming medium dense/very stiff to dense/hard with depth based on our equivalent Standard Penetration Test (SPT) data and in-place density testing. Consolidation testing of the older alluvial materials indicate normal consolidation/hydro-consolidation characteristics at depths of 7 feet and greater.

A detailed description of the subsurface soil conditions as encountered within our exploratory borings is presented on the Boring Logs within Appendix B.

Groundwater Hydrology

Groundwater was encountered within our exploratory borings B-2 at a depth of approximately 33.5 feet below the existing ground surface.

Records for nearby wells which were readily available from the State of California Department of Water Resources online database (CDWR, 2019) and the Western Municipal Water District Cooperative Well Measurement Program (WMWD, 2019) were reviewed as a part of this investigation. In addition, historic groundwater level data was reviewed from a groundwater contour map prepared by the U.S.G.S. (Carson and Matti, 1985).

According to the State of California Department for Water resources online database, the nearest well with available data is State Well Number 03S03W32B001S located to the southeast, approximately 1.4 kilometers (0.9 miles). In this well, groundwater was last measured at a depth of 21 feet below the ground surface on April 26, 2019. The depth to groundwater in the past was noted to vary slightly over time. Data for this well was presented from 2011 to 2019 and the elevation was listed as 1,476 feet above mean sea level.

Groundwater well data from the Cooperative Well Measuring Program, Spring 2019, indicates that the nearest well is the well noted above and no additional relevant information is presented within this database.

As illustrated on Enclosure A-1, the elevation of the site is approximately 1,495 feet above mean sea level. Based on the information above, groundwater is anticipated to lie approximately 35 feet in the general site area.

Surface Runoff

Current surface runoff of precipitation waters across the site is generally as sheet flow to the south-southeast.

Mass Movement

Mass movement features such as landslides, rockfalls, or debris flows within the site vicinity are not known to exist and no evidence of mass movement was observed on the site or in the vicinity during our review of aerial photographs or reconnaissance.

Faulting

No active or potentially active faults are known to exist at the subject site. In addition, the subject site does not lie within a current State of California Earthquake Fault Zone (Hart and Bryant, 2003).

As previously mentioned, the closest known active fault is the San Jacinto Valley segment of the San Jacinto fault zone, located approximately 9.8 kilometers (6.1 miles) to the northeast. In addition, other relatively close active faults include the Glen Ivy segment of the Elsinore fault zone, located approximately 26 kilometers (16.2 miles) to the southwest, and the San Bernardino segment of the San Andreas fault zone located approximately 27 kilometers (17 miles) to the northeast.

The San Jacinto fault zone is a sub-parallel branch of the San Andreas fault zone, extending from the northwestern San Bernardino area, southward into the El Centro region. This fault has been active in recent times with several large magnitude events. It is believed that the San Jacinto fault is capable of producing an earthquake magnitude on the order of 6.5 or greater.

The Elsinore fault zone is one of the largest in southern California. At its northern end it splays into two segments and at its southern end it is cut by the Yuba Wells fault. The primary sense of slip along the Elsinore fault is right lateral strike-slip. It is believed that the Elsinore fault zone is capable of producing an earthquake magnitude on the order of 6.5 to 7.5.

The San Andreas fault is considered to be the major tectonic feature of California, separating the Pacific Plate and the North American Plate. While estimates vary, the San Andreas fault is generally thought to have an average slip rate on the order of 24mm/yr and capable of generating large magnitude events on the order of 7.5 or greater.

Current standards of practice often include a discussion of all potential earthquake sources within a 100 kilometer (62 mile) radius. However, while there are other large earthquake faults within a 100 kilometer (62 mile) radius of the site, none of these are considered as relevant to the site due to their greater distance and/or smaller anticipated magnitudes.

Historical Seismicity

In order to obtain a general perspective of the historical seismicity of the site and surrounding region a search was conducted for seismic events at and around the area within various radii. This search was conducted utilizing the historical seismic search website of the USGS. This website conducts a search of a user selected cataloged seismic events database, within a specified radius and selected magnitudes, and then plots the events onto a map. At the time of our search, the database contained data from January 1, 1932 through November 20, 2019.

In our first search, the general seismicity of the region was analyzed by selecting an epicenter map listing all events of magnitude 4.0 and greater, recorded since 1932, within a 100 kilometer (62 mile)radius of the site, in accordance with guidelines of the California Division of Mines and Geology. This map illustrates the regional seismic history of moderate to large events. As depicted on Enclosure A-4, within Appendix A, the site lies within a relatively active region associated with the San Andreas fault trending northwest and the northwest trending faulting of the Mojave Desert geomorphic province.

In the second search, the micro seismicity of the area lying within a 15 kilometer (9.3 mile) radius of the site was examined by selecting an epicenter map listing events on the order of 1.0 and greater since 1978. In addition, only the “A” events, or most accurate events were selected. Caltech indicates the accuracy of the “A” events to be approximately 1 km. The results of this search is a map that presents the seismic history around the area of the site with much greater detail, not permitted on the larger map. The reason for limiting the events to the last 40± years on the detail map is to enhance the accuracy of the map. Events recorded prior the mid 1970's are generally considered to be less accurate due to advancements in technology. As depicted on this map, Enclosure A-5, the San Jacinto fault zone appear to be the source of numerous events.

In summary, the historical seismicity of the site entails numerous small to medium magnitude earthquake events occurring around the subject site, predominately associated with the presence of the San Jacinto fault zone. Any future developments at the subject site should anticipate that moderate to large seismic events could occur very near the site.

Secondary Seismic Hazards

Other secondary seismic hazards generally associated with severe ground shaking during an earthquake include liquefaction, seiches and tsunamis, earthquake induced flooding, landsliding and rockfalls, and seismic-induced settlement.

Liquefaction: The potential for liquefaction generally occurs during strong ground shaking within granular, loose, sediments where the groundwater is usually less than 50 feet. The County of Riverside has mapped the overall site area as having low liquefaction potential (TLMA, 2019).

Liquefaction is a process in which strong ground shaking causes saturated soils to lose their strength and behave as a fluid (Matti and Carson, 1991). Ground failure associated with liquefaction can result in severe damage to structures. Soil types susceptible to liquefaction include sand, silty sand, sandy silt, and silt, as well as soils having a plasticity

index (PI) less than 7 (Boulanger and Idriss, 2004) and loose soils with a PI less than 12 and a moisture content greater than 85 percent of the liquid limit (Bray and Sancio, 2006). The geologic conditions for increased susceptibility to liquefaction are: 1) shallow groundwater (generally less than 50 feet in depth); 2) the presence of unconsolidated sandy alluvium, typically Holocene in age; and 3) strong ground shaking. All three of these conditions must be present for liquefaction to occur.

Severe seismic shaking may cause dry and non-saturated sands to densify, resulting in settlement expressed at the ground surface. Seismic settlement in dry soils generally occurs in loose sands and silty sands, with cohesive soils being less prone to significant settlement.

A quantitative method using an index called the liquefaction potential index (LPI) was developed and presented by Iwasaki et al. (1978, 1982). The LPI is defined as:

$$LPI = \int_0^{20} F_1 W(z) dz$$

where $W(z) = 10 - 0.5z$, $F_1 = 1 - FS$ for $FS < 1.0$, $F_1 = 0$ for $FS > 1.0$ and z is the depth below the ground surface in meters. The LPI presents the risk of liquefaction damage as a single value with the following indicators of liquefaction-induced damage:

LPI Range and Damage	
LPI Range	**Damage**
LPI = 0	Liquefaction risk is very low.
0 < LPI ≤ 5	Liquefaction risk is low.
5 < LPI ≤ 15	Liquefaction risk is high.
LPI > 15	Liquefaction risk is very high.

The most recent development for quantitative descriptions of liquefaction-induced surface damage, called "liquefaction vulnerability", was made by Tonkin & Taylor (2013) after the Christchurch earthquakes occurred between 2010 and 2011 and was based on field observations and analyses of approximately 7,500 CPT investigations. A new index, the liquefaction severity number (LSN), was proposed and defined as:

$$LSN = \int \frac{\varepsilon_v}{z} dz$$

where ε_v is the calculated volumetric densification strain in the subject layer from Zhang et al. (2002) and z is the depth to the layer of interest in meters below the ground surface. The typical behaviors of sites with a given LSN are summarized in following table.

LSN Ranges and Observed Land Effects	
LSN Range	**Predominant Performance**
0-10	Little to no expression of liquefaction, minor effects
10-20	Minor expression of liquefaction, some sand boils
20-30	Moderate expression of liquefaction, with sand boils and some structural damage
30-40	Moderate to severe expression of liquefaction, settlement can cause structural damage
40-50	Major expression of liquefaction, undulations and damage to ground surface, severe total and differential settlement of structures
>50	Severe damage, extensive evidence of liquefaction at surface, severe total and differential settlements affecting structures, damage to services

Both LPI and LSN indices were calculated for the soil profiles of Exploratory Boring No. B-2. The results indicate that the liquefaction risk of the site is “very low” to "low" per the LPI index of 0. The site exhibits "little to no expression of liquefaction, minor effects" per the LSN index of 0.

The Idriss and Boulanger (2008) and Pradel (1998) methods were used to evaluate liquefaction-induced settlement and dry sand settlement. As input into our calculations a deaggregated modal moment magnitude of 6.5 and an acceleration of 0.553g were utilized for the representative soil profiles as provided in Boring B-2.

The results indicate that a maximum seismic settlement of less than one-half inch can be anticipated. Based on the relative uniformity of soil materials encountered, differential seismic settlement is anticipated to be approximately one-half of the total seismic settlement. The settlement calculated is accumulated from soil layers to a maximum depth of 50 feet and the result of our analysis is provided in Appendix E.

Seiches/Tsunamis: The potential for the site to be affected by a seiche or tsunami (earthquake generated wave) is considered nil due to the absence of any large bodies of water near the site.

Flooding (Water Storage Facility Failure): There are no large water storage facilities located on or upstream near the site which could possibly rupture during an earthquake and affect the site by flooding.

Seismically-Induced Landsliding: Our research, site reconnaissance and review of aerial imagery of the site and vicinity indicates that there are no known or suspected landslides at the site or in close proximity to the site and, therefore, the potential for seismically-induced landslides occurring at the site is considered very low.

Rockfalls: No large, exposed, loose or unrooted boulders that could affect the integrity of the site are present above the site.

Seismically-Induced Settlement: Settlement generally occurs within areas of loose, granular soils with relatively low density. Since the site is underlain by dense/stiff to dense/hard older alluvial materials, the potential for settlement is considered low. In addition, the earthwork operations recommended to be conducted during the development of the site will mitigate any near surface loose soil conditions.

SOILS AND SEISMIC DESIGN CRITERIA (California Building Code 2016)

Section 1613 of Chapter 16 of the 2016 California Building Code (CBC) contains the procedures and definitions for the calculations of the earthquake loads on structures and non structural components that are permanently attached to structures and their supports and attachments.

It should be noted that the classification of use and occupancy of all proposed structures at the site, and thus design requirements, shall be the responsibility of the structural engineer and the building official.

CBC Earthquake Design Summary

The following earthquake design criteria have been formulated for the site utilizing the source referenced above. However, these values should be reviewed and the final design should be performed by a qualified structural engineer familiar with the region.

CBC 2016 SEISMIC DESIGN SUMMARY* Site Location (WGS 84) 33.8872, -117.2226, Occupancy Category II	
Site Class Definition Chapter 20 ASCE 7	D
S_s Mapped Spectral Response Acceleration at 0.2s Period, (Figure 1613.3.1(1))	1.500
S_1 Mapped Spectral Response Acceleration at 1s Period, (Figure 1613.3.3(2))	0.605
F_a Short Period Site Coefficient at 0.2s Period, (Table 1613.3.3(1))	1.0
F_v Long Period Site Coefficient at 1s Period, (Table 1613.3.3(2))	1.5
S_{MS} Adjusted Spectral Response Acceleration at 0.2s Period, (eq .16-37)	1.500
S_{M1} Adjusted Spectral Response Acceleration at 1s Period, (eq .16-38)	0.907
S_{DS} Design Spectral Response Acceleration at 0.2s Period, (eq .16-39)	1.000
S_{D1} Design Spectral Response Acceleration at 1s Period, (eq .16-40)	0.605
Seismic Design Category - Short Period (Table 1613.3.5(1))	D
Seismic Design Category - Long Period (Table 1613.3.5(2))	D
*Values obtained from OSHPD online U.S. Seismic Design Maps tool	

INFILTRATION TESTING AND TEST RESULTS

Two constant head infiltration tests were conducted within the general area proposed for the infiltration of runoff waters. Testing consisted of two test holes which were excavated using a hollow stem auger drill rig to depths of approximately 5 feet below the existing ground surface. The holes were 8-inches in diameter. Two inches of gravel was placed in the bottom of the holes and perforated plastic liners were placed into each hole. A 2-inch PVC pipe with a preset water level of 0.5 feet was inserted into each liner. A 5-gallon glass bottle was then inverted over each pipe with a vacuum seal in order to maintain a constant 0.5 feet of water with each hole. The volume of water used in a given time period was recorded at various time intervals to establish the infiltration rates.

Infiltration test results are summarized in the following table:

Test No.	Depth (ft.)*	Infiltration Rate** in/hr
I-1	4	0.10
I-2	4	0.10

* depth measured below existing ground surface
** clear water rate

The results of our infiltration testing are attached as Enclosures D-1 and D-2. The test results indicate poor infiltration characteristics for the soils tested.

CONCLUSIONS

General

This investigation provides a broad overview of the geotechnical and geologic factors which are expected to influence future site planning and development. On the basis of our field investigation and testing program, it is the opinion of LOR Geotechnical Group, Inc., that the proposed development is feasible from a geotechnical standpoint, provided the recommendations presented in this report are incorporated into design and implemented during grading and construction.

The subsurface conditions encountered in our exploratory borings are indicative of the locations explored. The subsurface conditions presented here are not to be construed as being present the same everywhere on the site. If conditions are encountered during the construction of the project which differ significantly from those presented in this report, this firm should be notified immediately so we may assess the impact to the recommendations provided.

Foundation Support

Based upon the field investigation and test data, it is our opinion that the existing fill/topsoil and fill soils will not, in their present condition, provide uniform and/or adequate support for the proposed improvements. Left as is, this condition could cause unacceptable differential and/or overall settlements upon application of the anticipated foundation loads.

To provide adequate support for the proposed structural improvements, we recommend that a compacted fill mat be constructed beneath footings and slabs.

This compacted fill mat will provide a dense, high-strength soil layer to uniformly distribute the anticipated foundation loads over the underlying soils. In addition, the construction of this compacted fill mat will allow for the removal of any undocumented fill soils that are present within the proposed building areas. Conventional foundation systems, using either individual spread footings and/or continuous wall footings, will provide adequate support for the anticipated downward and lateral loads when utilized in conjunction with the recommended fill mat.

Soil Expansiveness

Our laboratory testing found the soils tested to have a very low expansion potential. For very low expansive soils, no specialized construction procedures to resist expansive soil activity are necessary.

Careful evaluation of on-site soils and any import fill for their expansion potential should be conducted during the grading operation.

Sulfate Protection

The results of the soluble sulfate tests conducted on selected subgrade soils expected to be encountered at foundation levels indicate that there is a negligible sulfate exposure to concrete elements in contact with the on site soils per the 2016 CBC. Therefore, no specific recommendations are given for concrete elements to be in contact with the onsite soils.

Infiltration

The results of our field investigation and test data indicates the site soils are not conducive to infiltration or percolation. Therefore, water quality storm water systems should not incorporate on-site infiltration/percolation when determining storm water treatment capacity.

Geologic Mitigations

No special geologic recommendation methods are deemed necessary at this time, other than the geotechnical recommendations provided in the following sections.

Seismicity

Seismic ground rupture is generally considered most likely to occur along pre-existing active faults. Since no known faults are known to exist at, or project into the site, the probability of ground surface rupture occurring at the site is considered nil.

Due to the site's close proximity to the faults described above, it is reasonable to expect a strong ground motion seismic event to occur during the lifetime of the proposed development on the site. Large earthquakes could occur on other faults in the general area, but because of their lesser anticipated magnitude and/or greater distance, they are considered less significant than the faults described above from a ground motion standpoint.

The effects of ground shaking anticipated at the subject site should be mitigated by the seismic design requirements and procedures outlined in Chapter 16 of the California Building Code. However, it should be noted that the current building code requires the minimum design to allow a structure to remain standing after a seismic event, in order to allow for safe evacuation. A structure built to code may still sustain damage which might ultimately result in the demolishing of the structure (Larson and Slosson, 1992).

RECOMMENDATIONS

Geologic Recommendations

No special geologic recommendation methods are deemed necessary at this time, other than the geotechnical recommendations provided in the following sections.

General Site Grading

It is imperative that no clearing and/or grading operations be performed without the presence of a qualified geotechnical engineer. An on-site, pre-job meeting with the owner, the developer, the contractor, and geotechnical engineer should occur prior to all grading related operations. Operations undertaken at the site without the geotechnical engineer present may result in exclusions of affected areas from the final compaction report for the project.

Grading of the subject site should be performed in accordance with the following recommendations as well as applicable portions of the California Building Code, and/or applicable local ordinances.

All areas to be graded should be stripped of significant vegetation and other deleterious materials.

It is our recommendation that any existing fills under any proposed flatwork and/or paved areas be removed and replaced with engineered compacted fill. If this is not done, premature structural distress (settlement) of the flatwork and pavement may occur. Any undocumented fills encountered during grading should be completely removed and cleaned of significant deleterious materials. These may then be reused as compacted fill.

Cavities created by removal of undocumented fill soils and/or subsurface obstructions should be thoroughly cleaned of loose soil, organic matter and other deleterious materials, shaped to provide access for construction equipment, and backfilled as recommended in the following Engineered Compacted Fill section of this report.

Initial Site Preparation

Any and all existing uncontrolled fills and any loose/soft native alluvial soils should be removed from structural areas and areas to receive structural fills. The data developed during this investigation indicates that removals on the order of 5 to 7 feet will be required to encounter competent older alluvium. However, deeper removals may be required locally. Removals should extend horizontally at a distance equal to the depth of the removals plus proposed fill and at least a minimum of 5 feet. The actual depths of removals should be determined during the grading operation by observation and/or by in-place density testing.

Preparation of Fill Areas

After completion of the removals described above and prior to placing fill, the surfaces of all areas to receive fill should be scarified to a depth of at least 6 inches. The scarified soil should be brought to near optimum moisture content and compacted to a relative compaction of at least 90 percent (ASTM D 1557).

Preparation of Foundation Areas

All footings should rest upon a minimum of 24 inches of properly compacted fill material placed over competent natural alluvial soils. In areas where the required fill thickness is not accomplished by the removal of unsuitable soils, the footing areas should be further subexcavated to a depth of at least 24 inches below the proposed footing base grade, with the subexcavation extending at least 5 feet beyond the footing lines. The bottom of this excavation should then be scarified to a depth of at least 6 inches, brought to near

optimum moisture content, and recompacted to at least 90 percent relative compaction (ASTM D 1557) prior to refilling the excavation to grade as properly compacted fill. Fill areas should not be constructed so as to place structures across any area where the maximum depth of fill to minimum depth of fill is greater than a 3:1 ratio.

To provide adequate support, concrete slabs-on-grade should bear on a minimum of 24 inches of compacted soil. The final pad surfaces should be rolled to provide smooth, dense surfaces upon which to place the concrete.

Engineered Compacted Fill

The on-site soils should provide adequate quality fill material, provided they are free from organic matter and other deleterious materials. Unless approved by the geotechnical engineer, rock or similar irreducible material with a maximum dimension greater than 6 inches should not be buried or placed in fills.

Import fill, if required, should be inorganic, non-expansive granular soils free from rocks or lumps greater than 6 inches in maximum dimension. Sources for import fill should be approved by the geotechnical engineer prior to their use.

Fill should be spread in maximum 8-inch uniform, loose lifts, with each lift brought to near optimum moisture content prior to, during and/or after placement, and compacted to a relative compaction of at least 90 percent in accordance with ASTM D 1557.

Based upon the relative compaction of the near surface soils determined during this investigation and the relative compaction anticipated for compacted fill soil, we estimate a compaction shrinkage factor of approximately 10 to 15 percent. Therefore, 1.10 to 1.15 cubic yards of in-place materials would be necessary to yield one cubic yard of properly compacted fill material. Subsidence is anticipated to be 0.10 feet. These values are for estimating purposes only, and are exclusive of losses due to stripping or the removal of subsurface obstructions.

These values may vary due to differing conditions within the project boundaries and the limitations of this investigation. Shrinkage should be monitored during construction. If percentages vary, provisions should be made to revise final grades or adjust quantities of borrow or export.

Short-Term Excavations

Following the California Occupational and Safety Health Act (CAL-OSHA) requirements, excavations 5 feet deep and greater should be sloped or shored. All excavations and shoring should conform to CAL-OSHA requirements.

Short-term excavations 5-feet deep and greater shall conform to Title 8 of the California Code of Regulations, Construction Safety Orders, Section 1504 and 1539 through 1547. Based on our exploratory borings, it appears that Type C soil is the predominant type of soil on the project and all short-term excavations should be based on this type of soil. Deviation from the standard short-term slopes are permitted using Option 4, Design by a Registered Professional Engineer (Section 1541.1).

Short-term slope construction and maintenance are the responsibility of the contractor, and should be a consideration of his methods of operation and the actual soil conditions encountered.

Slope Construction

Preliminary data indicates that cut and fill slopes should be constructed no steeper than two horizontal to one vertical. Fill slopes should be overfilled during construction and then cut back to expose fully compacted soil. A suitable alternative would be to compact the slopes during construction, then roll the final slopes to provide dense, erosion-resistant surfaces.

Slope Protection

Since the site soils are susceptible to erosion by running water, measures should be provided to prevent surface water from flowing over slope faces. Slopes at the project should be planted with a deep rooted ground cover as soon as possible after completion. The use of succulent ground covers such as iceplant or sedum is not recommended. If watering is necessary to sustain plant growth on slopes, the watering system should be monitored to assure proper operation and to prevent over watering.

Foundation Design

If the site is prepared as recommended, the proposed structures may be safely founded on conventional shallow foundations, either individual spread footings and/or continuous wall footings, bearing on a minimum of 24 inches of engineered compacted fill.

All foundations should have a minimum width of 12 inches and should be established a minimum of 12 inches below lowest adjacent grade.

For the minimum width and depth, spread foundations may be designed using an allowable bearing pressure of 1,800 psf. This bearing pressure may be increased by 400 psf for each additional foot of width, and by 400 psf for each additional foot of depth, up to a maximum of 4,000 psf. For example, a footing 3 feet wide and embedded 2 feet will have an allowable bearing pressure of 3,000 psf.

The above values are net pressures; therefore, the weight of the foundations and the backfill over the foundations may be neglected when computing dead loads. The values apply to the maximum edge pressure for foundations subjected to eccentric loads or overturning. The recommended pressures apply for the total of dead plus frequently applied live loads, and incorporate a factor of safety of at least 3.0. The allowable bearing pressures may be increased by one-third for temporary wind or seismic loading. The resultant of the combined vertical and lateral seismic loads should act within the middle one-third of the footing width. The maximum calculated edge pressure under the toe of foundations subjected to eccentric loads or overturning should not exceed the increased allowable pressure. Buildings should be setback from slopes in accordance with the California Building Code.

Resistance to lateral loads will be provided by passive earth pressure and base friction. For footings bearing against compacted fill, passive earth pressure may be considered to be developed at a rate of 400 pounds per square foot per foot of depth. Base friction may be computed at 0.30 times the normal load. Base friction and passive earth pressure may be combined without reduction. These values are for dead load plus live load and may be increased by one-third for wind or seismic loading.

Settlement

Total settlement of individual foundations will vary depending on the width of the foundation and the actual load supported. Maximum settlement of shallow foundations designed and constructed in accordance with the preceding recommendations are estimated to be on the order of 0.5 inch. Differential settlements between adjacent footings should be about one-half of the total settlement. Settlement of all foundations is expected to occur rapidly, primarily as a result of elastic compression of supporting soils as the loads are applied, and should be essentially completed shortly after initial application of the loads.

Building Area Slab-On-Grade

Concrete floor slabs should bear on a minimum of 24 inches of engineered compacted fill placed over competent native materials. The final pad surfaces should be rolled to provide smooth, dense surfaces upon which to place the concrete.

Slabs to receive moisture-sensitive coverings should be provided with a moisture vapor barrier. This barrier may consist of an impermeable membrane. Two inches of sand over the membrane will reduce punctures and aid in obtaining a satisfactory concrete cure. The sand should be moistened just prior to placing of concrete. The slabs should be protected from rapid and excessive moisture loss which could result in slab curling. Careful attention should be given to slab curing procedures, as the site area is subject to large temperature extremes, humidity, and strong winds.

Exterior Flatwork

To provide adequate support, exterior flatwork improvements should rest on a minimum of 12 inches of soil compacted to at least 90 percent (ASTM D 1557).

Flatwork surface should be sloped a minimum of 1 percent away from buildings and slopes, to approved drainage structures.

Wall Pressures

The design of footings for retaining structures should be performed in accordance with the recommendations described earlier under Preparation of Foundation Areas and Foundation Design. For design of retaining wall footings, the resultant of the applied loads should act in the middle one-third of the footing, and the maximum edge pressure should not exceed the basic allowable value without increase.

For design of retaining walls unrestrained against movement at the top, we recommend an equivalent fluid density of 48 pounds per cubic foot (pcf) be used. This assumes level backfill consisting of recompacted, non-expansive, native soils placed against the structures and with the backcut slope extending upward from the base of the stem at 35 degrees from the vertical or flatter.

To avoid overstressing or excessive tilting during placement of backfill behind walls, heavy compaction equipment should not be allowed within the zone delineated by a 45 degree line extending from the base of the wall to the fill surface.

The backfill directly behind the walls should be compacted using light equipment such as hand operated vibrating plates and rollers. No material larger than 3-inches in diameter should be placed in direct contact with the wall.

Wall pressures should be verified prior to construction, when the actual backfill materials and conditions have been determined. Recommended pressures are applicable only to level, non-expansive, properly drained backfill (with no additional surcharge loadings).

If inclined backfills are proposed, this firm should be contacted to develop appropriate active earth pressure parameters. Toe bearing pressure for non-structural walls on soils, not prepared as described earlier under Preparation of Foundation Areas, should not exceed California Building Code values.

Sulfate Protection

The results of the soluble sulfate tests conducted on selected subgrade soils expected to be encountered at foundation levels are presented on Enclosure C.

Based on the test results it appears that there is a negligible sulfate exposure to concrete elements in contact with on site soils. The CBC, therefore, does not recommend special design criteria for concrete elements in conduct with such materials.

Preliminary Pavement Design

Testing and design for preliminary on-site pavement was conducted in accordance with the California Highway Design Manual. Based upon our preliminary sampling and testing, and upon Traffic Index indicated by the City of Moreno Valley Standard Plans (2018), it appears that the structural section tabulated below should provide satisfactory pavement for the subject pavement improvements:

AREA	T.I.	DESIGN R-VALUE	PRELIMINARY SECTION
Local Street	6.0	30	0.35’ AC*/0.70' CAB
AC - Asphalt Concrete CAB - Crushed Aggregate Base * City of Moreno Valley minimum			

The above structural section is predicated upon 90 percent relative compaction (ASTM D 1557) of all utility trench backfills and 95 percent relative compaction (ASTM D 1557) of the upper 12 inches of pavement subgrade soils and of any aggregate base utilized.

In addition, the aggregate base should meet specifications for Crushed Aggregate Base.

In areas of the pavement which will receive high abrasion loads due to start-ups and stops, or where trucks will move on a tight turning radius, consideration should be given to installing concrete pads. Such pads should be a minimum of 0.5-foot thick concrete, with a 0.35-foot thick aggregate base. Concrete pads are also recommended in areas adjacent to trash storage areas where heavier loads will occur due to operation of trucks lifting trash dumpsters.

It should be noted that all of the above pavement design was based upon the results of preliminary sampling and testing, and should be verified by additional sampling and testing during construction when the actual subgrade soils are exposed.

Infiltration

Based upon our field investigation and infiltration test data, the site soils are not considered suitable for infiltration or percolation. Therefore water quality storm water systems should not incorporate on-site infiltration/percolation when determining storm water treatment capacity.

Construction Monitoring

Post investigative services are an important and necessary continuation of this investigation. Project plans and specifications should be reviewed by the project geotechnical consultant prior to construction to confirm that the intent of the

recommendations presented herein have been incorporated into the design. Additional expansion index, R-value, and soluble sulfate testing may be required during site rough grading.

During construction, sufficient and timely geotechnical observation and testing should be provided to correlate the findings of this investigation with the actual subsurface conditions exposed during construction. Items requiring observation and testing include, but are not necessarily limited to, the following:

1. Site preparation-stripping and removals.

2. Excavations, including approval of the bottom of excavation prior to filling.

3. Scarifying and recompacting prior to fill placement.

4. Subgrade preparation for pavements and slabs-on-grade.

5. Placement of engineered compacted fill and backfill, including approval of fill materials and the performance of sufficient density tests to evaluate the degree of compaction being achieved.

6. Foundation excavations.

LIMITATIONS

This report contains geotechnical conclusions and recommendations developed solely for use by Passco Pacifica, LLC, and their design consultants, for the purposes described earlier. It may not contain sufficient information for other uses or the purposes of other parties. The contents should not be extrapolated to other areas or used for other facilities without consulting LOR Geotechnical Group, Inc.

The recommendations are based on interpretations of the subsurface conditions concluded from information gained from subsurface explorations and a surficial site reconnaissance. The interpretations may differ from actual subsurface conditions, which can vary horizontally and vertically across the site. If conditions are encountered during the construction of the project which differ significantly from those presented in this report, this firm should be notified immediately in order that we may assess the impact to the recommendations provided.

Due to possible subsurface variations, all aspects of field construction addressed in this report should be observed and tested by the project geotechnical consultant.

If parties other than LOR Geotechnical Group, Inc., provide construction monitoring services, they must be notified that they will be required to assume responsibility for the geotechnical phase of the project being completed by concurring with the recommendations provided in this report or by providing alternative recommendations.

The report was prepared using generally accepted geotechnical engineering practices under the direction of a state licensed geotechnical engineer. No warranty, expressed or implied, is made as to conclusions and professional advice included in this report. Any persons using this report for bidding or construction purposes should perform such independent investigations as deemed necessary to satisfy themselves as to the surface and subsurface conditions to be encountered and the procedures to be used in the performance of work on this project.

TIME LIMITATIONS

The findings of this report are valid as of this date. Changes in the condition of a property can, however, occur with the passage of time, whether they be due to natural processes or the work of man on this or adjacent properties. In addition, changes in the Standards-of-Practice and/or Governmental Codes may occur. Due to such changes, the findings of this report may be invalidated wholly or in part by changes beyond our control. Therefore, this report should not be relied upon after a significant amount of time without a review by LOR Geotechnical Group, Inc. verifying the suitability of the conclusions and recommendations.

CLOSURE

It has been a pleasure to assist you with this project. We look forward to being of further assistance to you as construction begins. Should conditions be encountered during construction that appear to be different than as indicated by this report, please contact this office immediately in order that we might evaluate these conditions.

Should you have any questions regarding this report, please do not hesitate to contact our office at your convenience.

Respectfully submitted,
LOR Geotechnical Group, Inc.

Andrew A. Tardie
Staff Geologist

Robert M. Markoff, CEG
Engineering Geologist

John P. Leuer, GE 2030
President

AAT:RMM:JPL:ss

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REFERENCES

American Society of Civil Engineers, 2010, Minimum Design Load for Buildings and other Structures, ASCE 7-10.

Bray, J.D., and Sancio, R.B., 2006, Assessment of the Liquefaction Susceptibility of Fine-Grained Soils: American Society of Civil Engineers, Journal of Geotechnical and Geoenvironmental Engineering, v. 132, n. 9, p. 1165-1177.

California Building Standards Commission, 2016 California Building Code.

California Department of Water Resources, 2019, http://www.water.ca.gov/waterdatalibrary/.

County of Riverside, Transportation and Land Management Agency, 2019, Geographic Information System, http://www3.tlma.co.riverside.ca.us.

Google Earth, 2019, Imagery from various years, www.google.com/earth.

Hart, E.W. and W.A. Bryant, 1997, revised 2003, Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps: California Dept. of Conservation Division of Mines and Geology Special Publication 42, Revised Edition with Supplements 1, 2 and 3.

Historic Aerials, 2019, Imagery from various years, www.historicaerials.com.

Idriss, I.M., and Boulanger, R.W. (2004). "Semi-empirical procedures for evaluating liquefaction potential during earthquakes." Proc., 11th Int. Conference on Soil Dynamics and Earthquake Engineering, and 3rd Int. Conference on Earthquake Geotechnical Engineering, D. Doolin et al., eds., Stallion Press, Vol. 1, 32-56.

Idriss, I.M., and Boulanger, R.W. (2008). "Soil Liquefaction During Earthquake", Earthquake Engineering Research Institute, EERI Publication MNO-12.

Iwasaki, T., Tatsuoka, F., and Takagi, Y., 1978, Shear Modulus of Sands Under Cyclic Torsional Shear Loading, Soils and Foundations, (18(1), 39-50).

Larson, R., and Slosson, J., 1992, The Role of Seismic Hazard Evaluation in Engineering Reports, in Engineering Geology Practice in Southern California, AEG Special Publication Number 4, pp 191-194.

Morton, D.M., 2003, Geologic Map of the Perris 7.5' Quadrangle, California, Open-File Report 03-270.

Morton, D.M. and Matti, J.C., 2001, Geologic Map of the Sunnymead 7.5' Quadrangle, California, Open-File Report 01-450.

OSPHD, 2019 ,US Seismic Design Maps, https://seismicmaps.org.

Pradel, D. (1998), "Procedure to Evaluate Earthquake-Induced Settlement in Dry Sand Soils", Journal of Geotechnical and Geoenvironmental Engineering, Vol 124, No. 4.

Riverside County Flood Control and Water Conservation District, 2011, Design Handbook for Low Impact Development Best Management Practices, dated September 2011.

Tonkin & Taylor Ltd, 2013, Liquefaction Vulnerability Study, Report prepared for Earthquake Commission, New Zealand.

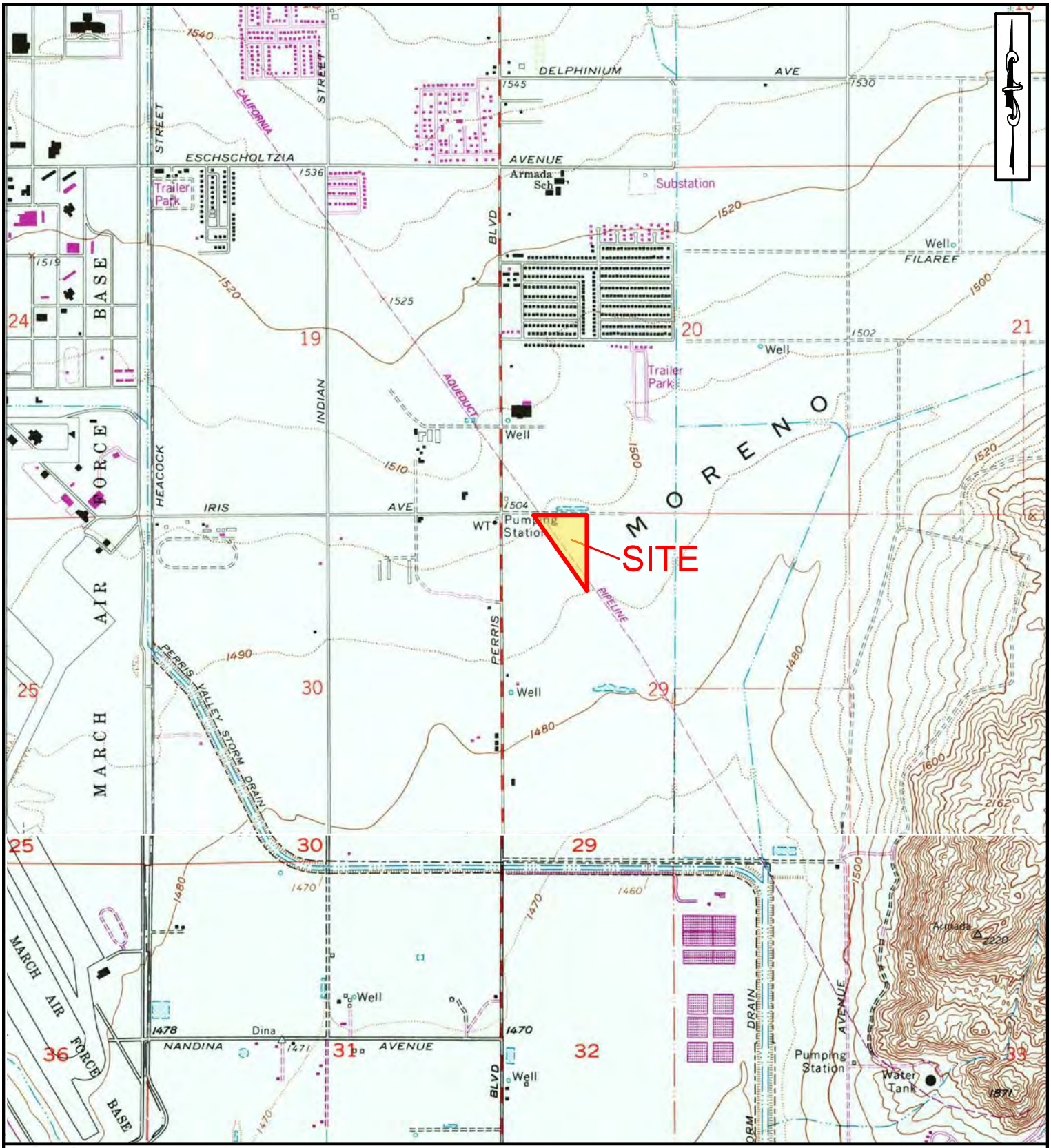
U.S.G.S., 2019, U.S. Seismic Design Maps, earthquake.usgs.gov/designmaps/us/application.php

Western Municipal Water District, 2019, Cooperative Well Measuring Program Spring 2019, Final.

Zhang, G., Robertson, P. K., and Brachman, R. W. I. (2002) "Estimating liquefaction-induced ground settlements from CPT for level ground" Canadian Geotechnical Journal, Ottawa, 39: 1168-1180.

APPENDIX A

Index Map, Site Plan, Regional Geologic Map and Historical Seismicity Maps



INDEX MAP

PROJECT:	IRIS PARK, MORENO VALLEY, CALIFORNIA	**PROJECT NO:**	33591.1
CLIENT:	PASSCO PACIFICA, LLC	**ENCLOSURE:**	A-1
LOR Geotechnical Group, Inc.		**DATE:**	NOVEMBER 2019
		SCALE:	1" = 2,000'

IDEArc

IRIS Park
Moreno Valley, CA October 25, 2019
Illustrative Concept Plan

Legend

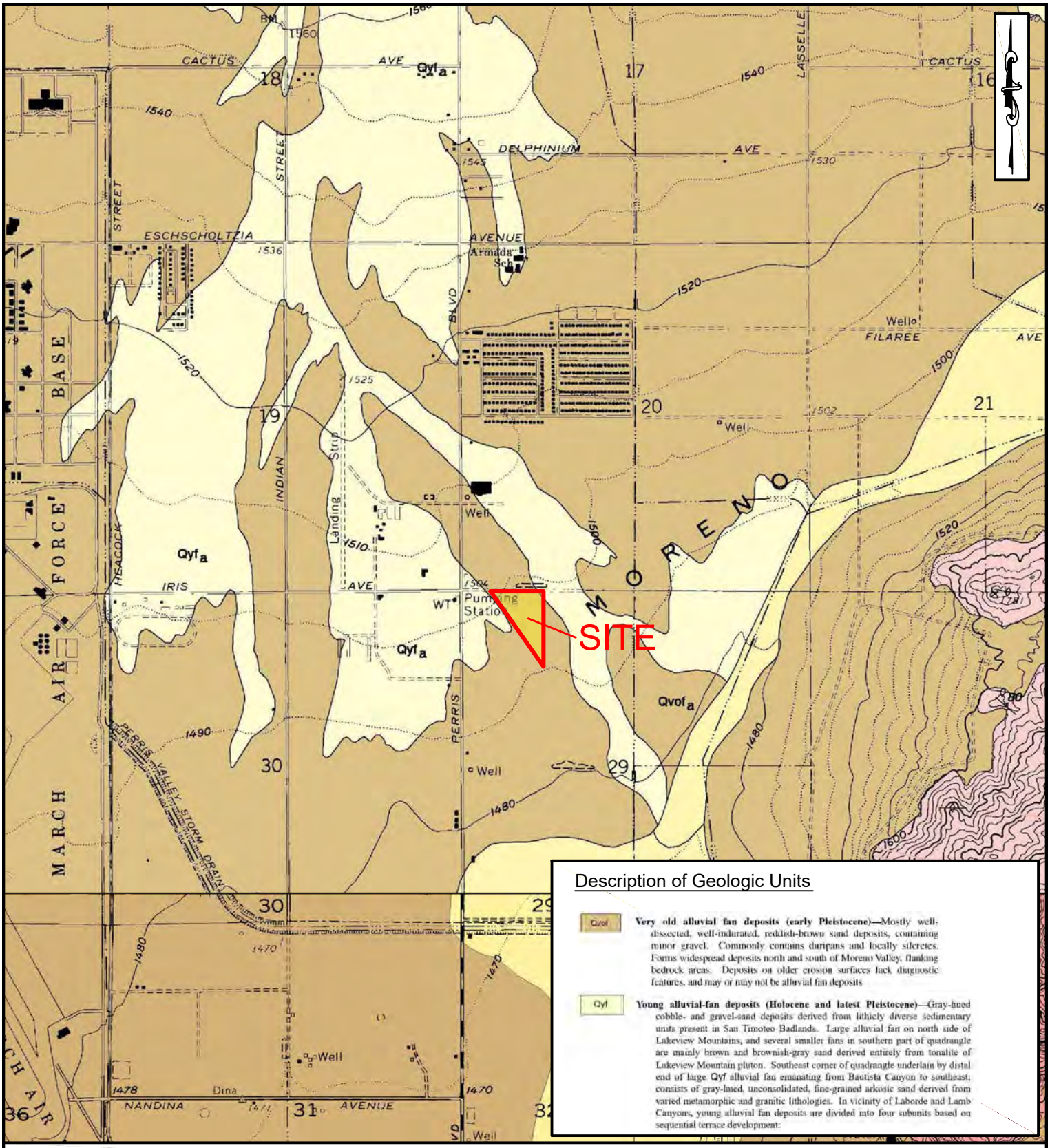
(Locations Approximate)

Map Symbols

- **B-5** - Exploratory Boring
- **I-2** - Infiltration Test

SITE PLAN

PROJECT:	IRIS PARK, MORENO VALLEY, CALIFORNIA	**PROJECT NO:**	33591.1
CLIENT:	PASSCO PACIFICA, LLC	**ENCLOSURE:**	A-2
LOR Geotechnical Group, Inc.		**DATE:**	NOVEMBER 2019
		SCALE:	1" ≈ 200'



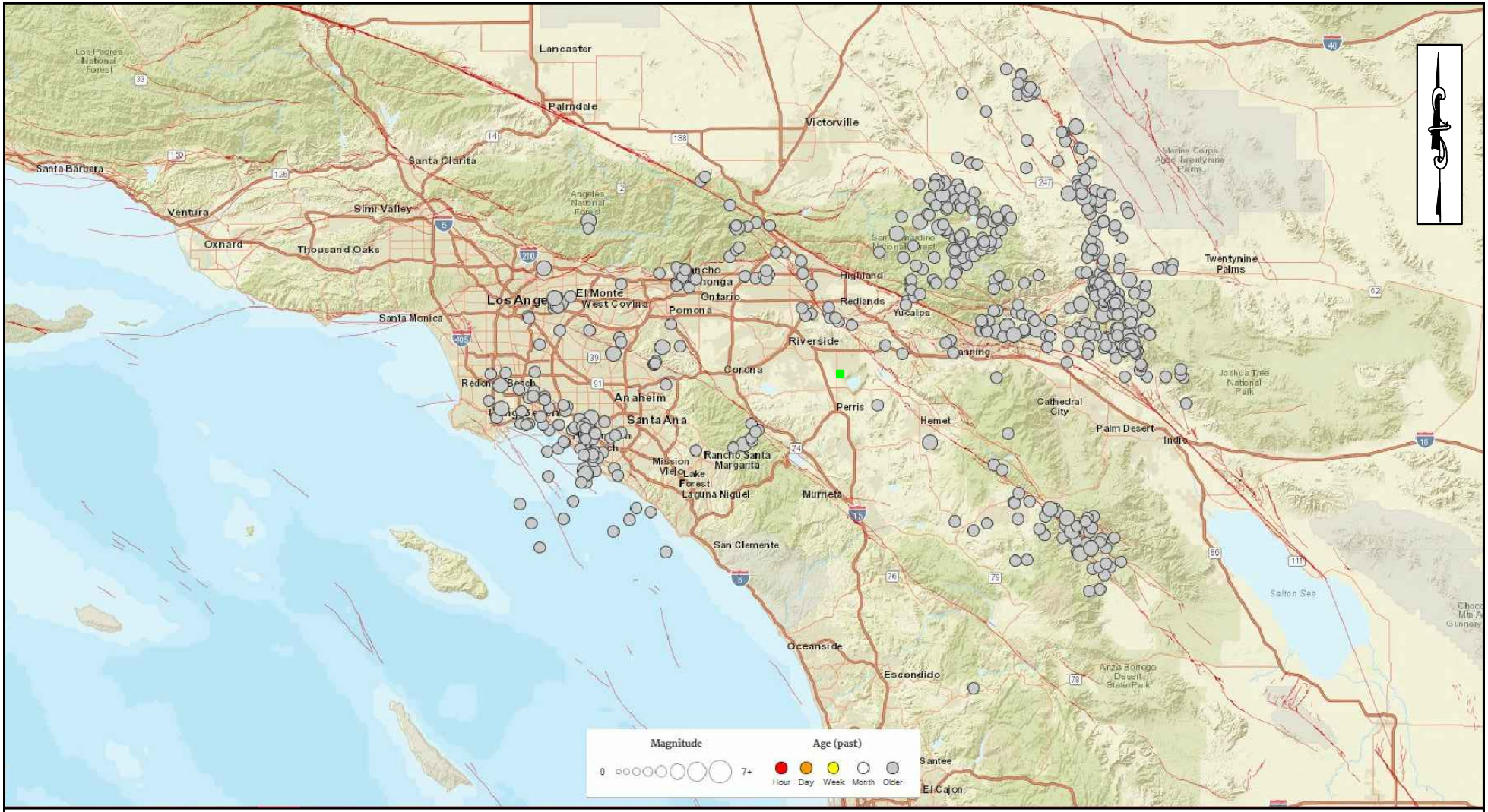
Description of Geologic Units

Qvof — **Very old alluvial fan deposits (early Pleistocene)**—Mostly well-dissected, well-indurated, reddish-brown sand deposits, containing minor gravel. Commonly contains duripans and locally silcretes. Forms widespread deposits north and south of Moreno Valley, flanking bedrock areas. Deposits on older erosion surfaces lack diagnostic features, and may or may not be alluvial fan deposits

Qyf — **Young alluvial-fan deposits (Holocene and latest Pleistocene)**—Gray-hued cobble- and gravel-sand deposits derived from lithicly diverse sedimentary units present in San Timoteo Badlands. Large alluvial fan on north side of Lakeview Mountains, and several smaller fans in southern part of quadrangle are mainly brown and brownish-gray sand derived entirely from tonalite of Lakeview Mountain pluton. Southeast corner of quadrangle underlain by distal end of large Qyf alluvial fan emanating from Bautista Canyon to southeast; consists of gray-hued, unconsolidated, fine-grained arkosic sand derived from varied metamorphic and granitic lithologies. In vicinity of Laborde and Lamb Canyons, young alluvial fan deposits are divided into four subunits based on sequential terrace development:

REGIONAL GEOLOGIC MAP (Morton, 2003 & Morton & Matti, 2001)

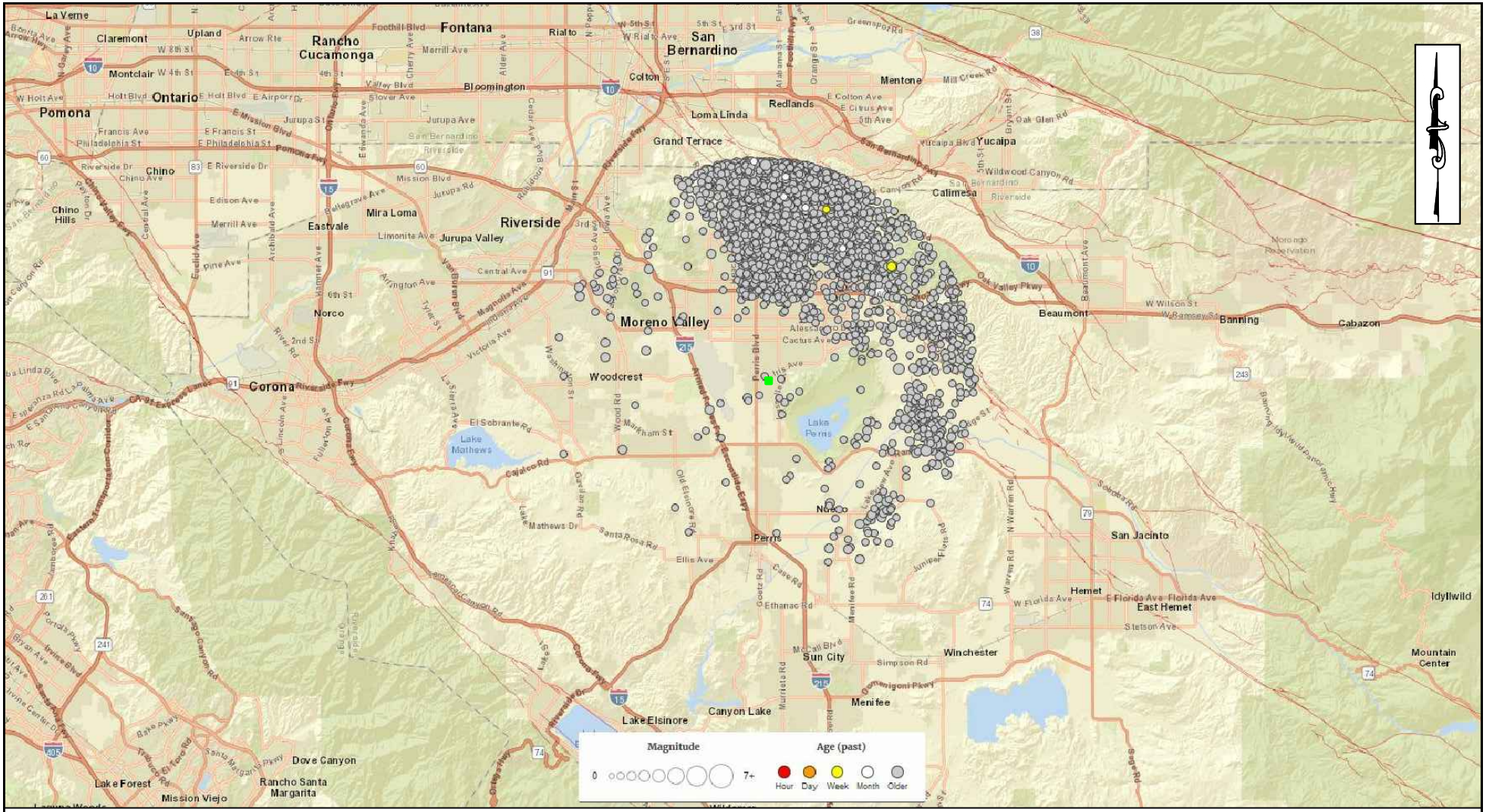
PROJECT:	IRIS PARK, MORENO VALLEY, CALIFORNIA	**PROJECT NO:**	33591.1
CLIENT:	PASSCO PACIFICA, LLC	**ENCLOSURE:**	A-3
LOR Geotechnical Group, Inc.		**DATE:**	NOVEMBER 2019
		SCALE:	1" = 2,000'



U.S. Geologic Survey (2017a) real-time earthquake epicenter map. Plotted are 544 epicenters of instrument-recorded events from 1978 to present (11/20/19) of local magnitude M4.0 or greater within a radius of ~62 miles (100 kilometers) of the site. Location accuracy varies. The site is indicated by the green square. The selected magnitude corresponds to a threshold intensity value where very light damage potential begins. These evens are also generally widely felt by persons. Red lines mark the surface traces of known Quaternary-age faults.

HISTORICAL SEISMICITY MAP - 100km Radius

PROJECT:	IRIS PARK, MORENO VALLEY, CALIFORNIA	**PROJECT NO:**	33591.1
CLIENT:	PASSCO PACIFICA, LLC	**FIGURE:**	A-4
LOR Geotechnical Group, Inc.		**DATE:**	NOVEMBER 2019
		SCALE:	1" ≈ 40km



U.S. Geologic Survey (2017a) real-time earthquake epicenter map. Plotted are 4,945 epicenters of instrument-recorded events from 1932 to present (11/20/19) of local magnitude M1.0 or greater within a radius of ~9.3 miles (15 kilometers) of the site. Location accuracy varies. The site is indicated by the green square. Red lines mark the surface traces of known Quaternary-age faults.

HISTORICAL SEISMICITY MAP - 15km Radius

PROJECT:	IRIS PARK, MORENO VALLEY, CALIFORNIA	**PROJECT NO:**	33591.1
CLIENT:	PASSCO PACIFICA, LLC	**FIGURE:**	A-5
LOR Geotechnical Group, Inc.		**DATE:**	NOVEMBER 2019
		SCALE:	1" ≈ 10km

APPENDIX B

Field Investigation Program and Boring Logs

APPENDIX B
FIELD INVESTIGATION

Subsurface Exploration

The site was investigated on November 7, 2019 and consisted of advancing 5 exploratory borings to depths between 21.5 feet and 51.5 feet below the existing ground surface. The approximate locations of the borings are shown on Enclosure A-2, within Appendix A.

The drilling exploration was conducted using a truck-mounted Mobile B-61 drill rig equipped with 8-inch diameter hollow stem augers. The soils were continuously logged by our geologist who inspected the site, created detailed logs of the borings, obtained undisturbed, as well as disturbed, soil samples for evaluation and testing, and classified the soils by visual examination in accordance with the Unified Soil Classification System.

Relatively undisturbed samples of the subsoils were obtained at a maximum interval of 5 feet. The samples were recovered by using a California split barrel sampler of 2.50 inch inside diameter and 3.25 inch outside diameter or a Standard Penetration Sampler (SPT) from the ground surface to the total depth explored. The samplers were driven by a 140 pound automatic trip hammer dropped from a height of 30 inches. The number of hammer blows required to drive the sampler into the ground the final 12 inches were recorded and further converted to an equivalent SPT N-value. Factors such as efficiency of the automatic trip hammer used during this investigation (80%), borehole diameter (8"), and rod length at the test depth were considered for further computing of equivalent SPT N-values corrected for field procedures (N60) which are included in the boring logs, Enclosures B-1 through B-5.

The undisturbed soil samples were retained in brass sample rings of 2.42 inches in diameter and 1.00 inch in height, and placed in sealed containers. Disturbed soil samples were obtained at selected levels within the borings and placed in sealed containers for transport to the laboratory.

All samples obtained were taken to our geotechnical laboratory for storage and testing. Detailed logs of the borings are presented on the enclosed Boring Logs, Enclosures B-1 through B-5. A Boring Log Legend and Soil Classification Chart are presented on Enclosures B-i and B-ii, respectively.

CONSISTENCY OF SOIL

SANDS

SPT BLOWS	CONSISTENCY
0-4	Very Loose
4-10	Loose
10-30	Medium Dense
30-50	Dense
Over 50	Very Dense

COHESIVE SOILS

SPT BLOWS	CONSISTENCY
0-2	Very Soft
2-4	Soft
4-8	Medium
8-15	Stiff
15-30	Very Stiff
30-60	Hard
Over 60	Very Hard

SAMPLE KEY

Symbol	Description
	INDICATES CALIFORNIA SPLIT SPOON SOIL SAMPLE
	INDICATES BULK SAMPLE
	INDICATES SAND CONE OR NUCLEAR DENSITY TEST
	INDICATES STANDARD PENETRATION TEST (SPT) SOIL SAMPLE

TYPES OF LABORATORY TESTS

1	Atterberg Limits
2	Consolidation
3	Direct Shear (undisturbed or remolded)
4	Expansion Index
5	Hydrometer
6	Organic Content
7	Proctor (4", 6", or Cal216)
8	R-value
9	Sand Equivalent
10	Sieve Analysis
11	Soluble Sulfate Content
12	Swell
13	Wash 200 Sieve

BORING LOG LEGEND

PROJECT: PROPOSED IRIS PARK RESIDENTIAL DEVELOPMENT, MORENO VALLEY, CALIFORNIA	**PROJECT NO.:** 33591.1
CLIENT: PASSCO PACIFICA, LLC	**ENCLOSURE:** B-i
LOR Geotechnical Group, Inc.	**DATE:** NOVEMBER 2019

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

PARTICLE SIZE LIMITS

BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	
12"	3"	3/4"	No. 4	No. 10	No. 40	200	

(U.S. STANDARD SIEVE SIZE)

SOIL CLASSIFICATION CHART

PROJECT PROPOSED IRIS PARK RESIDENTIAL DEVELOPMENT, MORENO VALLEY, CALIFORNIA	**PROJECT NO.** 33591.1
CLIENT: PASSCO PACIFICA, LLC	**ENCLOSURE:** B-ii
LOR Geotechnical Group, Inc.	**DATE:** NOVEMBER 2019

LOG OF BORING B-1

DEPTH IN FEET	SPT BLOW COUNTS	LABORATORY TESTS	MOISTURE CONTENT (%)		DRY DENSITY (PCF)	SAMPLE TYPE	LITHOLOGY	U.S.C.S.	DESCRIPTION
	TEST DATA								
0		3, 4, 7, 9, 10, 11						SM	@ 0 feet, FILL/TOPSOIL: SILTY SAND, approximately 10% coarse grained sand, 20% medium grained sand, 30% fine grained sand, 40% silty fines, light brown, dry, loose.
	14		6.0		120.0			ML	@ 2 feet, ALLUVIUM: SANDY SILT, approximately 5% coarse grained sand, 15% medium grained sand, 20% fine grained sand, 60% silty fines, brown, damp, trace pinhole porosity.
5	7		1.8		105.5			SW SM	@ 5 feet, WELL GRADED SAND with SILT, approximately 25% coarse grained sand, 35% medium grained sand, 30% fine grained sand, 10% silty fines, light brown, dry.
	21		9.5		101.2				@ 7 feet, some sandy silt layers approximately 1 to 2" thick, damp.
10	26		9.1		113.8			ML	@ 10 feet, SANDY SILT, approximately 5% coarse grained sand, 10% medium grained sand, 10% fine grained sand, 75% silty fines with trace clay, brown, damp, trace pinhole porosity.
15	32		10.6		117.5				@ 15 feet, increase in clay, strong brown.
20	40		10.9		112.3				@ 20 feet, contains some secondary calcite.
25	37		17.9		109.5			SM	@ 25 feet, SILTY SAND, trace medium grained sand, approximately 80% fine grained sand, 20% silty fines, light brown, damp.
30									END OF BORING @ 26.5'
35									Fill/topsoil to 2' No groundwater No bedrock

PROJECT: **Proposed Iris Park Residential Development**		PROJECT NUMBER:	**33591.1**
CLIENT: **Passco Pacifica, LLC**		ELEVATION:	
LOR GEOTECHNICAL GROUP INC.		DATE DRILLED:	**November 7, 2019**
		EQUIPMENT:	**Mobile B-61**
	HOLE DIA.: **8"**	ENCLOSURE:	**B-1**

LOG OF BORING B-2

DEPTH IN FEET	SPT BLOW COUNTS	LABORATORY TESTS	MOISTURE CONTENT (%)		DRY DENSITY (PCF)	SAMPLE TYPE	LITHOLOGY	U.S.C.S.	DESCRIPTION
	TEST DATA								
0								SM	@ 0 feet, FILL/TOPSOIL: SILTY SAND, approximately 15% coarse grained sand, 20% medium grained sand, 20% fine grained sand, 45% silty fines, light brown, dry, loose.
	9	2	3.7		112.4				@ 2 feet, ALLUVIUM: SILTY SAND, approximately 15% coarse grained sand, 25% medium grained sand, 25% fine grained sand, 35% silty fines, brown, damp.
5	8		3.5		100.8				@ 5 feet, SILTY SAND, approximately 10% coarse grained sand, 20% medium grained sand, 50% fine grained sand, 20% silty fines, light brown, dry, trace thin calcite stringers.
	21		4.2		113.5				
10	36		4.0		112.4			SP SM	@ 7 feet, becomes coarser grained, approximately 25% coarse grained sand, 30% medium grained sand, 35% fine grained sand, 15% silty fines, brown, dry.
									@ 10 feet, POORLY GRADED SAND with SILT, approximately 5% coarse grained sand, 25% medium grained sand, 60% fine grained sand, 10% silty fines, light brown, dry, micaceous.
15	66		13.0		120.6			CL	@ 15 feet, LEAN CLAY with SAND, approximately 20% fine grained sand, 80% clayey fines of low plasticity, strong brown, damp.
20	27		7.7		113.5			SM	@ 20 feet, SILTY SAND, approximately 20% coarse grained sand, 20% medium grained sand, 30% fine grained sand, 30% silty fines, brown, damp, some secondary calcite.
25	48		7.6		115.2				
30	31		12.2						
						▽			@ 33.5 feet, groundwater.
35	48		12.8					SW	@ 35 feet, WELL GRADED SAND, approximately 35% coarse grained sand, 35% medium grained sand, 35% fine grained sand, 5% silty fines, speckled red-brown, wet.
40	29		17.7					CL	@ 40 feet, LEAN CLAY with SAND, approximately 10% medium grained sand, 20% fine grained sand, 70% clayey fines of low plasticity, brown, moist.
45	17	1	14.9						
50	32		17.3						END OF BORING @ 51.5'
55									Fill/topsoil to 2' Groundwater @ 33.5' No bedrock

PROJECT: **Proposed Iris Park Residential Development**		PROJECT NUMBER:	**33591.1**
CLIENT:	**Passco Pacifica, LLC**	ELEVATION:	
LOR GEOTECHNICAL GROUP INC.		DATE DRILLED:	**November 7, 2019**
		EQUIPMENT:	**Mobile B-61**
		HOLE DIA.: **8"**	ENCLOSURE: **B-2**

LOG OF BORING B-3

DEPTH IN FEET	SPT BLOW COUNTS	LABORATORY TESTS	MOISTURE CONTENT (%)		DRY DENSITY *(PCF)*	SAMPLE TYPE	LITHOLOGY	U.S.C.S.	DESCRIPTION
			TEST DATA						
0								SM	**@ 0 feet, FILL/TOPSOIL: SILTY SAND, approximately 10% coarse grained sand, 25% medium grained sand, 25% fine grained sand, 40% silty fines, light brown, dry, loose.**
	9		6.7		106.3			ML	**@ 2 feet, ALLUVIUM: SANDY SILT, approximately 5% coarse grained sand, 15% medium grained sand, 20% fine grained sand, 60% silty fines, brown, damp, trace pinhole porosity.**
5	6		3.5		106.1			SM	**@ 5 feet, SILTY SAND, approximately 15% coarse grained sand, 25% medium grained sand, 35% fine grained sand, 20% silty fines, light brown, dry.**
	15		0.6		109.5			SP	**@ 7 feet, POORLY GRADED SAND, approximately 5% coarse grained sand, 35% medium grained sand, 45% fine grained sand, 5% silty fines, red-brown, dry.**
10	25		11.8		116.9			CL	**@ 10 feet, LEAN CLAY with SAND, approximately 5% coarse grained sand, 10% medium grained sand, 20% fine grained sand, 65% clayey fines of low plasticity, strong brown, damp, trace thin calcite stringers, trace pinhole porosity, some roothairs.**
15	22		10.6		117.0			SC	**@ 15 feet, CLAYEY SAND, approximately 15% coarse grained sand, 25% medium grained sand, 30% fine grained sand, 30% clayey fines of low plasticity, brown, damp.**
20	60		8.4		124.8				**END OF BORING @ 21.5'** **Fill/topsoil to 2'** **No groundwater** **No bedrock**
25									

PROJECT: **Proposed Iris Park Residential Development**		PROJECT NUMBER:	**33591.1**
CLIENT: **Passco Pacifica, LLC**		ELEVATION:	
LOR GEOTECHNICAL GROUP INC.		DATE DRILLED:	**November 7, 2019**
		EQUIPMENT:	**Mobile B-61**
		HOLE DIA.: **8"**	ENCLOSURE: **B-3**

LOG OF BORING B-4

DEPTH IN FEET	SPT BLOW COUNTS	LABORATORY TESTS	MOISTURE CONTENT (%)		DRY DENSITY *(PCF)*	SAMPLE TYPE	LITHOLOGY	U.S.C.S.	DESCRIPTION
		TEST DATA							
0	19	8, 9, 10, 11	5.8		106.8			SM	@ 0 feet, FILL/TOPSOIL: SILTY SAND, approximately 10% coarse grained sand, 15% medium grained sand, 30% fine grained sand, 45% silty fines, brown, dry, loose. @ 2 feet, ALLUVIUM: SILTY SAND, approximately 15% coarse grained sand, 25% medium grained sand, 25% fine grained sand, 35% silty fines, brown, dry, trace pinhole porosity.
5	19		4.9		101.1			ML	@ 5 feet, SANDY SILT, approximately 15% medium grained sand, 25% fine grained sand, 60% silty fines, light brown, dry, some roothairs, trace pinhole porosity.
	21	2	2.6		109.8			SM	@ 7 feet, SILTY SAND, approximately 10% coarse grained sand, 35% medium grained sand, 35% fine grained sand, 20% silty fines, light brown, dry.
10	21		3.5		107.9				
15	38		8.1		128.2			SC	@ 15 feet, CLAYEY SAND, approximately 20% coarse grained sand, 25% medium grained sand, 25% fine grained sand, 30% clayey fines of low plasticity, brown, damp.
20	55		8.8		121.3			ML	@ 20 feet, SANDY SILT, approximately 5% coarse grained sand, 15% medium grained sand, 15% fine grained sand, 65% silty fines with trace clay, brown, damp.
25									END OF BORING @ 21.5' Fill/topsoil to 2' No groundwater No bedrock

PROJECT: **Proposed Iris Park Residential Development**		PROJECT NUMBER:	**33591.1**
CLIENT:	**Passco Pacifica, LLC**	ELEVATION:	
LOR GEOTECHNICAL GROUP INC.		DATE DRILLED:	**November 7, 2019**
		EQUIPMENT:	**Mobile B-61**
		HOLE DIA.: **8"**	ENCLOSURE: **B-4**

LOG OF BORING B-5

DEPTH IN FEET	SPT BLOW COUNTS	LABORATORY TESTS	MOISTURE CONTENT (%)		DRY DENSITY (PCF)	SAMPLE TYPE	LITHOLOGY	U.S.C.S.	DESCRIPTION
	TEST DATA								
0		9, 10, 11						SM	@ 0 feet, FILL: SILTY SAND, approximately 10% coarse grained sand, 25% medium grained sand, 25% fine grained sand, 40% silty fines, dry, loose.
	43		7.7		104.4				@ 2 feet, some rope debris.
5	19		5.5		103.1			ML	@ 5 feet, ALLUVIUM: SANDY SILT, approximately 10% medium grained sand, 30% fine grained sand, 60% silty fines, light brown, dry, some pinhole porosity.
	16	2	7.4		105.4				
10	18	2	8.9		107.0				
15	25		11.6					SC	@ 15 feet, CLAYEY SAND, approximately 20% coarse grained sand, 25% medium grained sand, 30% fine grained sand, 25% clayey fines of low plasticity, brown, damp.
20	28		13.9						END OF BORING @ 21.5'
									Fill to 5'
									No groundwater
									No bedrock
25									

PROJECT: **Proposed Iris Park Residential Development**		PROJECT NUMBER:	**33591.1**
CLIENT: **Passco Pacifica, LLC**		ELEVATION:	
LOR GEOTECHNICAL GROUP INC.		DATE DRILLED:	**November 7, 2019**
		EQUIPMENT:	**Mobile B-61**
		HOLE DIA.: **8"**	ENCLOSURE: **B-5**

APPENDIX C

Laboratory Testing Program and Test Results

APPENDIX C
LABORATORY TESTING

General

Selected soil samples obtained from our borings were tested in our geotechnical laboratory to evaluate the physical properties of the soils affecting foundation design and construction procedures. The laboratory testing program performed in conjunction with our investigation included in-place moisture content and dry density, laboratory compaction characteristics, direct shear, sieve analysis, sand equivalent, R-value, consolidation, expansion index, Atterberg limits, and soluble sulfate content. Descriptions of the laboratory tests are presented in the following paragraphs:

Moisture Density Tests

The moisture content and dry density information provides an indirect measure of soil consistency for each stratum, and can also provide a correlation between soils on this site. The dry unit weight and field moisture content were determined for selected undisturbed samples, in accordance with ASTM D 2922 and ASTM D 2216, respectively, and the results are shown on the Boring Logs, Enclosures B-1 through B-5 for convenient correlation with the soil profile.

Laboratory Compaction

Selected soil samples were tested in the laboratory to determine compaction characteristics using the ASTM D 1557 compaction test method. The results are presented in the following table:

LABORATORY COMPACTION				
Boring Number	**Sample Depth (feet)**	**Soil Description (U.S.G.S.)**	**Maximum Dry Density (pcf)**	**Optimum Moisture Content (percent)**
B-1	0-3	(SM) Silty Sand	134.0	8.5

Direct Shear Tests

Shear tests are performed with a direct shear machine in general accordance with ASTM D 3080 at a constant rate-of-strain (usually 0.04 inches/minute). The machine is designed to test a sample partially extruded from a sample ring in single shear. Samples are tested at varying normal loads in order to evaluate the shear strength parameters, angle of internal friction and cohesion. Samples are tested in a remolded condition (90 percent relative compaction per ASTM D 1557) and soaked, to represent the worst case conditions expected in the field.

The results of the shear tests are presented in the following table:

DIRECT SHEAR TESTS				
Boring Number	**Sample Depth (feet)**	**Soil Description (U.S.G.S.)**	**Angle of Internal Friction (degrees)**	**Apparent Cohesion (psf)**
B-1	0-3	(SM) Silty Sand	28	200

Sieve Analysis

A quantitative determination of the grain size distribution was performed for selected samples in accordance with the ASTM D 422 laboratory test procedure. The determination is performed by passing the soil through a series of sieves, and recording the weights of retained particles on each screen. The results of the sieve analyses are presented graphically on Enclosure C-1.

Sand Equivalent

The sand equivalent of selected soils were evaluated using the California Sand Equivalent Test Method, Caltrans Number 217. The results of the sand equivalent tests are presented with the grain size distribution analyses on Enclosure C-1.

R-Value Test

Soil samples were obtained at probable pavement subgrade level and was tested to determine its R-value using the California R-Value Test Method, Caltrans Number 301. The results of the R-value test is presented on Enclosure C-1.

Consolidation Tests

The apparatus used for the consolidation tests (odometer) is designed to test a one-inch high portion of the undisturbed soil sample as contained in a sample ring. Porous stones and filler paper are placed in contact with the top and bottom of the specimen to permit the addition or release of water. Loads are applied to the test specimen in specified increments, and the resulting axial deformations are recorded. The results are plotted as log of axial pressure versus consolidation or compression, expressed as strain or sample height.

Samples are tested at field and greater-than field moisture contents. The results are shown on Enclosures C-2 through C-5.

Expansion Index Tests

Remolded samples are tested to determine their expansion potential in accordance with the Expansion Index (EI) test. The test is performed in accordance with the Uniform Building Code Standard 18-2. The test results are presented in the following table:

EXPANSION INDEX TESTS				
Boring Number	**Sample Depth (feet)**	**Soil Description (U.S.C.S.)**	**Expansion Index (EI)**	**Expansion Potential**
B-1	0-3	(SM) Silty Sand	11	Very Low

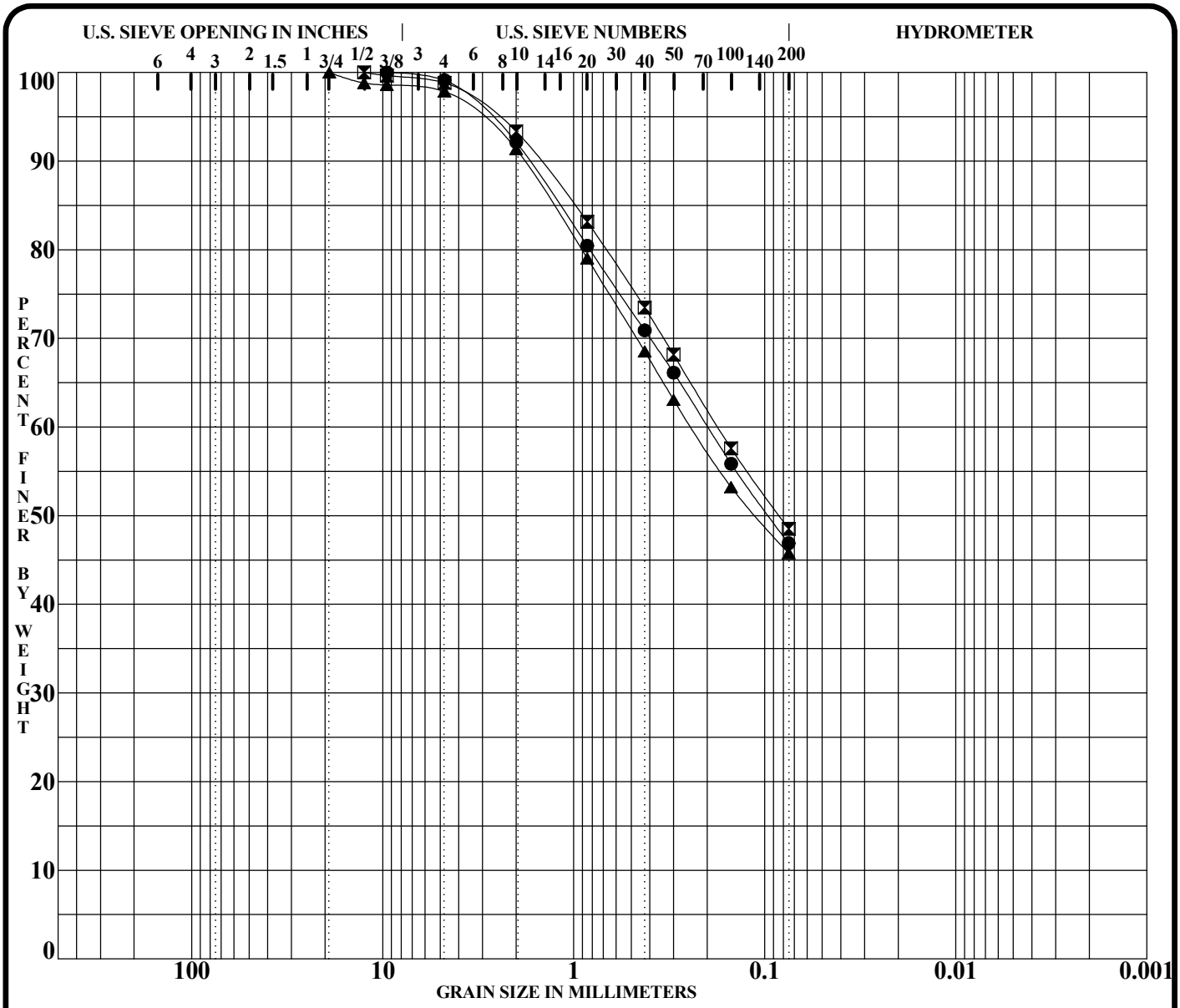
Atterberg Limits

Selected samples of the fine-grained soil units encountered at the site are tested for their Atterberg limits in accordance with ASTM D 4318. The results of these tests are presented on Enclosure C-6.

Soluble Sulfate Content Tests

The soluble sulfate content of selected subgrade soils was evaluated and the concentration of soluble sulfates in the soils was determined by measuring the optical density of a barium sulfate precipitate. The precipitate results from a reaction of barium chloride with water extractions from the soil samples. The measured optical density is correlated with readings on precipitates of known sulfate concentrations. The test results are presented on the following table:

SOLUBLE SULFATE CONTENT TESTS			
Boring Number	**Sample Depth (feet)**	**Soil Description (U.S.G.S.)**	**Sulfate Content (percent by weight)**
B-1	0-3	(SM) Silty Sand	< 0.0085
B-4	0-3	(SM) Silty Sand	< 0.0075
B-5	0-3	(SM) Silty Sand	< 0.0055



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Soil Classification	SE	RV	PL	PI	Cc	Cu
● B-1	@ 0-3 ft	(SM) Silty Sand	13	--				
⊠ B-4	@ 0-3 ft	(SM) Silty Sand	13	28				
▲ B-5	@ 0-3 ft	(SM) Silty Sand	16	--				

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-1	@ 0-3 ft	9.50	0.20			0.9	52.2	46.9	
⊠ B-4	@ 0-3 ft	12.50	0.18			1.2	50.3	48.5	
▲ B-5	@ 0-3 ft	19.00	0.24			2.1	52.1	45.8	

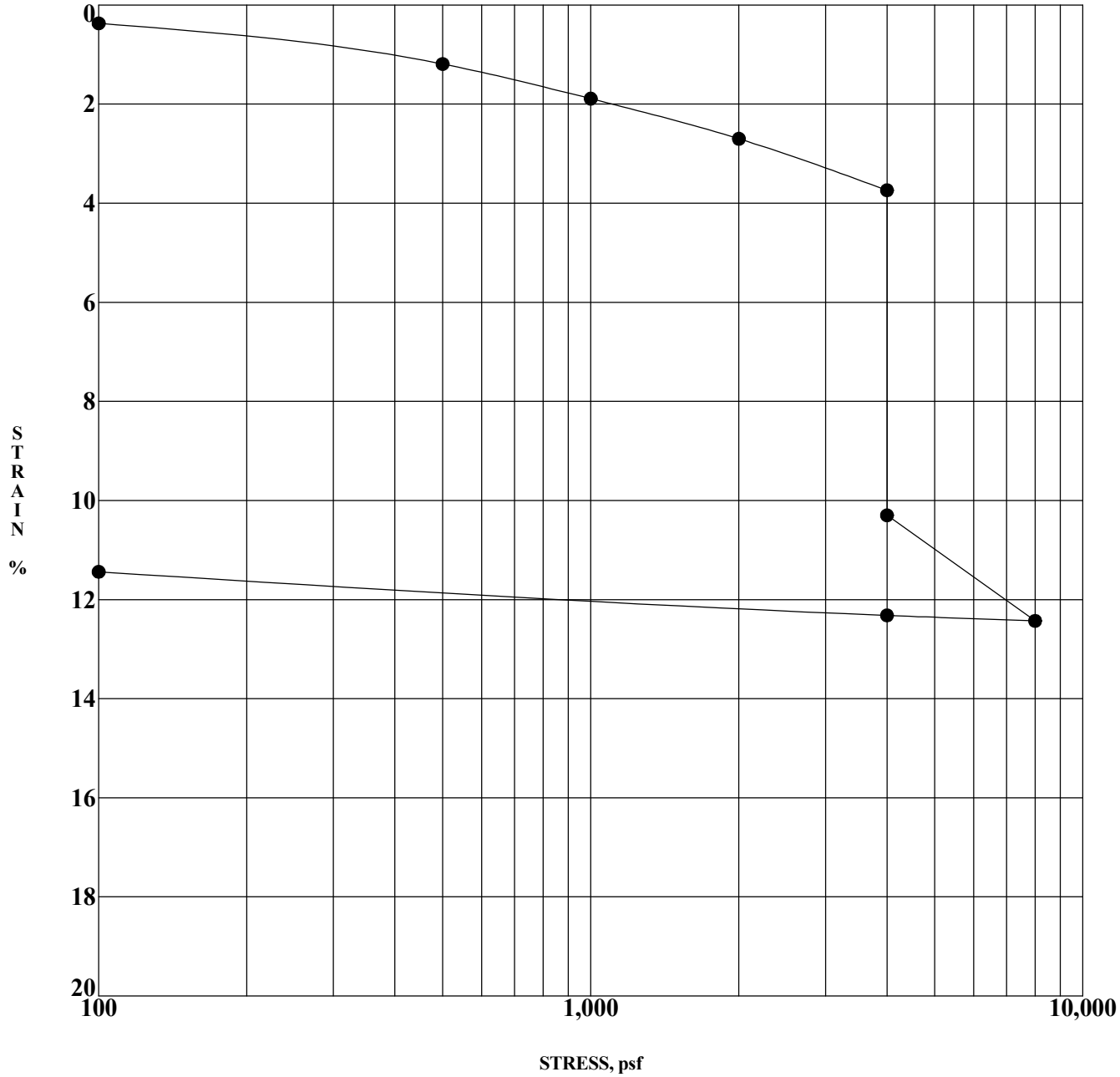
PROJECT *Proposed Iris Park Residential Development*

PROJECT NO. *33591.1*

DATE *11/19/19*

GRADATION CURVES
LOR Geotechnical Group, Inc.

ENCLOSURE C-1



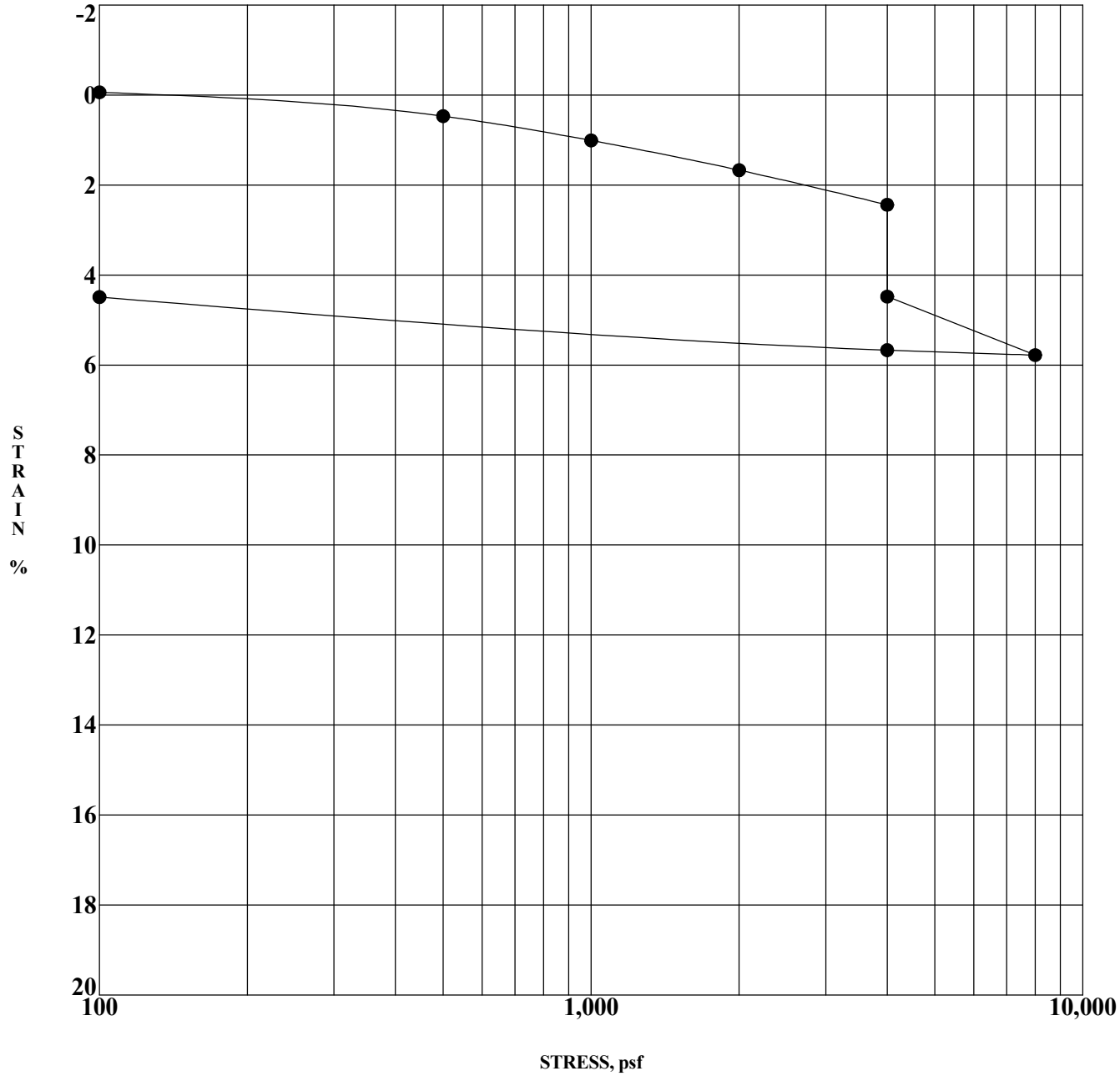
	Specimen I.D.		Classification	DD	MC%
●	B-2	@ 2 ft	**(SM) Silty Sand**	*107*	*4*

PROJECT *Proposed Iris Park Residential Development* **PROJECT NO.** *33591.1*

DATE *11/19/19*

CONSOLIDATION TEST
LOR Geotechnical Group, Inc.

ENCLOSURE C-2



	Specimen I.D.		Classification	DD	MC%
●	B-4	@ 7 ft	**(SM) Silty Sand**	*103*	*3*

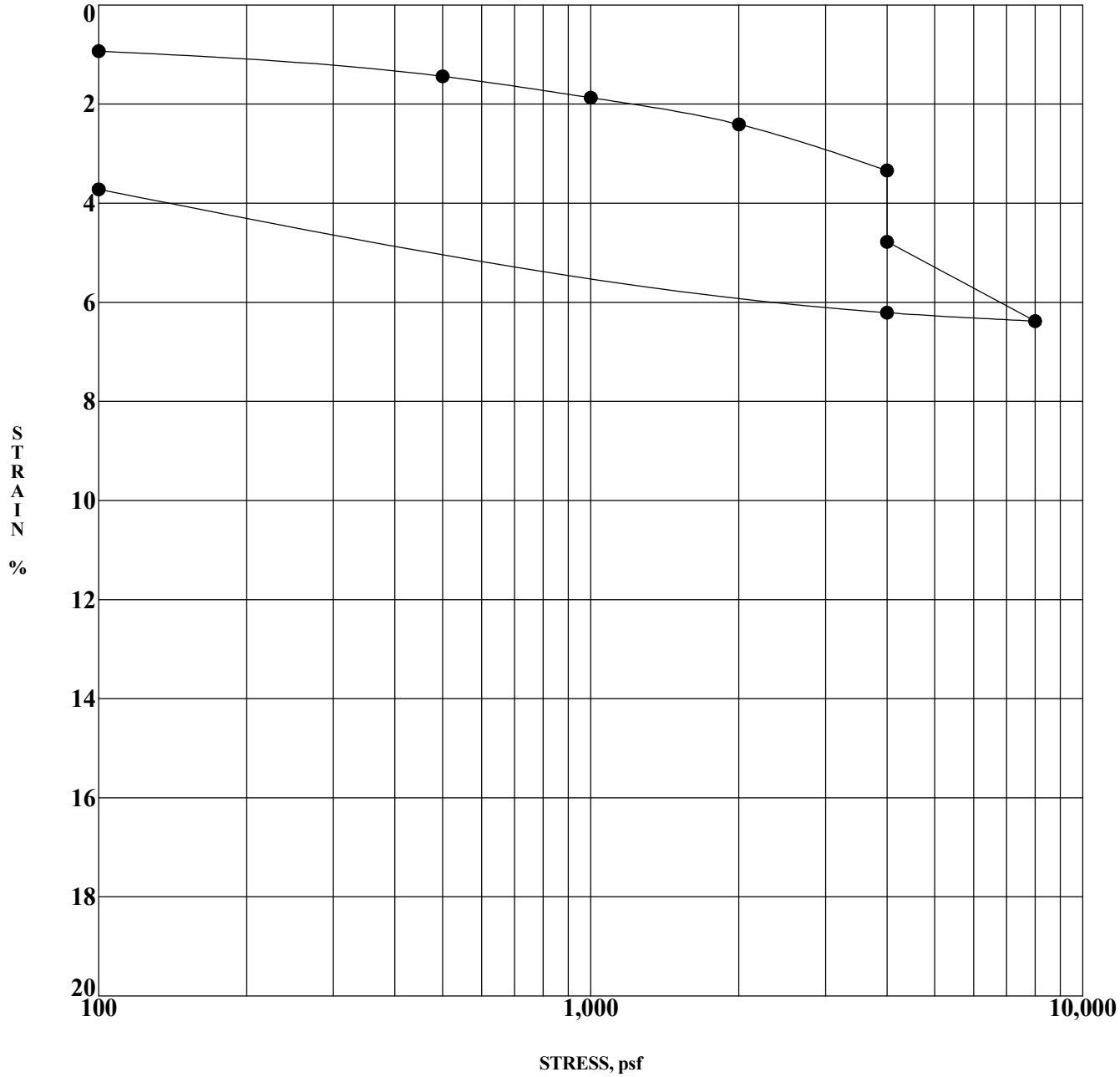
PROJECT *Proposed Iris Park Residential Development*

PROJECT NO. *33591.1*

DATE *11/19/19*

CONSOLIDATION TEST
LOR Geotechnical Group, Inc.

ENCLOSURE C-3



	Specimen I.D.		Classification	DD	MC%
●	B-5	@ 7 ft	**(ML) Sandy Silt**	*103*	*7*

PROJECT *Proposed Iris Park Residential Development*

PROJECT NO. *33591.1*

DATE *11/19/19*

CONSOLIDATION TEST
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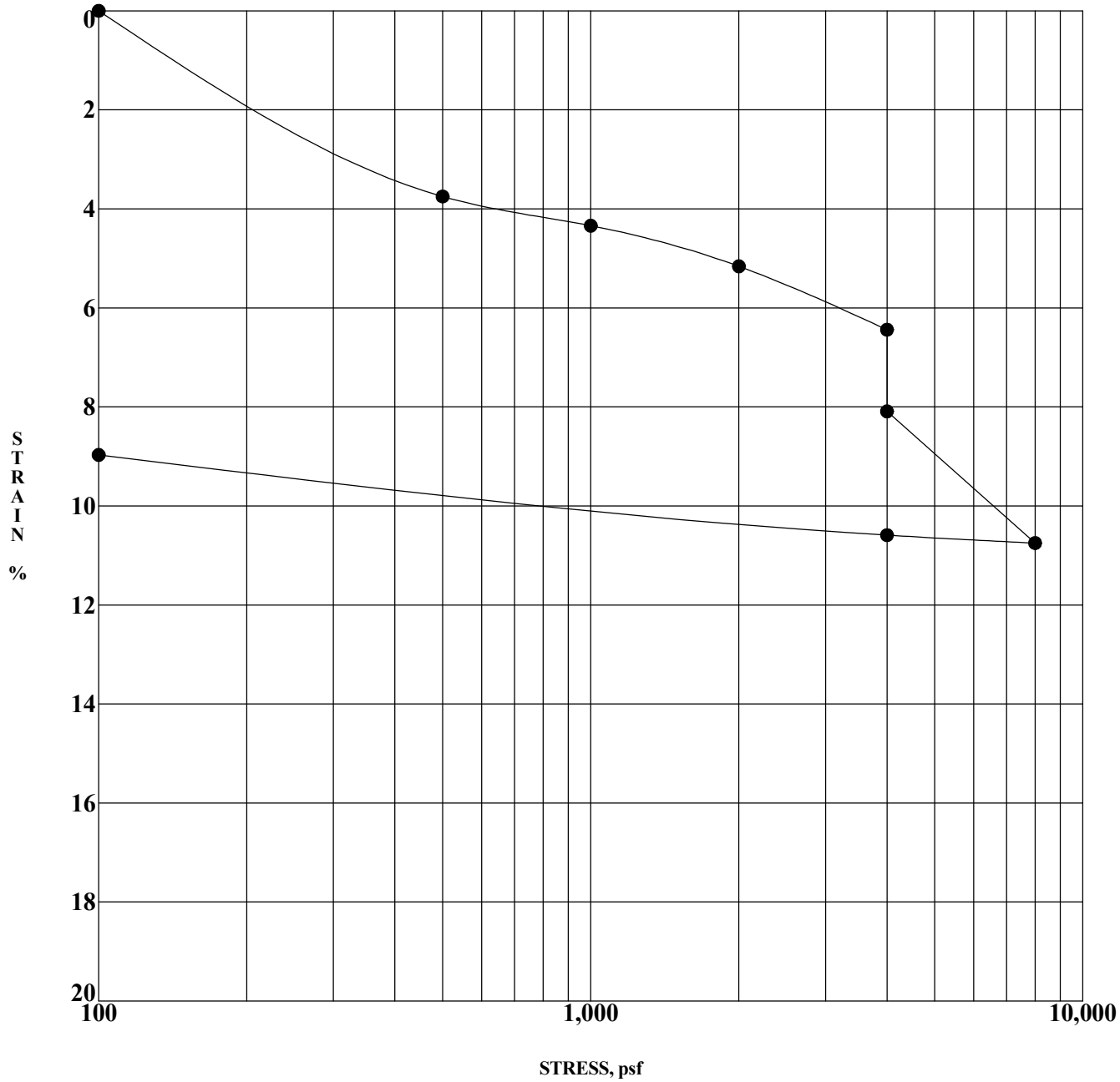
ENCLOSURE C-4



	Specimen I.D.		Classification	DD	MC%
●	B-5	@ 10 ft	**(ML) Sandy Silt**	*106*	*9*

PROJECT *Proposed Iris Park Residential Development*

PROJECT NO. *33591.1*

DATE *11/19/19*

CONSOLIDATION TEST
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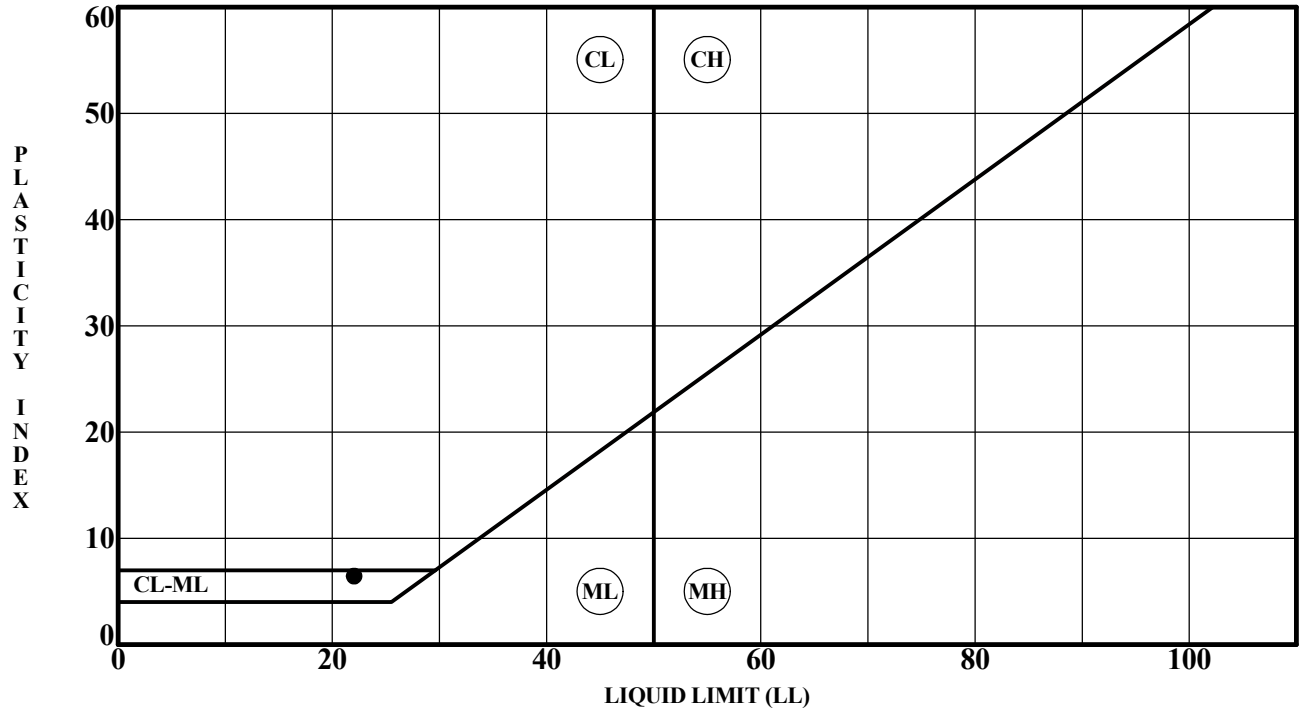
ENCLOSURE C-5



Specimen Identification	LL	PL	PI	Fines	Soil Classification
● B-2 @ 45 ft	22	16	6		(CL) Lean Clay with Sand

PROJECT *Proposed Iris Park Residential Development* **PROJECT NO.** *33591.1*

DATE *11/19/19*

ATTERBERG LIMITS RESULTS
LOR Geotechnical Group, Inc.

ENCLOSURE C-6

APPENDIX D

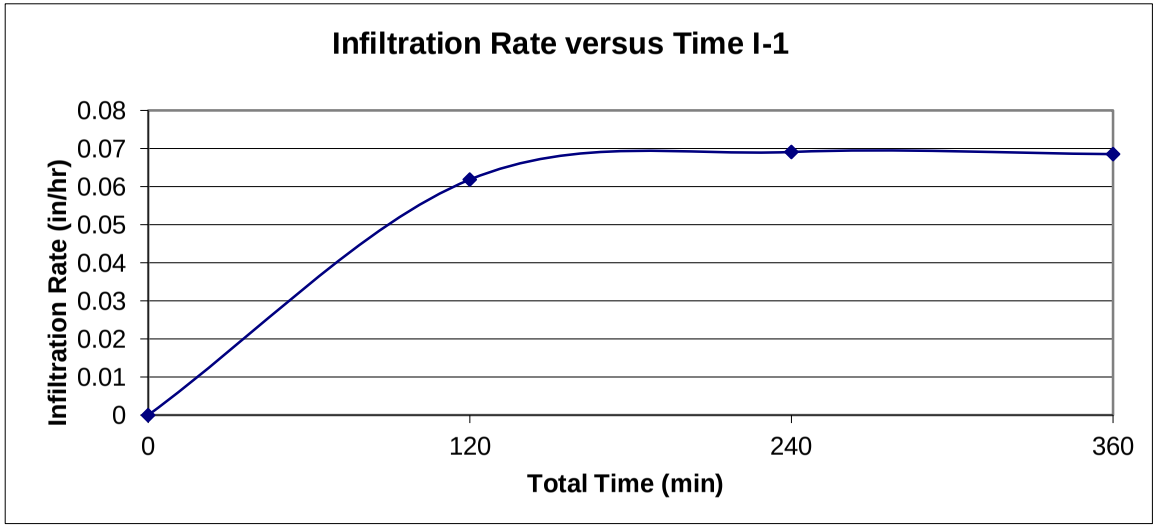
Infiltration Test Results

CONSTANT HEAD INFILTROMETER TEST DATA

Project:	Iris Park	Test Date:	November 7, 2019
Project No.:	33591.1	Test Hole No.:	I-1
Soil Classification:	(ML) Sandy Silt	Test Hole Size:	8" x 8"
Depth of Test Hole:	4 ft.	Date Excavated:	November 7, 2019
Tested By:	A.L.		

TEST PERIOD

TRIAL NO.	TIME		TIME INTERVAL (minutes)	TOTAL ELASPE TIME (minutes)	WATER USED (lbs.)	WATER USED (gal.)	INFILTRATION RATE (gal/sf/day)	INFILTRATION RATE (in/hr)	REMARKS
1	S	8:26	120	120	1.11	0.13	0.9	0.1	
	E	10:26							
2	S	10:26	120	240	1.24	0.15	1.0	0.1	
	E	12:26							
3	S	12:26	120	360	1.23	0.15	1.0	0.1	
	E	14:26							

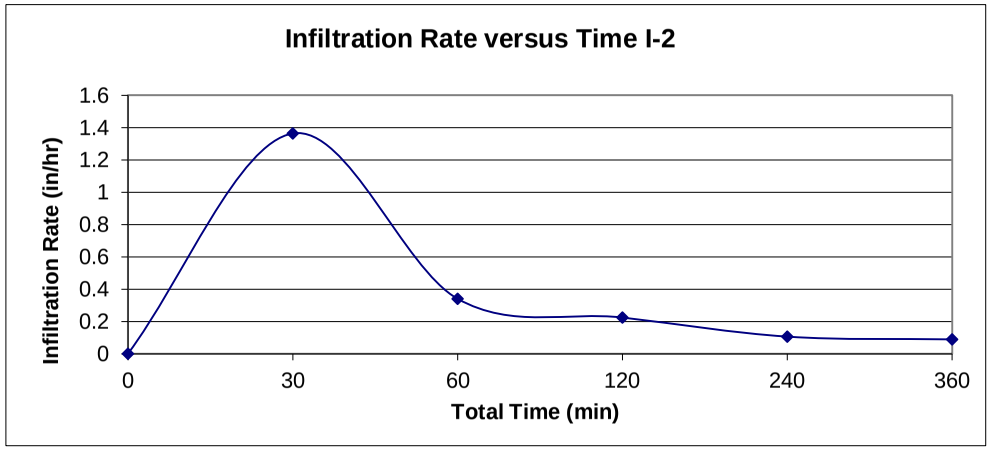


CONSTANT HEAD INFILTROMETER TEST DATA

Project:	Iris Park	Test Date:	November 7, 2019
Project No.:	33591.1	Test Hole No.:	I-2
Soil Classification:	(ML) Sandy Silt	Test Hole Size:	6" x 8"
Depth of Test Hole:	4 ft.	Date Excavated:	November 7, 2019
Tested By:	A.L.		

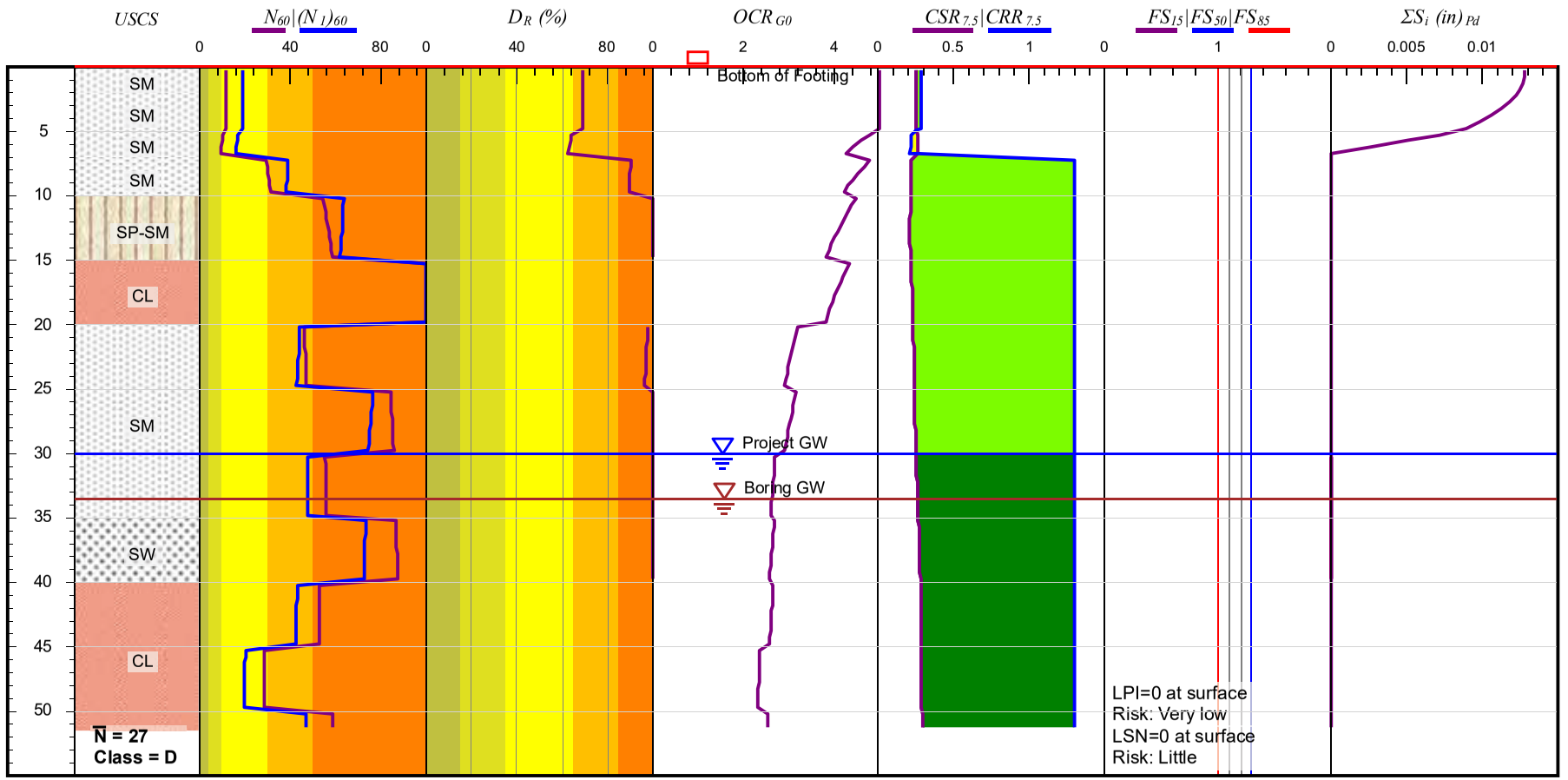
TEST PERIOD

TRIAL NO.	TIME		TIME INTERVAL (minutes)	TOTAL ELASPE TIME (minutes)	WATER USED (lbs.)	WATER USED (gal.)	INFILTRATION RATE (gal/sf/day)	INFILTRATION RATE (in/hr)	REMARKS
1	S	8:20	30	30	4.41	0.53	20.3	1.4	
	E	8:50							
2	S	8:50	30	60	1.10	0.13	5.1	0.3	
	E	9:20							
3	S	9:20	60	120	1.45	0.17	3.3	0.2	
	E	10:20							
4	S	10:20	120	240	1.37	0.16	1.6	0.1	
	E	12:20							
5	S	12:20	120	360	1.15	0.14	1.3	0.1	
	E	14:20							



APPENDIX E

Liquefaction Analysis



SM
CL
SP-SM
SW

Earthquake & Groundwater Information:
Magnitude = 6.5
Max. Acceleration = 0.553 g
Project GW = 30 ft
Maximum Settlement = 0.01 in
Settl. at Bottom of Footing = 0.01 in

Liquefaction: Boulanger & Idriss (2010-16)
Settl.: [dry] Pradel (1998); [sat] Idriss & Boulanger (2008)
Lateral spreading: Idriss & Boulanger (2008)
M correction: [Sand; Clay] Boulanger & Idriss(2004)
σv correction: Idriss & Boulanger (2008)
Stress reduction: Idriss & Boulanger (2008)

LOR GEOTECHNICAL GROUP, INC.
Soil Engineering ▲ Geology ▲ Environmental

Liquefaction Potential - SPT Data

Project:	Iris Park Residential Development				
Location:	Moreno Valley, California				
Job Number:	33591.1	Boring No.:	B-2	Enclosure:	E-1

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Appendix 4: Historical Site Conditions

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

"Not Applicable"

Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

“Not Applicable”

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation

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

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

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

Company Name	ADKAN ENGINEERS	Date	4/14/2020
Designed by	Jose Contreras	Case No	
Company Project Number/Name	Tract 37909		

BMP Identification

BMP NAME / ID: Bioretention Basin

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

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

D_{85}= 0.65 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)
D.1.1	127,146.00	Roofs	1	0.89	113414.2			
D.1.2	84,067.00	Concrete or Asphalt	1	0.89	74987.8			
D.1.3	68466	Ornamental Landscaping	0.1	0.11	7562.6			
D.1.4	53231	Ornamental Landscaping	0.1	0.11	5879.8			
	332910	Total			201844.4	0.65	10933.2	10933.2

Notes:

Bioretention Facility - Design Procedure	BMP ID	Legend:	Required Entries
			Calculated Cells

Company Name:	Adkan Engineers	Date:	4/14/2020
Designed by:	Jose Contreras	County/City Case No.:	

Design Volume

Enter the area tributary to this feature	A_T=	7.64	acres
Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	10,933	ft^3

Type of Bioretention Facility Design

(●) Side slopes required (parallel to parking spaces or adjacent to walkways)

( ) No side slopes required (perpendicular to parking space or Planter Boxes)

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer	d_S =	3.0	ft
Top Width of Bioretention Facility, excluding curb	w_T =	20.0	ft
Total Effective Depth, d_E $d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$	d_E =	1.77	ft
Minimum Surface Area, A_m $A_M\ (ft^2) = \frac{V_{BMP}\ (ft^3)}{d_E\ (ft)}$	A_M =	6,195	ft^2
Proposed Surface Area	A=	6,500	ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility	z =	4	:1
Diameter of Underdrain		6	inches
Longitudinal Slope of Site (3% maximum)		1	%
6" Check Dam Spacing		25	feet
Describe Vegetation:			

Notes:

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern

Riverside County SWCT²
Stormwater & Water Conservation Tracking Tool

TOC | Choose search item from list | Enter Value | Locate | Clear

Clear All | Metadata

- Base Maps
- Base Data
- Stormwater Data
  - Hydromodification Susceptibility Mapping
  - 2010 - 303d/TMDL
  - Hydromodification Exemption Areas
    - Potentially Not Exempt
    - Potentially Exempt
  - District Facilities
    - District Facilities
    - Proposed District Facilities
    - Basin
    - Detention Basin
    - Retention Basin
    - Debris Basin
    - Dam
    - Levee
    - Spreading Grounds
    - Other
  - Permit Areas
  - Hydrologic Unit Codes (HUC)
  - Topographic Drainage Boundary
  - Drainage Area Boundaries
  - City Storm Drains
  - WQMP 85% Design Isohyetal Map
  - CRP (Contol Release Point)
  - FEMA Flood Plain
  - Flood Plain - Other Special Studies
  - As-Built Plans
- Groundwater Data
  - SAR Groundwater Management Zones
  - SMR Groundwater Management Zones
  - WWR Groundwater Management Zones
  - Wholesaler (Water Districts)
  - Retailer (Water Districts)
  - Geotracker Locations
  - Ground Water Elevations
  - Soils
  - Plumes

SITE

1000ft

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

                Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2008, Version 8.1
                       Study date  04/10/20 File: ex2yr242.out


        ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
        ----------------------------------------------------------------------

        Riverside County Synthetic Unit Hydrology Method
        RCFC & WCD Manual date - April 1978
        Program License Serial Number 5006
        ----------------------------------------------------------------------
         English (in-lb) Input Units Used
         English Rainfall Data (Inches) Input Values Used
         English Units used in output format
        ----------------------------------------------------------------------
        ----------------------------------------------------------------------
        Drainage Area =       7.25(Ac.)  =      0.011 Sq. Mi.
        Drainage Area for Depth-Area Areal Adjustment =       7.25(Ac.)  =      0.011 Sq. Mi.
        Length along longest watercourse =    1000.00(Ft.)
        Length along longest watercourse measured to centroid =     500.00(Ft.)
        Length along longest watercourse =      0.189 Mi.
        Length along longest watercourse measured to centroid =      0.095 Mi.
        Difference in elevation =      10.00(Ft.)
        Slope along watercourse =     52.8000 Ft./Mi.
        Average Manning's 'N' = 0.030
        Lag time =    0.074 Hr.
        Lag time =     4.41 Min.
        25% of lag time =     1.10 Min.
        40% of lag time =     1.76 Min.
        Unit time =     5.00 Min.
        Duration of storm = 24 Hour(s)
        User Entered Base Flow =     0.00(CFS)
        2 YEAR Area rainfall data:
        Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
              7.25              1.60                 11.60
        100 YEAR Area rainfall data:
        Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
              7.25              4.00                 29.00
        STORM EVENT (YEAR) =    2.00
        Area Averaged 2-Year Rainfall =    1.600(In)
        Area Averaged 100-Year Rainfall =    4.000(In)
        Point rain (area averaged) =    1.600(In)
        Areal adjustment factor =  100.00 %
        Adjusted average point rain =    1.600(In)
        Sub-Area Data:
        Area(Ac.)         Runoff Index   Impervious %
             7.250           78.00          0.000
         Total Area Entered =      7.25(Ac.)
        RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
        AMC2 AMC-1     (In/Hr)    (Dec.%)     (In/Hr)      (Dec.)    (In/Hr)
        78.0  60.6      0.464     0.000        0.464        1.000      0.464
                                                          Sum (F) =   0.464
        Area averaged mean soil loss (F) (In/Hr) =  0.464
        Minimum soil loss rate ((In/Hr)) =  0.232
        (for 24 hour storm duration)
        Soil low loss rate (decimal) =   0.900
        ----------------------------------------------------------------------
                       U n i t  H y d r o g r a p h
                              VALLEY S-Curve
        ----------------------------------------------------------------------
                       Unit Hydrograph Data
        ----------------------------------------------------------------------
        Unit time period   Time % of lag   Distribution   Unit Hydrograph
            (hrs)                          Graph %           (CFS)
        ----------------------------------------------------------------------
            1   0.083        113.339         23.238             1.698
            2   0.167        226.678         48.846             3.569
            3   0.250        340.017         13.938             1.018
            4   0.333        453.357          6.374             0.466
            5   0.417        566.696          3.542             0.259
            6   0.500        680.035          2.153             0.157
            7   0.583        793.374          1.275             0.093
            8   0.667        906.713          0.633             0.046
                                      Sum = 100.000   Sum=       7.307
    ----------------------------------------------------------------------
     The following loss rate calculations reflect use of the minimum calculated loss
     rate subtracted from the Storm Rain to produce the maximum Effective Rain value
      Unit Time   Pattern   Storm Rain     Loss rate(In./Hr)     Effective
           (Hr.)  Percent   (In/Hr)         Max    |   Low        (In/Hr)
       1   0.08     0.07      0.013       (  0.822)       0.012        0.001
       2   0.17     0.07      0.013       (  0.819)       0.012        0.001
       3   0.25     0.07      0.013       (  0.815)       0.012        0.001
       4   0.33     0.10      0.019       (  0.812)       0.017        0.002
```

5	0.42	0.10	0.019	(0.809)	0.017	0.002
6	0.50	0.10	0.019	(0.806)	0.017	0.002
7	0.58	0.10	0.019	(0.803)	0.017	0.002
8	0.67	0.10	0.019	(0.800)	0.017	0.002
9	0.75	0.10	0.019	(0.796)	0.017	0.002
10	0.83	0.13	0.026	(0.793)	0.023	0.003
11	0.92	0.13	0.026	(0.790)	0.023	0.003
12	1.00	0.13	0.026	(0.787)	0.023	0.003
13	1.08	0.10	0.019	(0.784)	0.017	0.002
14	1.17	0.10	0.019	(0.781)	0.017	0.002
15	1.25	0.10	0.019	(0.778)	0.017	0.002
16	1.33	0.10	0.019	(0.775)	0.017	0.002
17	1.42	0.10	0.019	(0.772)	0.017	0.002
18	1.50	0.10	0.019	(0.769)	0.017	0.002
19	1.58	0.10	0.019	(0.765)	0.017	0.002
20	1.67	0.10	0.019	(0.762)	0.017	0.002
21	1.75	0.10	0.019	(0.759)	0.017	0.002
22	1.83	0.13	0.026	(0.756)	0.023	0.003
23	1.92	0.13	0.026	(0.753)	0.023	0.003
24	2.00	0.13	0.026	(0.750)	0.023	0.003
25	2.08	0.13	0.026	(0.747)	0.023	0.003
26	2.17	0.13	0.026	(0.744)	0.023	0.003
27	2.25	0.13	0.026	(0.741)	0.023	0.003
28	2.33	0.13	0.026	(0.738)	0.023	0.003
29	2.42	0.13	0.026	(0.735)	0.023	0.003
30	2.50	0.13	0.026	(0.732)	0.023	0.003
31	2.58	0.17	0.032	(0.729)	0.029	0.003
32	2.67	0.17	0.032	(0.726)	0.029	0.003
33	2.75	0.17	0.032	(0.723)	0.029	0.003
34	2.83	0.17	0.032	(0.720)	0.029	0.003
35	2.92	0.17	0.032	(0.717)	0.029	0.003
36	3.00	0.17	0.032	(0.714)	0.029	0.003
37	3.08	0.17	0.032	(0.711)	0.029	0.003
38	3.17	0.17	0.032	(0.708)	0.029	0.003
39	3.25	0.17	0.032	(0.705)	0.029	0.003
40	3.33	0.17	0.032	(0.702)	0.029	0.003
41	3.42	0.17	0.032	(0.699)	0.029	0.003
42	3.50	0.17	0.032	(0.697)	0.029	0.003
43	3.58	0.17	0.032	(0.694)	0.029	0.003
44	3.67	0.17	0.032	(0.691)	0.029	0.003
45	3.75	0.17	0.032	(0.688)	0.029	0.003
46	3.83	0.20	0.038	(0.685)	0.035	0.004
47	3.92	0.20	0.038	(0.682)	0.035	0.004
48	4.00	0.20	0.038	(0.679)	0.035	0.004
49	4.08	0.20	0.038	(0.676)	0.035	0.004
50	4.17	0.20	0.038	(0.673)	0.035	0.004
51	4.25	0.20	0.038	(0.670)	0.035	0.004
52	4.33	0.23	0.045	(0.668)	0.040	0.004
53	4.42	0.23	0.045	(0.665)	0.040	0.004
54	4.50	0.23	0.045	(0.662)	0.040	0.004
55	4.58	0.23	0.045	(0.659)	0.040	0.004
56	4.67	0.23	0.045	(0.656)	0.040	0.004
57	4.75	0.23	0.045	(0.653)	0.040	0.004
58	4.83	0.27	0.051	(0.651)	0.046	0.005
59	4.92	0.27	0.051	(0.648)	0.046	0.005
60	5.00	0.27	0.051	(0.645)	0.046	0.005
61	5.08	0.20	0.038	(0.642)	0.035	0.004
62	5.17	0.20	0.038	(0.639)	0.035	0.004
63	5.25	0.20	0.038	(0.637)	0.035	0.004
64	5.33	0.23	0.045	(0.634)	0.040	0.004
65	5.42	0.23	0.045	(0.631)	0.040	0.004
66	5.50	0.23	0.045	(0.628)	0.040	0.004
67	5.58	0.27	0.051	(0.626)	0.046	0.005
68	5.67	0.27	0.051	(0.623)	0.046	0.005
69	5.75	0.27	0.051	(0.620)	0.046	0.005
70	5.83	0.27	0.051	(0.617)	0.046	0.005
71	5.92	0.27	0.051	(0.615)	0.046	0.005
72	6.00	0.27	0.051	(0.612)	0.046	0.005
73	6.08	0.30	0.058	(0.609)	0.052	0.006
74	6.17	0.30	0.058	(0.606)	0.052	0.006
75	6.25	0.30	0.058	(0.604)	0.052	0.006
76	6.33	0.30	0.058	(0.601)	0.052	0.006
77	6.42	0.30	0.058	(0.598)	0.052	0.006
78	6.50	0.30	0.058	(0.596)	0.052	0.006
79	6.58	0.33	0.064	(0.593)	0.058	0.006
80	6.67	0.33	0.064	(0.590)	0.058	0.006
81	6.75	0.33	0.064	(0.588)	0.058	0.006
82	6.83	0.33	0.064	(0.585)	0.058	0.006
83	6.92	0.33	0.064	(0.582)	0.058	0.006
84	7.00	0.33	0.064	(0.580)	0.058	0.006
85	7.08	0.33	0.064	(0.577)	0.058	0.006
86	7.17	0.33	0.064	(0.574)	0.058	0.006
87	7.25	0.33	0.064	(0.572)	0.058	0.006
88	7.33	0.37	0.070	(0.569)	0.063	0.007
89	7.42	0.37	0.070	(0.567)	0.063	0.007
90	7.50	0.37	0.070	(0.564)	0.063	0.007

91	7.58	0.40	0.077	(0.561)	0.069	0.008
92	7.67	0.40	0.077	(0.559)	0.069	0.008
93	7.75	0.40	0.077	(0.556)	0.069	0.008
94	7.83	0.43	0.083	(0.554)	0.075	0.008
95	7.92	0.43	0.083	(0.551)	0.075	0.008
96	8.00	0.43	0.083	(0.549)	0.075	0.008
97	8.08	0.50	0.096	(0.546)	0.086	0.010
98	8.17	0.50	0.096	(0.543)	0.086	0.010
99	8.25	0.50	0.096	(0.541)	0.086	0.010
100	8.33	0.50	0.096	(0.538)	0.086	0.010
101	8.42	0.50	0.096	(0.536)	0.086	0.010
102	8.50	0.50	0.096	(0.533)	0.086	0.010
103	8.58	0.53	0.102	(0.531)	0.092	0.010
104	8.67	0.53	0.102	(0.528)	0.092	0.010
105	8.75	0.53	0.102	(0.526)	0.092	0.010
106	8.83	0.57	0.109	(0.523)	0.098	0.011
107	8.92	0.57	0.109	(0.521)	0.098	0.011
108	9.00	0.57	0.109	(0.518)	0.098	0.011
109	9.08	0.63	0.122	(0.516)	0.109	0.012
110	9.17	0.63	0.122	(0.514)	0.109	0.012
111	9.25	0.63	0.122	(0.511)	0.109	0.012
112	9.33	0.67	0.128	(0.509)	0.115	0.013
113	9.42	0.67	0.128	(0.506)	0.115	0.013
114	9.50	0.67	0.128	(0.504)	0.115	0.013
115	9.58	0.70	0.134	(0.501)	0.121	0.013
116	9.67	0.70	0.134	(0.499)	0.121	0.013
117	9.75	0.70	0.134	(0.497)	0.121	0.013
118	9.83	0.73	0.141	(0.494)	0.127	0.014
119	9.92	0.73	0.141	(0.492)	0.127	0.014
120	10.00	0.73	0.141	(0.489)	0.127	0.014
121	10.08	0.50	0.096	(0.487)	0.086	0.010
122	10.17	0.50	0.096	(0.485)	0.086	0.010
123	10.25	0.50	0.096	(0.482)	0.086	0.010
124	10.33	0.50	0.096	(0.480)	0.086	0.010
125	10.42	0.50	0.096	(0.478)	0.086	0.010
126	10.50	0.50	0.096	(0.475)	0.086	0.010
127	10.58	0.67	0.128	(0.473)	0.115	0.013
128	10.67	0.67	0.128	(0.471)	0.115	0.013
129	10.75	0.67	0.128	(0.468)	0.115	0.013
130	10.83	0.67	0.128	(0.466)	0.115	0.013
131	10.92	0.67	0.128	(0.464)	0.115	0.013
132	11.00	0.67	0.128	(0.462)	0.115	0.013
133	11.08	0.63	0.122	(0.459)	0.109	0.012
134	11.17	0.63	0.122	(0.457)	0.109	0.012
135	11.25	0.63	0.122	(0.455)	0.109	0.012
136	11.33	0.63	0.122	(0.453)	0.109	0.012
137	11.42	0.63	0.122	(0.450)	0.109	0.012
138	11.50	0.63	0.122	(0.448)	0.109	0.012
139	11.58	0.57	0.109	(0.446)	0.098	0.011
140	11.67	0.57	0.109	(0.444)	0.098	0.011
141	11.75	0.57	0.109	(0.441)	0.098	0.011
142	11.83	0.60	0.115	(0.439)	0.104	0.012
143	11.92	0.60	0.115	(0.437)	0.104	0.012
144	12.00	0.60	0.115	(0.435)	0.104	0.012
145	12.08	0.83	0.160	(0.433)	0.144	0.016
146	12.17	0.83	0.160	(0.431)	0.144	0.016
147	12.25	0.83	0.160	(0.428)	0.144	0.016
148	12.33	0.87	0.166	(0.426)	0.150	0.017
149	12.42	0.87	0.166	(0.424)	0.150	0.017
150	12.50	0.87	0.166	(0.422)	0.150	0.017
151	12.58	0.93	0.179	(0.420)	0.161	0.018
152	12.67	0.93	0.179	(0.418)	0.161	0.018
153	12.75	0.93	0.179	(0.416)	0.161	0.018
154	12.83	0.97	0.186	(0.413)	0.167	0.019
155	12.92	0.97	0.186	(0.411)	0.167	0.019
156	13.00	0.97	0.186	(0.409)	0.167	0.019
157	13.08	1.13	0.218	(0.407)	0.196	0.022
158	13.17	1.13	0.218	(0.405)	0.196	0.022
159	13.25	1.13	0.218	(0.403)	0.196	0.022
160	13.33	1.13	0.218	(0.401)	0.196	0.022
161	13.42	1.13	0.218	(0.399)	0.196	0.022
162	13.50	1.13	0.218	(0.397)	0.196	0.022
163	13.58	0.77	0.147	(0.395)	0.132	0.015
164	13.67	0.77	0.147	(0.393)	0.132	0.015
165	13.75	0.77	0.147	(0.391)	0.132	0.015
166	13.83	0.77	0.147	(0.389)	0.132	0.015
167	13.92	0.77	0.147	(0.387)	0.132	0.015
168	14.00	0.77	0.147	(0.385)	0.132	0.015
169	14.08	0.90	0.173	(0.383)	0.156	0.017
170	14.17	0.90	0.173	(0.381)	0.156	0.017
171	14.25	0.90	0.173	(0.379)	0.156	0.017
172	14.33	0.87	0.166	(0.377)	0.150	0.017
173	14.42	0.87	0.166	(0.375)	0.150	0.017
174	14.50	0.87	0.166	(0.373)	0.150	0.017
175	14.58	0.87	0.166	(0.371)	0.150	0.017
176	14.67	0.87	0.166	(0.370)	0.150	0.017

177	14.75	0.87	0.166	(0.368)	0.150	0.017
178	14.83	0.83	0.160	(0.366)	0.144	0.016
179	14.92	0.83	0.160	(0.364)	0.144	0.016
180	15.00	0.83	0.160	(0.362)	0.144	0.016
181	15.08	0.80	0.154	(0.360)	0.138	0.015
182	15.17	0.80	0.154	(0.358)	0.138	0.015
183	15.25	0.80	0.154	(0.356)	0.138	0.015
184	15.33	0.77	0.147	(0.355)	0.132	0.015
185	15.42	0.77	0.147	(0.353)	0.132	0.015
186	15.50	0.77	0.147	(0.351)	0.132	0.015
187	15.58	0.63	0.122	(0.349)	0.109	0.012
188	15.67	0.63	0.122	(0.347)	0.109	0.012
189	15.75	0.63	0.122	(0.346)	0.109	0.012
190	15.83	0.63	0.122	(0.344)	0.109	0.012
191	15.92	0.63	0.122	(0.342)	0.109	0.012
192	16.00	0.63	0.122	(0.340)	0.109	0.012
193	16.08	0.13	0.026	(0.339)	0.023	0.003
194	16.17	0.13	0.026	(0.337)	0.023	0.003
195	16.25	0.13	0.026	(0.335)	0.023	0.003
196	16.33	0.13	0.026	(0.333)	0.023	0.003
197	16.42	0.13	0.026	(0.332)	0.023	0.003
198	16.50	0.13	0.026	(0.330)	0.023	0.003
199	16.58	0.10	0.019	(0.328)	0.017	0.002
200	16.67	0.10	0.019	(0.327)	0.017	0.002
201	16.75	0.10	0.019	(0.325)	0.017	0.002
202	16.83	0.10	0.019	(0.323)	0.017	0.002
203	16.92	0.10	0.019	(0.322)	0.017	0.002
204	17.00	0.10	0.019	(0.320)	0.017	0.002
205	17.08	0.17	0.032	(0.319)	0.029	0.003
206	17.17	0.17	0.032	(0.317)	0.029	0.003
207	17.25	0.17	0.032	(0.315)	0.029	0.003
208	17.33	0.17	0.032	(0.314)	0.029	0.003
209	17.42	0.17	0.032	(0.312)	0.029	0.003
210	17.50	0.17	0.032	(0.311)	0.029	0.003
211	17.58	0.17	0.032	(0.309)	0.029	0.003
212	17.67	0.17	0.032	(0.308)	0.029	0.003
213	17.75	0.17	0.032	(0.306)	0.029	0.003
214	17.83	0.13	0.026	(0.304)	0.023	0.003
215	17.92	0.13	0.026	(0.303)	0.023	0.003
216	18.00	0.13	0.026	(0.301)	0.023	0.003
217	18.08	0.13	0.026	(0.300)	0.023	0.003
218	18.17	0.13	0.026	(0.299)	0.023	0.003
219	18.25	0.13	0.026	(0.297)	0.023	0.003
220	18.33	0.13	0.026	(0.296)	0.023	0.003
221	18.42	0.13	0.026	(0.294)	0.023	0.003
222	18.50	0.13	0.026	(0.293)	0.023	0.003
223	18.58	0.10	0.019	(0.291)	0.017	0.002
224	18.67	0.10	0.019	(0.290)	0.017	0.002
225	18.75	0.10	0.019	(0.289)	0.017	0.002
226	18.83	0.07	0.013	(0.287)	0.012	0.001
227	18.92	0.07	0.013	(0.286)	0.012	0.001
228	19.00	0.07	0.013	(0.284)	0.012	0.001
229	19.08	0.10	0.019	(0.283)	0.017	0.002
230	19.17	0.10	0.019	(0.282)	0.017	0.002
231	19.25	0.10	0.019	(0.280)	0.017	0.002
232	19.33	0.13	0.026	(0.279)	0.023	0.003
233	19.42	0.13	0.026	(0.278)	0.023	0.003
234	19.50	0.13	0.026	(0.277)	0.023	0.003
235	19.58	0.10	0.019	(0.275)	0.017	0.002
236	19.67	0.10	0.019	(0.274)	0.017	0.002
237	19.75	0.10	0.019	(0.273)	0.017	0.002
238	19.83	0.07	0.013	(0.272)	0.012	0.001
239	19.92	0.07	0.013	(0.270)	0.012	0.001
240	20.00	0.07	0.013	(0.269)	0.012	0.001
241	20.08	0.10	0.019	(0.268)	0.017	0.002
242	20.17	0.10	0.019	(0.267)	0.017	0.002
243	20.25	0.10	0.019	(0.266)	0.017	0.002
244	20.33	0.10	0.019	(0.264)	0.017	0.002
245	20.42	0.10	0.019	(0.263)	0.017	0.002
246	20.50	0.10	0.019	(0.262)	0.017	0.002
247	20.58	0.10	0.019	(0.261)	0.017	0.002
248	20.67	0.10	0.019	(0.260)	0.017	0.002
249	20.75	0.10	0.019	(0.259)	0.017	0.002
250	20.83	0.07	0.013	(0.258)	0.012	0.001
251	20.92	0.07	0.013	(0.257)	0.012	0.001
252	21.00	0.07	0.013	(0.256)	0.012	0.001
253	21.08	0.10	0.019	(0.255)	0.017	0.002
254	21.17	0.10	0.019	(0.254)	0.017	0.002
255	21.25	0.10	0.019	(0.253)	0.017	0.002
256	21.33	0.07	0.013	(0.252)	0.012	0.001
257	21.42	0.07	0.013	(0.251)	0.012	0.001
258	21.50	0.07	0.013	(0.250)	0.012	0.001
259	21.58	0.10	0.019	(0.249)	0.017	0.002
260	21.67	0.10	0.019	(0.248)	0.017	0.002
261	21.75	0.10	0.019	(0.247)	0.017	0.002
262	21.83	0.07	0.013	(0.246)	0.012	0.001

```
263  21.92     0.07      0.013       (  0.246)       0.012        0.001
264  22.00     0.07      0.013       (  0.245)       0.012        0.001
265  22.08     0.10      0.019       (  0.244)       0.017        0.002
266  22.17     0.10      0.019       (  0.243)       0.017        0.002
267  22.25     0.10      0.019       (  0.242)       0.017        0.002
268  22.33     0.07      0.013       (  0.242)       0.012        0.001
269  22.42     0.07      0.013       (  0.241)       0.012        0.001
270  22.50     0.07      0.013       (  0.240)       0.012        0.001
271  22.58     0.07      0.013       (  0.239)       0.012        0.001
272  22.67     0.07      0.013       (  0.239)       0.012        0.001
273  22.75     0.07      0.013       (  0.238)       0.012        0.001
274  22.83     0.07      0.013       (  0.238)       0.012        0.001
275  22.92     0.07      0.013       (  0.237)       0.012        0.001
276  23.00     0.07      0.013       (  0.236)       0.012        0.001
277  23.08     0.07      0.013       (  0.236)       0.012        0.001
278  23.17     0.07      0.013       (  0.235)       0.012        0.001
279  23.25     0.07      0.013       (  0.235)       0.012        0.001
280  23.33     0.07      0.013       (  0.234)       0.012        0.001
281  23.42     0.07      0.013       (  0.234)       0.012        0.001
282  23.50     0.07      0.013       (  0.233)       0.012        0.001
283  23.58     0.07      0.013       (  0.233)       0.012        0.001
284  23.67     0.07      0.013       (  0.233)       0.012        0.001
285  23.75     0.07      0.013       (  0.232)       0.012        0.001
286  23.83     0.07      0.013       (  0.232)       0.012        0.001
287  23.92     0.07      0.013       (  0.232)       0.012        0.001
288  24.00     0.07      0.013       (  0.232)       0.012        0.001
               (Loss Rate Not Used)
    Sum =     100.0                                  Sum =     1.9
      Flood volume = Effective rainfall      0.16(In)
       times area       7.3(Ac.)/[(In)/(Ft.)] =       0.1(Ac.Ft)
      Total soil loss =      1.44(In)
      Total soil loss =     0.870(Ac.Ft)
      Total rainfall =      1.60(In)
      Flood volume =        4210.7 Cubic Feet
      Total soil loss =       37896.7 Cubic Feet
      ---------------------------------------------------------------------
       Peak flow rate of this hydrograph =      0.159(CFS)
      ---------------------------------------------------------------------
      +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                        24 - H O U R    S T O R M
                    R u n o f f      H y d r o g r a p h
      ---------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))
      ---------------------------------------------------------------------
 Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
 ----------------------------------------------------------------------------
   0+ 5       0.0000      0.00  Q         |         |         |         |
   0+10       0.0001      0.01  Q         |         |         |         |
   0+15       0.0001      0.01  Q         |         |         |         |
   0+20       0.0002      0.01  Q         |         |         |         |
   0+25       0.0003      0.01  Q         |         |         |         |
   0+30       0.0004      0.01  Q         |         |         |         |
   0+35       0.0005      0.01  Q         |         |         |         |
   0+40       0.0005      0.01  Q         |         |         |         |
   0+45       0.0006      0.01  Q         |         |         |         |
   0+50       0.0007      0.02  Q         |         |         |         |
   0+55       0.0009      0.02  Q         |         |         |         |
   1+ 0       0.0010      0.02  Q         |         |         |         |
   1+ 5       0.0011      0.02  Q         |         |         |         |
   1+10       0.0012      0.02  Q         |         |         |         |
   1+15       0.0013      0.01  Q         |         |         |         |
   1+20       0.0014      0.01  Q         |         |         |         |
   1+25       0.0015      0.01  Q         |         |         |         |
   1+30       0.0016      0.01  Q         |         |         |         |
   1+35       0.0017      0.01  Q         |         |         |         |
   1+40       0.0018      0.01  Q         |         |         |         |
   1+45       0.0019      0.01  Q         |         |         |         |
   1+50       0.0020      0.02  Q         |         |         |         |
   1+55       0.0021      0.02  Q         |         |         |         |
   2+ 0       0.0022      0.02  Q         |         |         |         |
   2+ 5       0.0024      0.02  Q         |         |         |         |
   2+10       0.0025      0.02  QV        |         |         |         |
   2+15       0.0026      0.02  QV        |         |         |         |
   2+20       0.0028      0.02  QV        |         |         |         |
   2+25       0.0029      0.02  QV        |         |         |         |
   2+30       0.0030      0.02  QV        |         |         |         |
   2+35       0.0032      0.02  QV        |         |         |         |
   2+40       0.0033      0.02  QV        |         |         |         |
   2+45       0.0035      0.02  QV        |         |         |         |
   2+50       0.0036      0.02  QV        |         |         |         |
   2+55       0.0038      0.02  QV        |         |         |         |
   3+ 0       0.0039      0.02  QV        |         |         |         |
   3+ 5       0.0041      0.02  QV        |         |         |         |
   3+10       0.0043      0.02  QV        |         |         |         |
   3+15       0.0044      0.02  QV        |         |         |         |
   3+20       0.0046      0.02  QV        |         |         |         |
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 3+25      0.0047      0.02  QV        |         |         |         |
 3+30      0.0049      0.02  Q V       |         |         |         |
 3+35      0.0051      0.02  Q V       |         |         |         |
 3+40      0.0052      0.02  Q V       |         |         |         |
 3+45      0.0054      0.02  Q V       |         |         |         |
 3+50      0.0056      0.02  Q V       |         |         |         |
 3+55      0.0057      0.03  Q V       |         |         |         |
 4+ 0      0.0059      0.03  Q V       |         |         |         |
 4+ 5      0.0061      0.03  Q V       |         |         |         |
 4+10      0.0063      0.03  Q V       |         |         |         |
 4+15      0.0065      0.03  Q V       |         |         |         |
 4+20      0.0067      0.03  Q V       |         |         |         |
 4+25      0.0069      0.03  Q V       |         |         |         |
 4+30      0.0071      0.03  Q V       |         |         |         |
 4+35      0.0074      0.03  Q  V      |         |         |         |
 4+40      0.0076      0.03  Q  V      |         |         |         |
 4+45      0.0078      0.03  Q  V      |         |         |         |
 4+50      0.0081      0.03  Q  V      |         |         |         |
 4+55      0.0083      0.04  Q  V      |         |         |         |
 5+ 0      0.0086      0.04  Q  V      |         |         |         |
 5+ 5      0.0088      0.03  Q  V      |         |         |         |
 5+10      0.0090      0.03  Q  V      |         |         |         |
 5+15      0.0092      0.03  Q  V      |         |         |         |
 5+20      0.0094      0.03  Q  V      |         |         |         |
 5+25      0.0096      0.03  Q  V      |         |         |         |
 5+30      0.0099      0.03  Q   V     |         |         |         |
 5+35      0.0101      0.03  Q   V     |         |         |         |
 5+40      0.0103      0.04  Q   V     |         |         |         |
 5+45      0.0106      0.04  Q   V     |         |         |         |
 5+50      0.0108      0.04  Q   V     |         |         |         |
 5+55      0.0111      0.04  Q   V     |         |         |         |
 6+ 0      0.0114      0.04  Q   V     |         |         |         |
 6+ 5      0.0116      0.04  Q   V     |         |         |         |
 6+10      0.0119      0.04  Q   V     |         |         |         |
 6+15      0.0122      0.04  Q    V    |         |         |         |
 6+20      0.0125      0.04  Q    V    |         |         |         |
 6+25      0.0128      0.04  Q    V    |         |         |         |
 6+30      0.0131      0.04  Q    V    |         |         |         |
 6+35      0.0133      0.04  Q    V    |         |         |         |
 6+40      0.0137      0.05  Q    V    |         |         |         |
 6+45      0.0140      0.05  Q    V    |         |         |         |
 6+50      0.0143      0.05  Q    V    |         |         |         |
 6+55      0.0146      0.05  Q     V   |         |         |         |
 7+ 0      0.0149      0.05  Q     V   |         |         |         |
 7+ 5      0.0153      0.05  Q     V   |         |         |         |
 7+10      0.0156      0.05  Q     V   |         |         |         |
 7+15      0.0159      0.05  Q     V   |         |         |         |
 7+20      0.0162      0.05  Q     V   |         |         |         |
 7+25      0.0166      0.05  Q     V   |         |         |         |
 7+30      0.0169      0.05  Q      V  |         |         |         |
 7+35      0.0173      0.05  Q      V  |         |         |         |
 7+40      0.0177      0.05  Q      V  |         |         |         |
 7+45      0.0181      0.06  Q      V  |         |         |         |
 7+50      0.0184      0.06  Q      V  |         |         |         |
 7+55      0.0189      0.06  Q      V  |         |         |         |
 8+ 0      0.0193      0.06  Q      V  |         |         |         |
 8+ 5      0.0197      0.06  Q       V |         |         |         |
 8+10      0.0202      0.07  Q       V |         |         |         |
 8+15      0.0206      0.07  Q       V |         |         |         |
 8+20      0.0211      0.07  Q       V |         |         |         |
 8+25      0.0216      0.07  Q       V |         |         |         |
 8+30      0.0221      0.07  Q        V|         |         |         |
 8+35      0.0226      0.07  Q        V|         |         |         |
 8+40      0.0231      0.07  Q        V|         |         |         |
 8+45      0.0236      0.07  Q        V|         |         |         |
 8+50      0.0241      0.08  Q        V|         |         |         |
 8+55      0.0246      0.08  Q         V         |         |         |
 9+ 0      0.0252      0.08  Q         V         |         |         |
 9+ 5      0.0257      0.08  Q         V         |         |         |
 9+10      0.0263      0.09  Q         V         |         |         |
 9+15      0.0269      0.09  Q         |V        |         |         |
 9+20      0.0276      0.09  Q         |V        |         |         |
 9+25      0.0282      0.09  Q         |V        |         |         |
 9+30      0.0288      0.09  Q         |V        |         |         |
 9+35      0.0295      0.09  Q         | V       |         |         |
 9+40      0.0301      0.10  Q         | V       |         |         |
 9+45      0.0308      0.10  Q         | V       |         |         |
 9+50      0.0315      0.10  Q         |  V      |         |         |
 9+55      0.0322      0.10  Q         |  V      |         |         |
10+ 0      0.0329      0.10  Q         |  V      |         |         |
10+ 5      0.0335      0.09  Q         |  V      |         |         |
10+10      0.0341      0.08  Q         |   V     |         |         |
10+15      0.0346      0.07  Q         |   V     |         |         |
10+20      0.0351      0.07  Q         |   V     |         |         |
10+25      0.0356      0.07  Q         |   V     |         |         |
10+30      0.0361      0.07  Q         |   V     |         |         |
```

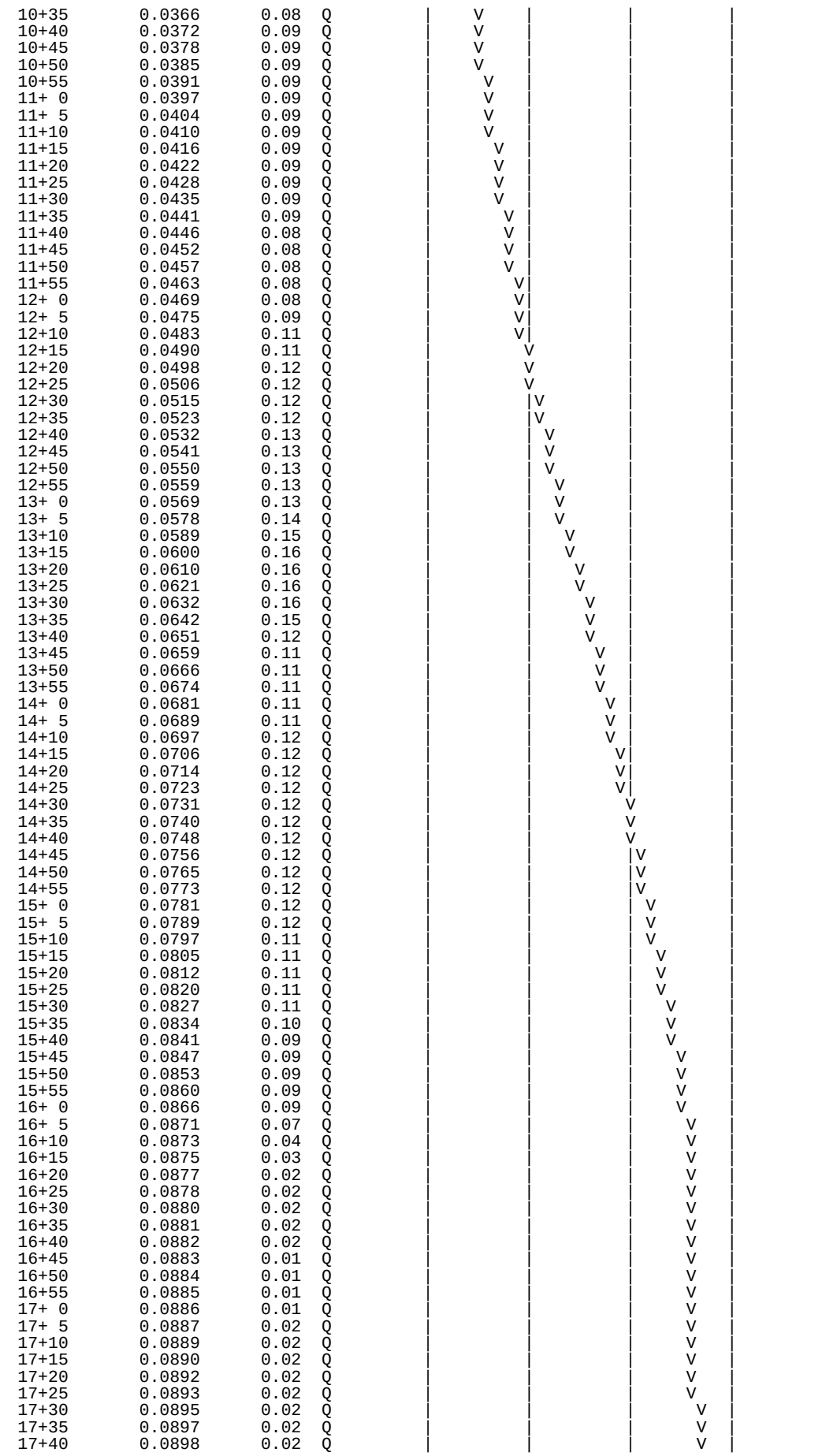

10+35	0.0366	0.08	Q		V		
10+40	0.0372	0.09	Q		V		
10+45	0.0378	0.09	Q		V		
10+50	0.0385	0.09	Q		V		
10+55	0.0391	0.09	Q		V		
11+ 0	0.0397	0.09	Q		V		
11+ 5	0.0404	0.09	Q		V		
11+10	0.0410	0.09	Q		V		
11+15	0.0416	0.09	Q		V		
11+20	0.0422	0.09	Q		V		
11+25	0.0428	0.09	Q		V		
11+30	0.0435	0.09	Q		V		
11+35	0.0441	0.09	Q		V		
11+40	0.0446	0.08	Q		V		
11+45	0.0452	0.08	Q		V		
11+50	0.0457	0.08	Q		V		
11+55	0.0463	0.08	Q		V		
12+ 0	0.0469	0.08	Q		V		
12+ 5	0.0475	0.09	Q		V		
12+10	0.0483	0.11	Q		V		
12+15	0.0490	0.11	Q		V		
12+20	0.0498	0.12	Q		V		
12+25	0.0506	0.12	Q		V		
12+30	0.0515	0.12	Q		V		
12+35	0.0523	0.12	Q		V		
12+40	0.0532	0.13	Q		V		
12+45	0.0541	0.13	Q		V		
12+50	0.0550	0.13	Q		V		
12+55	0.0559	0.13	Q		V		
13+ 0	0.0569	0.13	Q		V		
13+ 5	0.0578	0.14	Q		V		
13+10	0.0589	0.15	Q		V		
13+15	0.0600	0.16	Q		V		
13+20	0.0610	0.16	Q		V		
13+25	0.0621	0.16	Q		V		
13+30	0.0632	0.16	Q		V		
13+35	0.0642	0.15	Q		V		
13+40	0.0651	0.12	Q		V		
13+45	0.0659	0.11	Q		V		
13+50	0.0666	0.11	Q		V		
13+55	0.0674	0.11	Q		V		
14+ 0	0.0681	0.11	Q		V		
14+ 5	0.0689	0.11	Q		V		
14+10	0.0697	0.12	Q		V		
14+15	0.0706	0.12	Q		V		
14+20	0.0714	0.12	Q		V		
14+25	0.0723	0.12	Q		V		
14+30	0.0731	0.12	Q		V		
14+35	0.0740	0.12	Q		V		
14+40	0.0748	0.12	Q		V		
14+45	0.0756	0.12	Q		V		
14+50	0.0765	0.12	Q		V		
14+55	0.0773	0.12	Q		V		
15+ 0	0.0781	0.12	Q		V		
15+ 5	0.0789	0.12	Q		V		
15+10	0.0797	0.11	Q		V		
15+15	0.0805	0.11	Q		V		
15+20	0.0812	0.11	Q		V		
15+25	0.0820	0.11	Q		V		
15+30	0.0827	0.11	Q		V		
15+35	0.0834	0.10	Q		V		
15+40	0.0841	0.09	Q		V		
15+45	0.0847	0.09	Q		V		
15+50	0.0853	0.09	Q		V		
15+55	0.0860	0.09	Q		V		
16+ 0	0.0866	0.09	Q		V		
16+ 5	0.0871	0.07	Q		V		
16+10	0.0873	0.04	Q		V		
16+15	0.0875	0.03	Q		V		
16+20	0.0877	0.02	Q		V		
16+25	0.0878	0.02	Q		V		
16+30	0.0880	0.02	Q		V		
16+35	0.0881	0.02	Q		V		
16+40	0.0882	0.02	Q		V		
16+45	0.0883	0.01	Q		V		
16+50	0.0884	0.01	Q		V		
16+55	0.0885	0.01	Q		V		
17+ 0	0.0886	0.01	Q		V		
17+ 5	0.0887	0.02	Q		V		
17+10	0.0889	0.02	Q		V		
17+15	0.0890	0.02	Q		V		
17+20	0.0892	0.02	Q		V		
17+25	0.0893	0.02	Q		V		
17+30	0.0895	0.02	Q		V		
17+35	0.0897	0.02	Q		V		
17+40	0.0898	0.02	Q		V		

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   17+45       0.0900      0.02  Q          |          |          |       V  |
   17+50       0.0901      0.02  Q          |          |          |       V  |
   17+55       0.0903      0.02  Q          |          |          |       V  |
   18+ 0       0.0904      0.02  Q          |          |          |       V  |
   18+ 5       0.0905      0.02  Q          |          |          |       V  |
   18+10       0.0907      0.02  Q          |          |          |       V  |
   18+15       0.0908      0.02  Q          |          |          |       V  |
   18+20       0.0909      0.02  Q          |          |          |       V  |
   18+25       0.0910      0.02  Q          |          |          |       V  |
   18+30       0.0912      0.02  Q          |          |          |       V  |
   18+35       0.0913      0.02  Q          |          |          |       V  |
   18+40       0.0914      0.02  Q          |          |          |       V  |
   18+45       0.0915      0.01  Q          |          |          |       V  |
   18+50       0.0916      0.01  Q          |          |          |       V  |
   18+55       0.0917      0.01  Q          |          |          |       V  |
   19+ 0       0.0917      0.01  Q          |          |          |       V  |
   19+ 5       0.0918      0.01  Q          |          |          |       V  |
   19+10       0.0919      0.01  Q          |          |          |        V |
   19+15       0.0920      0.01  Q          |          |          |        V |
   19+20       0.0921      0.01  Q          |          |          |        V |
   19+25       0.0922      0.02  Q          |          |          |        V |
   19+30       0.0923      0.02  Q          |          |          |        V |
   19+35       0.0925      0.02  Q          |          |          |        V |
   19+40       0.0926      0.02  Q          |          |          |        V |
   19+45       0.0927      0.01  Q          |          |          |        V |
   19+50       0.0928      0.01  Q          |          |          |        V |
   19+55       0.0928      0.01  Q          |          |          |        V |
   20+ 0       0.0929      0.01  Q          |          |          |        V |
   20+ 5       0.0930      0.01  Q          |          |          |        V |
   20+10       0.0931      0.01  Q          |          |          |        V |
   20+15       0.0932      0.01  Q          |          |          |        V |
   20+20       0.0933      0.01  Q          |          |          |        V |
   20+25       0.0933      0.01  Q          |          |          |        V |
   20+30       0.0934      0.01  Q          |          |          |        V |
   20+35       0.0935      0.01  Q          |          |          |        V |
   20+40       0.0936      0.01  Q          |          |          |        V |
   20+45       0.0937      0.01  Q          |          |          |        V |
   20+50       0.0938      0.01  Q          |          |          |        V |
   20+55       0.0939      0.01  Q          |          |          |        V |
   21+ 0       0.0940      0.01  Q          |          |          |        V |
   21+ 5       0.0940      0.01  Q          |          |          |        V |
   21+10       0.0941      0.01  Q          |          |          |        V |
   21+15       0.0942      0.01  Q          |          |          |        V |
   21+20       0.0943      0.01  Q          |          |          |         V|
   21+25       0.0944      0.01  Q          |          |          |         V|
   21+30       0.0944      0.01  Q          |          |          |         V|
   21+35       0.0945      0.01  Q          |          |          |         V|
   21+40       0.0946      0.01  Q          |          |          |         V|
   21+45       0.0947      0.01  Q          |          |          |         V|
   21+50       0.0948      0.01  Q          |          |          |         V|
   21+55       0.0949      0.01  Q          |          |          |         V|
   22+ 0       0.0949      0.01  Q          |          |          |         V|
   22+ 5       0.0950      0.01  Q          |          |          |         V|
   22+10       0.0951      0.01  Q          |          |          |         V|
   22+15       0.0952      0.01  Q          |          |          |         V|
   22+20       0.0953      0.01  Q          |          |          |         V|
   22+25       0.0953      0.01  Q          |          |          |         V|
   22+30       0.0954      0.01  Q          |          |          |         V|
   22+35       0.0955      0.01  Q          |          |          |         V|
   22+40       0.0955      0.01  Q          |          |          |         V|
   22+45       0.0956      0.01  Q          |          |          |         V|
   22+50       0.0957      0.01  Q          |          |          |         V|
   22+55       0.0957      0.01  Q          |          |          |         V|
   23+ 0       0.0958      0.01  Q          |          |          |         V|
   23+ 5       0.0959      0.01  Q          |          |          |         V|
   23+10       0.0959      0.01  Q          |          |          |         V|
   23+15       0.0960      0.01  Q          |          |          |         V|
   23+20       0.0961      0.01  Q          |          |          |         V|
   23+25       0.0961      0.01  Q          |          |          |         V|
   23+30       0.0962      0.01  Q          |          |          |         V|
   23+35       0.0963      0.01  Q          |          |          |         V|
   23+40       0.0963      0.01  Q          |          |          |         V|
   23+45       0.0964      0.01  Q          |          |          |         V|
   23+50       0.0965      0.01  Q          |          |          |         V|
   23+55       0.0965      0.01  Q          |          |          |         V|
   24+ 0       0.0966      0.01  Q          |          |          |         V|
   24+ 5       0.0966      0.01  Q          |          |          |         V|
   24+10       0.0966      0.00  Q          |          |          |         V|
   24+15       0.0967      0.00  Q          |          |          |         V|
   24+20       0.0967      0.00  Q          |          |          |         V|
   24+25       0.0967      0.00  Q          |          |          |         V|
   24+30       0.0967      0.00  Q          |          |          |         V|
   24+35       0.0967      0.00  Q          |          |          |          V
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U n i t H y d r o g r a p h A n a l y s i s

Study date 04/10/20 File: pro2yr242.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978
Program License Serial Number 5006

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

Drainage Area = 7.70(Ac.) = 0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 7.70(Ac.) = 0.012 Sq. Mi.
Length along longest watercourse = 1268.00(Ft.)
Length along longest watercourse measured to centroid = 634.00(Ft.)
Length along longest watercourse = 0.240 Mi.
Length along longest watercourse measured to centroid = 0.120 Mi.
Difference in elevation = 14.30(Ft.)
Slope along watercourse = 59.5457 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time = 0.043 Hr.
Lag time = 2.58 Min.
25% of lag time = 0.65 Min.
40% of lag time = 1.03 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)
2 YEAR Area rainfall data:
Area(Ac.)[1] Rainfall(In)[2] Weighting[1*2]
7.70 1.60 12.32
100 YEAR Area rainfall data:
Area(Ac.)[1] Rainfall(In)[2] Weighting[1*2]
7.70 4.00 30.80
STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 1.600(In)
Area Averaged 100-Year Rainfall = 4.000(In)
Point rain (area averaged) = 1.600(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 1.600(In)
Sub-Area Data:
Area(Ac.) Runoff Index Impervious %
7.700 56.00 0.650
Total Area Entered = 7.70(Ac.)
RI RI Infil. Rate Impervious Adj. Infil. Rate Area% F
AMC2 AMC-1 (In/Hr) (Dec.%) (In/Hr) (Dec.) (In/Hr)
56.0 36.0 0.706 0.650 0.293 1.000 0.293
Sum (F) = 0.293
Area averaged mean soil loss (F) (In/Hr) = 0.293
Minimum soil loss rate ((In/Hr)) = 0.146
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.380

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

Unit Hydrograph Data

Unit time period (hrs)	Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	193.625	42.278	3.281
2	0.167	387.249	43.815	3.400
3	0.250	580.874	9.059	0.703
4	0.333	774.498	3.572	0.277
5	0.417	968.123	1.276	0.099
		Sum = 100.000	Sum=	7.760

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

Unit Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.07	0.013	(0.519)	0.005	0.008
2	0.17	0.07	0.013	(0.517)	0.005	0.008
3	0.25	0.07	0.013	(0.515)	0.005	0.008
4	0.33	0.10	0.019	(0.513)	0.007	0.012
5	0.42	0.10	0.019	(0.511)	0.007	0.012
6	0.50	0.10	0.019	(0.509)	0.007	0.012
7	0.58	0.10	0.019	(0.507)	0.007	0.012
8	0.67	0.10	0.019	(0.505)	0.007	0.012

9	0.75	0.10	0.019	(0.503)	0.007	0.012
10	0.83	0.13	0.026	(0.501)	0.010	0.016
11	0.92	0.13	0.026	(0.499)	0.010	0.016
12	1.00	0.13	0.026	(0.498)	0.010	0.016
13	1.08	0.10	0.019	(0.496)	0.007	0.012
14	1.17	0.10	0.019	(0.494)	0.007	0.012
15	1.25	0.10	0.019	(0.492)	0.007	0.012
16	1.33	0.10	0.019	(0.490)	0.007	0.012
17	1.42	0.10	0.019	(0.488)	0.007	0.012
18	1.50	0.10	0.019	(0.486)	0.007	0.012
19	1.58	0.10	0.019	(0.484)	0.007	0.012
20	1.67	0.10	0.019	(0.482)	0.007	0.012
21	1.75	0.10	0.019	(0.480)	0.007	0.012
22	1.83	0.13	0.026	(0.478)	0.010	0.016
23	1.92	0.13	0.026	(0.476)	0.010	0.016
24	2.00	0.13	0.026	(0.474)	0.010	0.016
25	2.08	0.13	0.026	(0.472)	0.010	0.016
26	2.17	0.13	0.026	(0.470)	0.010	0.016
27	2.25	0.13	0.026	(0.468)	0.010	0.016
28	2.33	0.13	0.026	(0.467)	0.010	0.016
29	2.42	0.13	0.026	(0.465)	0.010	0.016
30	2.50	0.13	0.026	(0.463)	0.010	0.016
31	2.58	0.17	0.032	(0.461)	0.012	0.020
32	2.67	0.17	0.032	(0.459)	0.012	0.020
33	2.75	0.17	0.032	(0.457)	0.012	0.020
34	2.83	0.17	0.032	(0.455)	0.012	0.020
35	2.92	0.17	0.032	(0.453)	0.012	0.020
36	3.00	0.17	0.032	(0.451)	0.012	0.020
37	3.08	0.17	0.032	(0.450)	0.012	0.020
38	3.17	0.17	0.032	(0.448)	0.012	0.020
39	3.25	0.17	0.032	(0.446)	0.012	0.020
40	3.33	0.17	0.032	(0.444)	0.012	0.020
41	3.42	0.17	0.032	(0.442)	0.012	0.020
42	3.50	0.17	0.032	(0.440)	0.012	0.020
43	3.58	0.17	0.032	(0.438)	0.012	0.020
44	3.67	0.17	0.032	(0.437)	0.012	0.020
45	3.75	0.17	0.032	(0.435)	0.012	0.020
46	3.83	0.20	0.038	(0.433)	0.015	0.024
47	3.92	0.20	0.038	(0.431)	0.015	0.024
48	4.00	0.20	0.038	(0.429)	0.015	0.024
49	4.08	0.20	0.038	(0.427)	0.015	0.024
50	4.17	0.20	0.038	(0.426)	0.015	0.024
51	4.25	0.20	0.038	(0.424)	0.015	0.024
52	4.33	0.23	0.045	(0.422)	0.017	0.028
53	4.42	0.23	0.045	(0.420)	0.017	0.028
54	4.50	0.23	0.045	(0.418)	0.017	0.028
55	4.58	0.23	0.045	(0.417)	0.017	0.028
56	4.67	0.23	0.045	(0.415)	0.017	0.028
57	4.75	0.23	0.045	(0.413)	0.017	0.028
58	4.83	0.27	0.051	(0.411)	0.019	0.032
59	4.92	0.27	0.051	(0.409)	0.019	0.032
60	5.00	0.27	0.051	(0.408)	0.019	0.032
61	5.08	0.20	0.038	(0.406)	0.015	0.024
62	5.17	0.20	0.038	(0.404)	0.015	0.024
63	5.25	0.20	0.038	(0.402)	0.015	0.024
64	5.33	0.23	0.045	(0.401)	0.017	0.028
65	5.42	0.23	0.045	(0.399)	0.017	0.028
66	5.50	0.23	0.045	(0.397)	0.017	0.028
67	5.58	0.27	0.051	(0.395)	0.019	0.032
68	5.67	0.27	0.051	(0.394)	0.019	0.032
69	5.75	0.27	0.051	(0.392)	0.019	0.032
70	5.83	0.27	0.051	(0.390)	0.019	0.032
71	5.92	0.27	0.051	(0.388)	0.019	0.032
72	6.00	0.27	0.051	(0.387)	0.019	0.032
73	6.08	0.30	0.058	(0.385)	0.022	0.036
74	6.17	0.30	0.058	(0.383)	0.022	0.036
75	6.25	0.30	0.058	(0.382)	0.022	0.036
76	6.33	0.30	0.058	(0.380)	0.022	0.036
77	6.42	0.30	0.058	(0.378)	0.022	0.036
78	6.50	0.30	0.058	(0.377)	0.022	0.036
79	6.58	0.33	0.064	(0.375)	0.024	0.040
80	6.67	0.33	0.064	(0.373)	0.024	0.040
81	6.75	0.33	0.064	(0.371)	0.024	0.040
82	6.83	0.33	0.064	(0.370)	0.024	0.040
83	6.92	0.33	0.064	(0.368)	0.024	0.040
84	7.00	0.33	0.064	(0.366)	0.024	0.040
85	7.08	0.33	0.064	(0.365)	0.024	0.040
86	7.17	0.33	0.064	(0.363)	0.024	0.040
87	7.25	0.33	0.064	(0.361)	0.024	0.040
88	7.33	0.37	0.070	(0.360)	0.027	0.044
89	7.42	0.37	0.070	(0.358)	0.027	0.044
90	7.50	0.37	0.070	(0.356)	0.027	0.044
91	7.58	0.40	0.077	(0.355)	0.029	0.048
92	7.67	0.40	0.077	(0.353)	0.029	0.048
93	7.75	0.40	0.077	(0.352)	0.029	0.048
94	7.83	0.43	0.083	(0.350)	0.032	0.052

95	7.92	0.43	0.083	(0.348)	0.032	0.052
96	8.00	0.43	0.083	(0.347)	0.032	0.052
97	8.08	0.50	0.096	(0.345)	0.036	0.060
98	8.17	0.50	0.096	(0.344)	0.036	0.060
99	8.25	0.50	0.096	(0.342)	0.036	0.060
100	8.33	0.50	0.096	(0.340)	0.036	0.060
101	8.42	0.50	0.096	(0.339)	0.036	0.060
102	8.50	0.50	0.096	(0.337)	0.036	0.060
103	8.58	0.53	0.102	(0.336)	0.039	0.063
104	8.67	0.53	0.102	(0.334)	0.039	0.063
105	8.75	0.53	0.102	(0.332)	0.039	0.063
106	8.83	0.57	0.109	(0.331)	0.041	0.067
107	8.92	0.57	0.109	(0.329)	0.041	0.067
108	9.00	0.57	0.109	(0.328)	0.041	0.067
109	9.08	0.63	0.122	(0.326)	0.046	0.075
110	9.17	0.63	0.122	(0.325)	0.046	0.075
111	9.25	0.63	0.122	(0.323)	0.046	0.075
112	9.33	0.67	0.128	(0.322)	0.049	0.079
113	9.42	0.67	0.128	(0.320)	0.049	0.079
114	9.50	0.67	0.128	(0.318)	0.049	0.079
115	9.58	0.70	0.134	(0.317)	0.051	0.083
116	9.67	0.70	0.134	(0.315)	0.051	0.083
117	9.75	0.70	0.134	(0.314)	0.051	0.083
118	9.83	0.73	0.141	(0.312)	0.054	0.087
119	9.92	0.73	0.141	(0.311)	0.054	0.087
120	10.00	0.73	0.141	(0.309)	0.054	0.087
121	10.08	0.50	0.096	(0.308)	0.036	0.060
122	10.17	0.50	0.096	(0.306)	0.036	0.060
123	10.25	0.50	0.096	(0.305)	0.036	0.060
124	10.33	0.50	0.096	(0.303)	0.036	0.060
125	10.42	0.50	0.096	(0.302)	0.036	0.060
126	10.50	0.50	0.096	(0.300)	0.036	0.060
127	10.58	0.67	0.128	(0.299)	0.049	0.079
128	10.67	0.67	0.128	(0.298)	0.049	0.079
129	10.75	0.67	0.128	(0.296)	0.049	0.079
130	10.83	0.67	0.128	(0.295)	0.049	0.079
131	10.92	0.67	0.128	(0.293)	0.049	0.079
132	11.00	0.67	0.128	(0.292)	0.049	0.079
133	11.08	0.63	0.122	(0.290)	0.046	0.075
134	11.17	0.63	0.122	(0.289)	0.046	0.075
135	11.25	0.63	0.122	(0.287)	0.046	0.075
136	11.33	0.63	0.122	(0.286)	0.046	0.075
137	11.42	0.63	0.122	(0.285)	0.046	0.075
138	11.50	0.63	0.122	(0.283)	0.046	0.075
139	11.58	0.57	0.109	(0.282)	0.041	0.067
140	11.67	0.57	0.109	(0.280)	0.041	0.067
141	11.75	0.57	0.109	(0.279)	0.041	0.067
142	11.83	0.60	0.115	(0.278)	0.044	0.071
143	11.92	0.60	0.115	(0.276)	0.044	0.071
144	12.00	0.60	0.115	(0.275)	0.044	0.071
145	12.08	0.83	0.160	(0.273)	0.061	0.099
146	12.17	0.83	0.160	(0.272)	0.061	0.099
147	12.25	0.83	0.160	(0.271)	0.061	0.099
148	12.33	0.87	0.166	(0.269)	0.063	0.103
149	12.42	0.87	0.166	(0.268)	0.063	0.103
150	12.50	0.87	0.166	(0.267)	0.063	0.103
151	12.58	0.93	0.179	(0.265)	0.068	0.111
152	12.67	0.93	0.179	(0.264)	0.068	0.111
153	12.75	0.93	0.179	(0.263)	0.068	0.111
154	12.83	0.97	0.186	(0.261)	0.071	0.115
155	12.92	0.97	0.186	(0.260)	0.071	0.115
156	13.00	0.97	0.186	(0.259)	0.071	0.115
157	13.08	1.13	0.218	(0.257)	0.083	0.135
158	13.17	1.13	0.218	(0.256)	0.083	0.135
159	13.25	1.13	0.218	(0.255)	0.083	0.135
160	13.33	1.13	0.218	(0.254)	0.083	0.135
161	13.42	1.13	0.218	(0.252)	0.083	0.135
162	13.50	1.13	0.218	(0.251)	0.083	0.135
163	13.58	0.77	0.147	(0.250)	0.056	0.091
164	13.67	0.77	0.147	(0.248)	0.056	0.091
165	13.75	0.77	0.147	(0.247)	0.056	0.091
166	13.83	0.77	0.147	(0.246)	0.056	0.091
167	13.92	0.77	0.147	(0.245)	0.056	0.091
168	14.00	0.77	0.147	(0.243)	0.056	0.091
169	14.08	0.90	0.173	(0.242)	0.066	0.107
170	14.17	0.90	0.173	(0.241)	0.066	0.107
171	14.25	0.90	0.173	(0.240)	0.066	0.107
172	14.33	0.87	0.166	(0.238)	0.063	0.103
173	14.42	0.87	0.166	(0.237)	0.063	0.103
174	14.50	0.87	0.166	(0.236)	0.063	0.103
175	14.58	0.87	0.166	(0.235)	0.063	0.103
176	14.67	0.87	0.166	(0.234)	0.063	0.103
177	14.75	0.87	0.166	(0.232)	0.063	0.103
178	14.83	0.83	0.160	(0.231)	0.061	0.099
179	14.92	0.83	0.160	(0.230)	0.061	0.099
180	15.00	0.83	0.160	(0.229)	0.061	0.099

181	15.08	0.80	0.154	(0.228)	0.058	0.095
182	15.17	0.80	0.154	(0.226)	0.058	0.095
183	15.25	0.80	0.154	(0.225)	0.058	0.095
184	15.33	0.77	0.147	(0.224)	0.056	0.091
185	15.42	0.77	0.147	(0.223)	0.056	0.091
186	15.50	0.77	0.147	(0.222)	0.056	0.091
187	15.58	0.63	0.122	(0.221)	0.046	0.075
188	15.67	0.63	0.122	(0.220)	0.046	0.075
189	15.75	0.63	0.122	(0.218)	0.046	0.075
190	15.83	0.63	0.122	(0.217)	0.046	0.075
191	15.92	0.63	0.122	(0.216)	0.046	0.075
192	16.00	0.63	0.122	(0.215)	0.046	0.075
193	16.08	0.13	0.026	(0.214)	0.010	0.016
194	16.17	0.13	0.026	(0.213)	0.010	0.016
195	16.25	0.13	0.026	(0.212)	0.010	0.016
196	16.33	0.13	0.026	(0.211)	0.010	0.016
197	16.42	0.13	0.026	(0.210)	0.010	0.016
198	16.50	0.13	0.026	(0.209)	0.010	0.016
199	16.58	0.10	0.019	(0.208)	0.007	0.012
200	16.67	0.10	0.019	(0.207)	0.007	0.012
201	16.75	0.10	0.019	(0.205)	0.007	0.012
202	16.83	0.10	0.019	(0.204)	0.007	0.012
203	16.92	0.10	0.019	(0.203)	0.007	0.012
204	17.00	0.10	0.019	(0.202)	0.007	0.012
205	17.08	0.17	0.032	(0.201)	0.012	0.020
206	17.17	0.17	0.032	(0.200)	0.012	0.020
207	17.25	0.17	0.032	(0.199)	0.012	0.020
208	17.33	0.17	0.032	(0.198)	0.012	0.020
209	17.42	0.17	0.032	(0.197)	0.012	0.020
210	17.50	0.17	0.032	(0.196)	0.012	0.020
211	17.58	0.17	0.032	(0.195)	0.012	0.020
212	17.67	0.17	0.032	(0.194)	0.012	0.020
213	17.75	0.17	0.032	(0.193)	0.012	0.020
214	17.83	0.13	0.026	(0.192)	0.010	0.016
215	17.92	0.13	0.026	(0.192)	0.010	0.016
216	18.00	0.13	0.026	(0.191)	0.010	0.016
217	18.08	0.13	0.026	(0.190)	0.010	0.016
218	18.17	0.13	0.026	(0.189)	0.010	0.016
219	18.25	0.13	0.026	(0.188)	0.010	0.016
220	18.33	0.13	0.026	(0.187)	0.010	0.016
221	18.42	0.13	0.026	(0.186)	0.010	0.016
222	18.50	0.13	0.026	(0.185)	0.010	0.016
223	18.58	0.10	0.019	(0.184)	0.007	0.012
224	18.67	0.10	0.019	(0.183)	0.007	0.012
225	18.75	0.10	0.019	(0.182)	0.007	0.012
226	18.83	0.07	0.013	(0.182)	0.005	0.008
227	18.92	0.07	0.013	(0.181)	0.005	0.008
228	19.00	0.07	0.013	(0.180)	0.005	0.008
229	19.08	0.10	0.019	(0.179)	0.007	0.012
230	19.17	0.10	0.019	(0.178)	0.007	0.012
231	19.25	0.10	0.019	(0.177)	0.007	0.012
232	19.33	0.13	0.026	(0.176)	0.010	0.016
233	19.42	0.13	0.026	(0.176)	0.010	0.016
234	19.50	0.13	0.026	(0.175)	0.010	0.016
235	19.58	0.10	0.019	(0.174)	0.007	0.012
236	19.67	0.10	0.019	(0.173)	0.007	0.012
237	19.75	0.10	0.019	(0.172)	0.007	0.012
238	19.83	0.07	0.013	(0.172)	0.005	0.008
239	19.92	0.07	0.013	(0.171)	0.005	0.008
240	20.00	0.07	0.013	(0.170)	0.005	0.008
241	20.08	0.10	0.019	(0.169)	0.007	0.012
242	20.17	0.10	0.019	(0.169)	0.007	0.012
243	20.25	0.10	0.019	(0.168)	0.007	0.012
244	20.33	0.10	0.019	(0.167)	0.007	0.012
245	20.42	0.10	0.019	(0.166)	0.007	0.012
246	20.50	0.10	0.019	(0.166)	0.007	0.012
247	20.58	0.10	0.019	(0.165)	0.007	0.012
248	20.67	0.10	0.019	(0.164)	0.007	0.012
249	20.75	0.10	0.019	(0.164)	0.007	0.012
250	20.83	0.07	0.013	(0.163)	0.005	0.008
251	20.92	0.07	0.013	(0.162)	0.005	0.008
252	21.00	0.07	0.013	(0.162)	0.005	0.008
253	21.08	0.10	0.019	(0.161)	0.007	0.012
254	21.17	0.10	0.019	(0.160)	0.007	0.012
255	21.25	0.10	0.019	(0.160)	0.007	0.012
256	21.33	0.07	0.013	(0.159)	0.005	0.008
257	21.42	0.07	0.013	(0.159)	0.005	0.008
258	21.50	0.07	0.013	(0.158)	0.005	0.008
259	21.58	0.10	0.019	(0.157)	0.007	0.012
260	21.67	0.10	0.019	(0.157)	0.007	0.012
261	21.75	0.10	0.019	(0.156)	0.007	0.012
262	21.83	0.07	0.013	(0.156)	0.005	0.008
263	21.92	0.07	0.013	(0.155)	0.005	0.008
264	22.00	0.07	0.013	(0.155)	0.005	0.008
265	22.08	0.10	0.019	(0.154)	0.007	0.012
266	22.17	0.10	0.019	(0.154)	0.007	0.012

267	22.25	0.10	0.019	(	0.153)	0.007	0.012
268	22.33	0.07	0.013	(	0.153)	0.005	0.008
269	22.42	0.07	0.013	(	0.152)	0.005	0.008
270	22.50	0.07	0.013	(	0.152)	0.005	0.008
271	22.58	0.07	0.013	(	0.151)	0.005	0.008
272	22.67	0.07	0.013	(	0.151)	0.005	0.008
273	22.75	0.07	0.013	(	0.151)	0.005	0.008
274	22.83	0.07	0.013	(	0.150)	0.005	0.008
275	22.92	0.07	0.013	(	0.150)	0.005	0.008
276	23.00	0.07	0.013	(	0.149)	0.005	0.008
277	23.08	0.07	0.013	(	0.149)	0.005	0.008
278	23.17	0.07	0.013	(	0.149)	0.005	0.008
279	23.25	0.07	0.013	(	0.148)	0.005	0.008
280	23.33	0.07	0.013	(	0.148)	0.005	0.008
281	23.42	0.07	0.013	(	0.148)	0.005	0.008
282	23.50	0.07	0.013	(	0.148)	0.005	0.008
283	23.58	0.07	0.013	(	0.147)	0.005	0.008
284	23.67	0.07	0.013	(	0.147)	0.005	0.008
285	23.75	0.07	0.013	(	0.147)	0.005	0.008
286	23.83	0.07	0.013	(	0.147)	0.005	0.008
287	23.92	0.07	0.013	(	0.147)	0.005	0.008
288	24.00	0.07	0.013	(	0.147)	0.005	0.008

(Loss Rate Not Used)

Sum = 100.0 Sum = 11.9

Flood volume = Effective rainfall 0.99(In)
times area 7.7(Ac.)/[(In)/(Ft.)] = 0.6(Ac.Ft)
Total soil loss = 0.61(In)
Total soil loss = 0.390(Ac.Ft)
Total rainfall = 1.60(In)
Flood volume = 27727.0 Cubic Feet
Total soil loss = 16994.0 Cubic Feet

Peak flow rate of this hydrograph = 1.047(CFS)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0002	0.03	Q				
0+10	0.0005	0.05	Q				
0+15	0.0009	0.06	Q				
0+20	0.0015	0.07	Q				
0+25	0.0021	0.09	Q				
0+30	0.0027	0.09	Q				
0+35	0.0033	0.09	Q				
0+40	0.0040	0.09	Q				
0+45	0.0046	0.09	Q				
0+50	0.0053	0.11	Q				
0+55	0.0061	0.12	Q				
1+ 0	0.0070	0.12	Q				
1+ 5	0.0077	0.11	Q				
1+10	0.0084	0.10	Q				
1+15	0.0091	0.09	Q				
1+20	0.0097	0.09	Q				
1+25	0.0103	0.09	Q				
1+30	0.0110	0.09	Q				
1+35	0.0116	0.09	Q				
1+40	0.0122	0.09	Q				
1+45	0.0129	0.09	Q				
1+50	0.0136	0.11	Q				
1+55	0.0144	0.12	Q				
2+ 0	0.0153	0.12	Q				
2+ 5	0.0161	0.12	QV				
2+10	0.0170	0.12	QV				
2+15	0.0178	0.12	QV				
2+20	0.0186	0.12	QV				
2+25	0.0195	0.12	QV				
2+30	0.0203	0.12	QV				
2+35	0.0213	0.14	QV				
2+40	0.0223	0.15	QV				
2+45	0.0234	0.15	QV				
2+50	0.0244	0.15	QV				
2+55	0.0255	0.15	QV				
3+ 0	0.0265	0.15	QV				
3+ 5	0.0276	0.15	QV				
3+10	0.0287	0.15	QV				
3+15	0.0297	0.15	QV				
3+20	0.0308	0.15	QV				
3+25	0.0319	0.15	Q V				
3+30	0.0329	0.15	Q V				
3+35	0.0340	0.15	Q V				
3+40	0.0350	0.15	Q V				

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 3+45      0.0361      0.15  Q V       |         |         |         |
 3+50      0.0372      0.17  Q V       |         |         |         |
 3+55      0.0385      0.18  Q V       |         |         |         |
 4+ 0      0.0398      0.18  Q V       |         |         |         |
 4+ 5      0.0410      0.18  Q V       |         |         |         |
 4+10      0.0423      0.18  Q V       |         |         |         |
 4+15      0.0436      0.18  Q V       |         |         |         |
 4+20      0.0449      0.20  Q V       |         |         |         |
 4+25      0.0464      0.21  Q V       |         |         |         |
 4+30      0.0479      0.21  Q  V      |         |         |         |
 4+35      0.0493      0.22  Q  V      |         |         |         |
 4+40      0.0508      0.22  Q  V      |         |         |         |
 4+45      0.0523      0.22  Q  V      |         |         |         |
 4+50      0.0539      0.23  Q  V      |         |         |         |
 4+55      0.0556      0.24  Q  V      |         |         |         |
 5+ 0      0.0572      0.24  Q  V      |         |         |         |
 5+ 5      0.0588      0.22  Q  V      |         |         |         |
 5+10      0.0601      0.19  Q  V      |         |         |         |
 5+15      0.0614      0.19  Q  V      |         |         |         |
 5+20      0.0628      0.20  Q  V      |         |         |         |
 5+25      0.0642      0.21  Q   V     |         |         |         |
 5+30      0.0657      0.21  Q   V     |         |         |         |
 5+35      0.0673      0.23  Q   V     |         |         |         |
 5+40      0.0689      0.24  Q   V     |         |         |         |
 5+45      0.0706      0.24  Q   V     |         |         |         |
 5+50      0.0723      0.25  Q   V     |         |         |         |
 5+55      0.0740      0.25  Q   V     |         |         |         |
 6+ 0      0.0757      0.25  Q   V     |         |         |         |
 6+ 5      0.0775      0.26  |Q  V     |         |         |         |
 6+10      0.0794      0.27  |Q  V     |         |         |         |
 6+15      0.0813      0.28  |Q   V    |         |         |         |
 6+20      0.0832      0.28  |Q   V    |         |         |         |
 6+25      0.0851      0.28  |Q   V    |         |         |         |
 6+30      0.0870      0.28  |Q   V    |         |         |         |
 6+35      0.0890      0.29  |Q   V    |         |         |         |
 6+40      0.0911      0.30  |Q   V    |         |         |         |
 6+45      0.0932      0.31  |Q   V    |         |         |         |
 6+50      0.0953      0.31  |Q   V    |         |         |         |
 6+55      0.0974      0.31  |Q    V   |         |         |         |
 7+ 0      0.0996      0.31  |Q    V   |         |         |         |
 7+ 5      0.1017      0.31  |Q    V   |         |         |         |
 7+10      0.1038      0.31  |Q    V   |         |         |         |
 7+15      0.1059      0.31  |Q    V   |         |         |         |
 7+20      0.1081      0.32  |Q    V   |         |         |         |
 7+25      0.1104      0.33  |Q    V   |         |         |         |
 7+30      0.1128      0.34  |Q     V  |         |         |         |
 7+35      0.1152      0.35  |Q     V  |         |         |         |
 7+40      0.1177      0.37  |Q     V  |         |         |         |
 7+45      0.1202      0.37  |Q     V  |         |         |         |
 7+50      0.1229      0.38  |Q     V  |         |         |         |
 7+55      0.1256      0.40  |Q     V  |         |         |         |
 8+ 0      0.1283      0.40  |Q      V |         |         |         |
 8+ 5      0.1313      0.43  |Q      V |         |         |         |
 8+10      0.1344      0.45  |Q      V |         |         |         |
 8+15      0.1376      0.46  |Q      V |         |         |         |
 8+20      0.1407      0.46  |Q      V |         |         |         |
 8+25      0.1439      0.46  |Q       V|         |         |         |
 8+30      0.1471      0.46  |Q       V|         |         |         |
 8+35      0.1504      0.48  |Q       V|         |         |         |
 8+40      0.1537      0.49  |Q       V|         |         |         |
 8+45      0.1571      0.49  |Q       V|         |         |         |
 8+50      0.1606      0.51  | Q       V         |         |         |
 8+55      0.1642      0.52  | Q       V         |         |         |
 9+ 0      0.1678      0.52  | Q       V         |         |         |
 9+ 5      0.1716      0.55  | Q       V         |         |         |
 9+10      0.1755      0.58  | Q       |V        |         |         |
 9+15      0.1796      0.58  | Q       |V        |         |         |
 9+20      0.1837      0.60  | Q       |V        |         |         |
 9+25      0.1879      0.61  | Q       |V        |         |         |
 9+30      0.1921      0.61  | Q       | V       |         |         |
 9+35      0.1964      0.63  | Q       | V       |         |         |
 9+40      0.2009      0.64  | Q       | V       |         |         |
 9+45      0.2053      0.65  | Q       | V       |         |         |
 9+50      0.2099      0.66  | Q       |  V      |         |         |
 9+55      0.2145      0.67  | Q       |  V      |         |         |
10+ 0      0.2192      0.68  | Q       |  V      |         |         |
10+ 5      0.2232      0.59  | Q       |   V     |         |         |
10+10      0.2266      0.49  |Q        |   V     |         |         |
10+15      0.2298      0.47  |Q        |   V     |         |         |
10+20      0.2330      0.46  |Q        |   V     |         |         |
10+25      0.2362      0.46  |Q        |   V     |         |         |
10+30      0.2394      0.46  |Q        |    V    |         |         |
10+35      0.2430      0.53  | Q       |    V    |         |         |
10+40      0.2471      0.59  | Q       |    V    |         |         |
10+45      0.2513      0.61  | Q       |    V    |         |         |
10+50      0.2556      0.61  | Q       |     V   |         |         |
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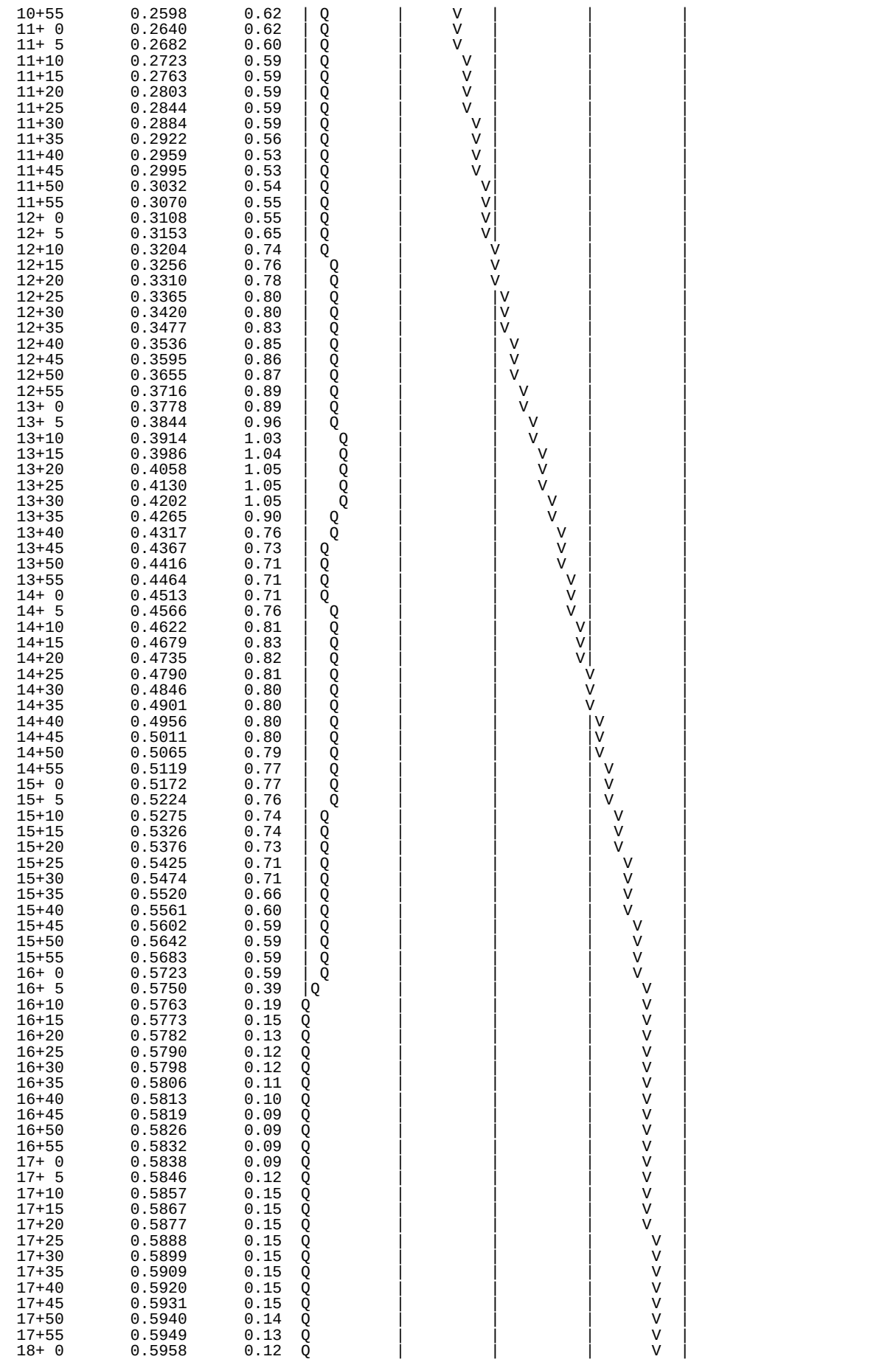

10+55	0.2598	0.62	Q	V			
11+ 0	0.2640	0.62	Q	V			
11+ 5	0.2682	0.60	Q	V			
11+10	0.2723	0.59	Q	V			
11+15	0.2763	0.59	Q	V			
11+20	0.2803	0.59	Q	V			
11+25	0.2844	0.59	Q	V			
11+30	0.2884	0.59	Q	V			
11+35	0.2922	0.56	Q	V			
11+40	0.2959	0.53	Q	V			
11+45	0.2995	0.53	Q	V			
11+50	0.3032	0.54	Q	V			
11+55	0.3070	0.55	Q	V			
12+ 0	0.3108	0.55	Q	V			
12+ 5	0.3153	0.65	Q	V			
12+10	0.3204	0.74	Q	V			
12+15	0.3256	0.76	Q	V			
12+20	0.3310	0.78	Q	V			
12+25	0.3365	0.80	Q	V			
12+30	0.3420	0.80	Q	V			
12+35	0.3477	0.83	Q	V			
12+40	0.3536	0.85	Q	V			
12+45	0.3595	0.86	Q	V			
12+50	0.3655	0.87	Q	V			
12+55	0.3716	0.89	Q	V			
13+ 0	0.3778	0.89	Q	V			
13+ 5	0.3844	0.96	Q	V			
13+10	0.3914	1.03	Q	V			
13+15	0.3986	1.04	Q	V			
13+20	0.4058	1.05	Q	V			
13+25	0.4130	1.05	Q	V			
13+30	0.4202	1.05	Q	V			
13+35	0.4265	0.90	Q	V			
13+40	0.4317	0.76	Q	V			
13+45	0.4367	0.73	Q	V			
13+50	0.4416	0.71	Q	V			
13+55	0.4464	0.71	Q	V			
14+ 0	0.4513	0.71	Q	V			
14+ 5	0.4566	0.76	Q	V			
14+10	0.4622	0.81	Q	V			
14+15	0.4679	0.83	Q	V			
14+20	0.4735	0.82	Q	V			
14+25	0.4790	0.81	Q	V			
14+30	0.4846	0.80	Q	V			
14+35	0.4901	0.80	Q	V			
14+40	0.4956	0.80	Q	V			
14+45	0.5011	0.80	Q	V			
14+50	0.5065	0.79	Q	V			
14+55	0.5119	0.77	Q	V			
15+ 0	0.5172	0.77	Q	V			
15+ 5	0.5224	0.76	Q	V			
15+10	0.5275	0.74	Q	V			
15+15	0.5326	0.74	Q	V			
15+20	0.5376	0.73	Q	V			
15+25	0.5425	0.71	Q	V			
15+30	0.5474	0.71	Q	V			
15+35	0.5520	0.66	Q	V			
15+40	0.5561	0.60	Q	V			
15+45	0.5602	0.59	Q	V			
15+50	0.5642	0.59	Q	V			
15+55	0.5683	0.59	Q	V			
16+ 0	0.5723	0.59	Q	V			
16+ 5	0.5750	0.39	Q	V			
16+10	0.5763	0.19	Q	V			
16+15	0.5773	0.15	Q	V			
16+20	0.5782	0.13	Q	V			
16+25	0.5790	0.12	Q	V			
16+30	0.5798	0.12	Q	V			
16+35	0.5806	0.11	Q	V			
16+40	0.5813	0.10	Q	V			
16+45	0.5819	0.09	Q	V			
16+50	0.5826	0.09	Q	V			
16+55	0.5832	0.09	Q	V			
17+ 0	0.5838	0.09	Q	V			
17+ 5	0.5846	0.12	Q	V			
17+10	0.5857	0.15	Q	V			
17+15	0.5867	0.15	Q	V			
17+20	0.5877	0.15	Q	V			
17+25	0.5888	0.15	Q	V			
17+30	0.5899	0.15	Q	V			
17+35	0.5909	0.15	Q	V			
17+40	0.5920	0.15	Q	V			
17+45	0.5931	0.15	Q	V			
17+50	0.5940	0.14	Q	V			
17+55	0.5949	0.13	Q	V			
18+ 0	0.5958	0.12	Q	V			

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  18+ 5       0.5966      0.12  Q          |          |          |       V  |
  18+10       0.5975      0.12  Q          |          |          |       V  |
  18+15       0.5983      0.12  Q          |          |          |       V  |
  18+20       0.5992      0.12  Q          |          |          |       V  |
  18+25       0.6000      0.12  Q          |          |          |       V  |
  18+30       0.6009      0.12  Q          |          |          |       V  |
  18+35       0.6016      0.11  Q          |          |          |       V  |
  18+40       0.6023      0.10  Q          |          |          |       V  |
  18+45       0.6029      0.09  Q          |          |          |       V  |
  18+50       0.6035      0.08  Q          |          |          |       V  |
  18+55       0.6039      0.07  Q          |          |          |       V  |
  19+ 0       0.6044      0.06  Q          |          |          |       V  |
  19+ 5       0.6049      0.08  Q          |          |          |        V |
  19+10       0.6055      0.09  Q          |          |          |        V |
  19+15       0.6061      0.09  Q          |          |          |        V |
  19+20       0.6068      0.11  Q          |          |          |        V |
  19+25       0.6077      0.12  Q          |          |          |        V |
  19+30       0.6085      0.12  Q          |          |          |        V |
  19+35       0.6093      0.11  Q          |          |          |        V |
  19+40       0.6099      0.10  Q          |          |          |        V |
  19+45       0.6106      0.09  Q          |          |          |        V |
  19+50       0.6111      0.08  Q          |          |          |        V |
  19+55       0.6116      0.07  Q          |          |          |        V |
  20+ 0       0.6120      0.06  Q          |          |          |        V |
  20+ 5       0.6125      0.08  Q          |          |          |        V |
  20+10       0.6131      0.09  Q          |          |          |        V |
  20+15       0.6138      0.09  Q          |          |          |        V |
  20+20       0.6144      0.09  Q          |          |          |        V |
  20+25       0.6150      0.09  Q          |          |          |        V |
  20+30       0.6157      0.09  Q          |          |          |        V |
  20+35       0.6163      0.09  Q          |          |          |        V |
  20+40       0.6169      0.09  Q          |          |          |        V |
  20+45       0.6176      0.09  Q          |          |          |        V |
  20+50       0.6181      0.08  Q          |          |          |        V |
  20+55       0.6186      0.07  Q          |          |          |        V |
  21+ 0       0.6190      0.06  Q          |          |          |        V |
  21+ 5       0.6195      0.08  Q          |          |          |        V |
  21+10       0.6201      0.09  Q          |          |          |        V |
  21+15       0.6208      0.09  Q          |          |          |         V|
  21+20       0.6213      0.08  Q          |          |          |         V|
  21+25       0.6218      0.07  Q          |          |          |         V|
  21+30       0.6222      0.06  Q          |          |          |         V|
  21+35       0.6227      0.08  Q          |          |          |         V|
  21+40       0.6233      0.09  Q          |          |          |         V|
  21+45       0.6239      0.09  Q          |          |          |         V|
  21+50       0.6245      0.08  Q          |          |          |         V|
  21+55       0.6249      0.07  Q          |          |          |         V|
  22+ 0       0.6254      0.06  Q          |          |          |         V|
  22+ 5       0.6259      0.08  Q          |          |          |         V|
  22+10       0.6265      0.09  Q          |          |          |         V|
  22+15       0.6271      0.09  Q          |          |          |         V|
  22+20       0.6277      0.08  Q          |          |          |         V|
  22+25       0.6281      0.07  Q          |          |          |         V|
  22+30       0.6286      0.06  Q          |          |          |         V|
  22+35       0.6290      0.06  Q          |          |          |         V|
  22+40       0.6294      0.06  Q          |          |          |         V|
  22+45       0.6298      0.06  Q          |          |          |         V|
  22+50       0.6303      0.06  Q          |          |          |         V|
  22+55       0.6307      0.06  Q          |          |          |         V|
  23+ 0       0.6311      0.06  Q          |          |          |         V|
  23+ 5       0.6315      0.06  Q          |          |          |         V|
  23+10       0.6320      0.06  Q          |          |          |         V|
  23+15       0.6324      0.06  Q          |          |          |         V|
  23+20       0.6328      0.06  Q          |          |          |         V|
  23+25       0.6332      0.06  Q          |          |          |         V|
  23+30       0.6336      0.06  Q          |          |          |         V|
  23+35       0.6341      0.06  Q          |          |          |         V|
  23+40       0.6345      0.06  Q          |          |          |         V|
  23+45       0.6349      0.06  Q          |          |          |         V|
  23+50       0.6353      0.06  Q          |          |          |         V|
  23+55       0.6358      0.06  Q          |          |          |         V|
  24+ 0       0.6362      0.06  Q          |          |          |         V|
  24+ 5       0.6364      0.04  Q          |          |          |         V|
  24+10       0.6365      0.01  Q          |          |          |         V|
  24+15       0.6365      0.00  Q          |          |          |         V|
  24+20       0.6365      0.00  Q          |          |          |          V
-------------------------------------------------------------------------
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Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

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

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

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

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

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

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

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

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

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

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

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

Appendix 9: O&M

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

"Will be provided in Final WQMP"

Appendix 10: Educational Materials

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

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.

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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

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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

Efficient Irrigation SD-12

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

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

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

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

Redeveloping Existing Installations

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

Other Resources

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

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

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

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

Storm Drain Signage SD-13

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

Designing New Installations

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

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

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

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

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Placement

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

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

Supplemental Information

Examples

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

Other Resources

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

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

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

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

Bioretention TC-32

Design Considerations

- Soil for Infiltration
- Tributary Area
- Slope
- Aesthetics
- Environmental Side-effects

Description

The bioretention best management practice (BMP) functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. These facilities normally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. The runoff's velocity is reduced by passing over or through buffer strip and subsequently distributed evenly along a ponding area. Exfiltration of the stored water in the bioretention area planting soil into the underlying soils occurs over a period of days.

Targeted Constituents

☑	Sediment	■
☑	Nutrients	▲
☑	Trash	■
☑	Metals	■
☑	Bacteria	■
☑	Oil and Grease	■
☑	Organics	■

Legend *(Removal Effectiveness)*

- ● Low
- ▲ Medium
- ■ High

California Experience

None documented. Bioretention has been used as a stormwater BMP since 1992. In addition to Prince George's County, MD and Alexandria, VA, bioretention has been used successfully at urban and suburban areas in Montgomery County, MD; Baltimore County, MD; Chesterfield County, VA; Prince William County, VA; Smith Mountain Lake State Park, VA; and Cary, NC.

Advantages

- Bioretention provides stormwater treatment that enhances the quality of downstream water bodies by temporarily storing runoff in the BMP and releasing it over a period of four days to the receiving water (EPA, 1999).
- The vegetation provides shade and wind breaks, absorbs noise, and improves an area's landscape.

Limitations

- The bioretention BMP is not recommended for areas with slopes greater than 20% or where mature tree removal would

be required since clogging may result, particularly if the BMP receives runoff with high sediment loads (EPA, 1999).

- Bioretention is not a suitable BMP at locations where the water table is within 6 feet of the ground surface and where the surrounding soil stratum is unstable.
- By design, bioretention BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water.
- In cold climates the soil may freeze, preventing runoff from infiltrating into the planting soil.

Design and Sizing Guidelines

- The bioretention area should be sized to capture the design storm runoff.
- In areas where the native soil permeability is less than 0.5 in/hr an underdrain should be provided.
- Recommended minimum dimensions are 15 feet by 40 feet, although the preferred width is 25 feet. Excavated depth should be 4 feet.
- Area should drain completely within 72 hours.
- Approximately 1 tree or shrub per 50 ft^2 of bioretention area should be included.
- Cover area with about 3 inches of mulch.

Construction/Inspection Considerations

Bioretention area should not be established until contributing watershed is stabilized.

Performance

Bioretention removes stormwater pollutants through physical and biological processes, including adsorption, filtration, plant uptake, microbial activity, decomposition, sedimentation and volatilization (EPA, 1999). Adsorption is the process whereby particulate pollutants attach to soil (e.g., clay) or vegetation surfaces. Adequate contact time between the surface and pollutant must be provided for in the design of the system for this removal process to occur. Thus, the infiltration rate of the soils must not exceed those specified in the design criteria or pollutant removal may decrease. Pollutants removed by adsorption include metals, phosphorus, and hydrocarbons. Filtration occurs as runoff passes through the bioretention area media, such as the sand bed, ground cover, and planting soil.

Common particulates removed from stormwater include particulate organic matter, phosphorus, and suspended solids. Biological processes that occur in wetlands result in pollutant uptake by plants and microorganisms in the soil. Plant growth is sustained by the uptake of nutrients from the soils, with woody plants locking up these nutrients through the seasons. Microbial activity within the soil also contributes to the removal of nitrogen and organic matter. Nitrogen is removed by nitrifying and denitrifying bacteria, while aerobic bacteria are responsible for the decomposition of the organic matter. Microbial processes require oxygen and can result in depleted oxygen levels if the bioretention area is not adequately

aerated. Sedimentation occurs in the swale or ponding area as the velocity slows and solids fall out of suspension.

The removal effectiveness of bioretention has been studied during field and laboratory studies conducted by the University of Maryland (Davis et al, 1998). During these experiments, synthetic stormwater runoff was pumped through several laboratory and field bioretention areas to simulate typical storm events in Prince George's County, MD. Removal rates for heavy metals and nutrients are shown in Table 1.

Table 1 Laboratory and Estimated Bioretention Davis et al. (1998); PGDER (1993)

Pollutant	Removal Rate
Total Phosphorus	70-83%
Metals (Cu, Zn, Pb)	93-98%
TKN	68-80%
Total Suspended Solids	90%
Organics	90%
Bacteria	90%

Results for both the laboratory and field experiments were similar for each of the pollutants analyzed. Doubling or halving the influent pollutant levels had little effect on the effluent pollutants concentrations (Davis et al, 1998).

The microbial activity and plant uptake occurring in the bioretention area will likely result in higher removal rates than those determined for infiltration BMPs.

Siting Criteria

Bioretention BMPs are generally used to treat stormwater from impervious surfaces at commercial, residential, and industrial areas (EPA, 1999). Implementation of bioretention for stormwater management is ideal for median strips, parking lot islands, and swales. Moreover, the runoff in these areas can be designed to either divert directly into the bioretention area or convey into the bioretention area by a curb and gutter collection system.

The best location for bioretention areas is upland from inlets that receive sheet flow from graded areas and at areas that will be excavated (EPA, 1999). In order to maximize treatment effectiveness, the site must be graded in such a way that minimizes erosive conditions as sheet flow is conveyed to the treatment area. Locations where a bioretention area can be readily incorporated into the site plan without further environmental damage are preferred. Furthermore, to effectively minimize sediment loading in the treatment area, bioretention only should be used in stabilized drainage areas.

Additional Design Guidelines

The layout of the bioretention area is determined after site constraints such as location of utilities, underlying soils, existing vegetation, and drainage are considered (EPA, 1999). Sites with loamy sand soils are especially appropriate for bioretention because the excavated soil can be backfilled and used as the planting soil, thus eliminating the cost of importing planting soil.

The use of bioretention may not be feasible given an unstable surrounding soil stratum, soils with clay content greater than 25 percent, a site with slopes greater than 20 percent, and/or a site with mature trees that would be removed during construction of the BMP.

Bioretention can be designed to be off-line or on-line of the existing drainage system (EPA, 1999). The drainage area for a bioretention area should be between 0.1 and 0.4 hectares (0.25 and 1.0 acres). Larger drainage areas may require multiple bioretention areas. Furthermore, the maximum drainage area for a bioretention area is determined by the expected rainfall intensity and runoff rate. Stabilized areas may erode when velocities are greater than 5 feet per second (1.5 meter per second). The designer should determine the potential for erosive conditions at the site.

The size of the bioretention area, which is a function of the drainage area and the runoff generated from the area is sized to capture the water quality volume.

The recommended minimum dimensions of the bioretention area are 15 feet (4.6 meters) wide by 40 feet (12.2 meters) long, where the minimum width allows enough space for a dense, randomly-distributed area of trees and shrubs to become established. Thus replicating a natural forest and creating a microclimate, thereby enabling the bioretention area to tolerate the effects of heat stress, acid rain, runoff pollutants, and insect and disease infestations which landscaped areas in urban settings typically are unable to tolerate. The preferred width is 25 feet (7.6 meters), with a length of twice the width. Essentially, any facilities wider than 20 feet (6.1 meters) should be twice as long as they are wide, which promotes the distribution of flow and decreases the chances of concentrated flow.

In order to provide adequate storage and prevent water from standing for excessive periods of time the ponding depth of the bioretention area should not exceed 6 inches (15 centimeters). Water should not be left to stand for more than 72 hours. A restriction on the type of plants that can be used may be necessary due to some plants' water intolerance. Furthermore, if water is left standing for longer than 72 hours mosquitoes and other insects may start to breed.

The appropriate planting soil should be backfilled into the excavated bioretention area. Planting soils should be sandy loam, loamy sand, or loam texture with a clay content ranging from 10 to 25 percent.

Generally the soil should have infiltration rates greater than 0.5 inches (1.25 centimeters) per hour, which is typical of sandy loams, loamy sands, or loams. The pH of the soil should range between 5.5 and 6.5, where pollutants such as organic nitrogen and phosphorus can be adsorbed by the soil and microbial activity can flourish. Additional requirements for the planting soil include a 1.5 to 3 percent organic content and a maximum 500 ppm concentration of soluble salts.

Soil tests should be performed for every 500 cubic yards (382 cubic meters) of planting soil, with the exception of pH and organic content tests, which are required only once per bioretention area (EPA, 1999). Planting soil should be 4 inches (10.1 centimeters) deeper than the bottom of the largest root ball and 4 feet (1.2 meters) altogether. This depth will provide adequate soil for the plants' root systems to become established, prevent plant damage due to severe wind, and provide adequate moisture capacity. Most sites will require excavation in order to obtain the recommended depth.

Planting soil depths of greater than 4 feet (1.2 meters) may require additional construction practices such as shoring measures (EPA, 1999). Planting soil should be placed in 18 inches or greater lifts and lightly compacted until the desired depth is reached. Since high canopy trees may be destroyed during maintenance the bioretention area should be vegetated to resemble a terrestrial forest community ecosystem that is dominated by understory trees. Three species each of both trees and shrubs are recommended to be planted at a rate of 2500 trees and shrubs per hectare (1000 per acre). For instance, a 15 foot (4.6 meter) by 40 foot (12.2 meter) bioretention area (600 square feet or 55.75 square meters) would require 14 trees and shrubs. The shrub-to-tree ratio should be 2:1 to 3:1.

Trees and shrubs should be planted when conditions are favorable. Vegetation should be watered at the end of each day for fourteen days following its planting. Plant species tolerant of pollutant loads and varying wet and dry conditions should be used in the bioretention area.

The designer should assess aesthetics, site layout, and maintenance requirements when selecting plant species. Adjacent non-native invasive species should be identified and the designer should take measures, such as providing a soil breach to eliminate the threat of these species invading the bioretention area. Regional landscaping manuals should be consulted to ensure that the planting of the bioretention area meets the landscaping requirements established by the local authorities. The designers should evaluate the best placement of vegetation within the bioretention area. Plants should be placed at irregular intervals to replicate a natural forest. Trees should be placed on the perimeter of the area to provide shade and shelter from the wind. Trees and shrubs can be sheltered from damaging flows if they are placed away from the path of the incoming runoff. In cold climates, species that are more tolerant to cold winds, such as evergreens, should be placed in windier areas of the site.

Following placement of the trees and shrubs, the ground cover and/or mulch should be established. Ground cover such as grasses or legumes can be planted at the beginning of the growing season. Mulch should be placed immediately after trees and shrubs are planted. Two to 3 inches (5 to 7.6 cm) of commercially-available fine shredded hardwood mulch or shredded hardwood chips should be applied to the bioretention area to protect from erosion.

Maintenance

The primary maintenance requirement for bioretention areas is that of inspection and repair or replacement of the treatment area's components. Generally, this involves nothing more than the routine periodic maintenance that is required of any landscaped area. Plants that are appropriate for the site, climatic, and watering conditions should be selected for use in the bioretention cell. Appropriately selected plants will aide in reducing fertilizer, pesticide, water, and overall maintenance requirements. Bioretention system components should blend over time through plant and root growth, organic decomposition, and the development of a natural

soil horizon. These biologic and physical processes over time will lengthen the facility's life span and reduce the need for extensive maintenance.

Routine maintenance should include a biannual health evaluation of the trees and shrubs and subsequent removal of any dead or diseased vegetation (EPA, 1999). Diseased vegetation should be treated as needed using preventative and low-toxic measures to the extent possible. BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water. Routine inspections for areas of standing water within the BMP and corrective measures to restore proper infiltration rates are necessary to prevent creating mosquito and other vector habitat. In addition, bioretention BMPs are susceptible to invasion by aggressive plant species such as cattails, which increase the chances of water standing and subsequent vector production if not routinely maintained.

In order to maintain the treatment area's appearance it may be necessary to prune and weed. Furthermore, mulch replacement is suggested when erosion is evident or when the site begins to look unattractive. Specifically, the entire area may require mulch replacement every two to three years, although spot mulching may be sufficient when there are random void areas. Mulch replacement should be done prior to the start of the wet season.

New Jersey's Department of Environmental Protection states in their bioretention systems standards that accumulated sediment and debris removal (especially at the inflow point) will normally be the primary maintenance function. Other potential tasks include replacement of dead vegetation, soil pH regulation, erosion repair at inflow points, mulch replenishment, unclogging the underdrain, and repairing overflow structures. There is also the possibility that the cation exchange capacity of the soils in the cell will be significantly reduced over time. Depending on pollutant loads, soils may need to be replaced within 5-10 years of construction (LID, 2000).

Cost

Construction Cost

Construction cost estimates for a bioretention area are slightly greater than those for the required landscaping for a new development (EPA, 1999). A general rule of thumb (Coffman, 1999) is that residential bioretention areas average about $3 to $4 per square foot, depending on soil conditions and the density and types of plants used. Commercial, industrial and institutional site costs can range between $10 to $40 per square foot, based on the need for control structures, curbing, storm drains and underdrains.

Retrofitting a site typically costs more, averaging $6,500 per bioretention area. The higher costs are attributed to the demolition of existing concrete, asphalt, and existing structures and the replacement of fill material with planting soil. The costs of retrofitting a commercial site in Maryland, Kettering Development, with 15 bioretention areas were estimated at $111,600.

In any bioretention area design, the cost of plants varies substantially and can account for a significant portion of the expenditures. While these cost estimates are slightly greater than those of typical landscaping treatment (due to the increased number of plantings, additional soil excavation, backfill material, use of underdrains etc.), those landscaping expenses that would be required regardless of the bioretention installation should be subtracted when determining the net cost.

Perhaps of most importance, however, the cost savings compared to the use of traditional structural stormwater conveyance systems makes bioretention areas quite attractive financially. For example, the use of bioretention can decrease the cost required for constructing stormwater conveyance systems at a site. A medical office building in Maryland was able to reduce the amount of storm drain pipe that was needed from 800 to 230 feet - a cost savings of $24,000 (PGDER, 1993). And a new residential development spent a total of approximately $100,000 using bioretention cells on each lot instead of nearly $400,000 for the traditional stormwater ponds that were originally planned (Rappahanock,). Also, in residential areas, stormwater management controls become a part of each property owner's landscape, reducing the public burden to maintain large centralized facilities.

Maintenance Cost

The operation and maintenance costs for a bioretention facility will be comparable to those of typical landscaping required for a site. Costs beyond the normal landscaping fees will include the cost for testing the soils and may include costs for a sand bed and planting soil.

References and Sources of Additional Information

Coffman, L.S., R. Goo and R. Frederick, 1999: Low impact development: an innovative alternative approach to stormwater management. Proceedings of the 26th Annual Water Resources Planning and Management Conference ASCE, June 6-9, Tempe, Arizona.

Davis, A.P., Shokouhian, M., Sharma, H. and Minami, C., "Laboratory Study of Biological Retention (Bioretention) for Urban Stormwater Management," *Water Environ. Res.*, 73(1), 5-14 (2001).

Davis, A.P., Shokouhian, M., Sharma, H., Minami, C., and Winogradoff, D. "Water Quality Improvement through Bioretention: Lead, Copper, and Zinc," *Water Environ. Res.*, accepted for publication, August 2002.

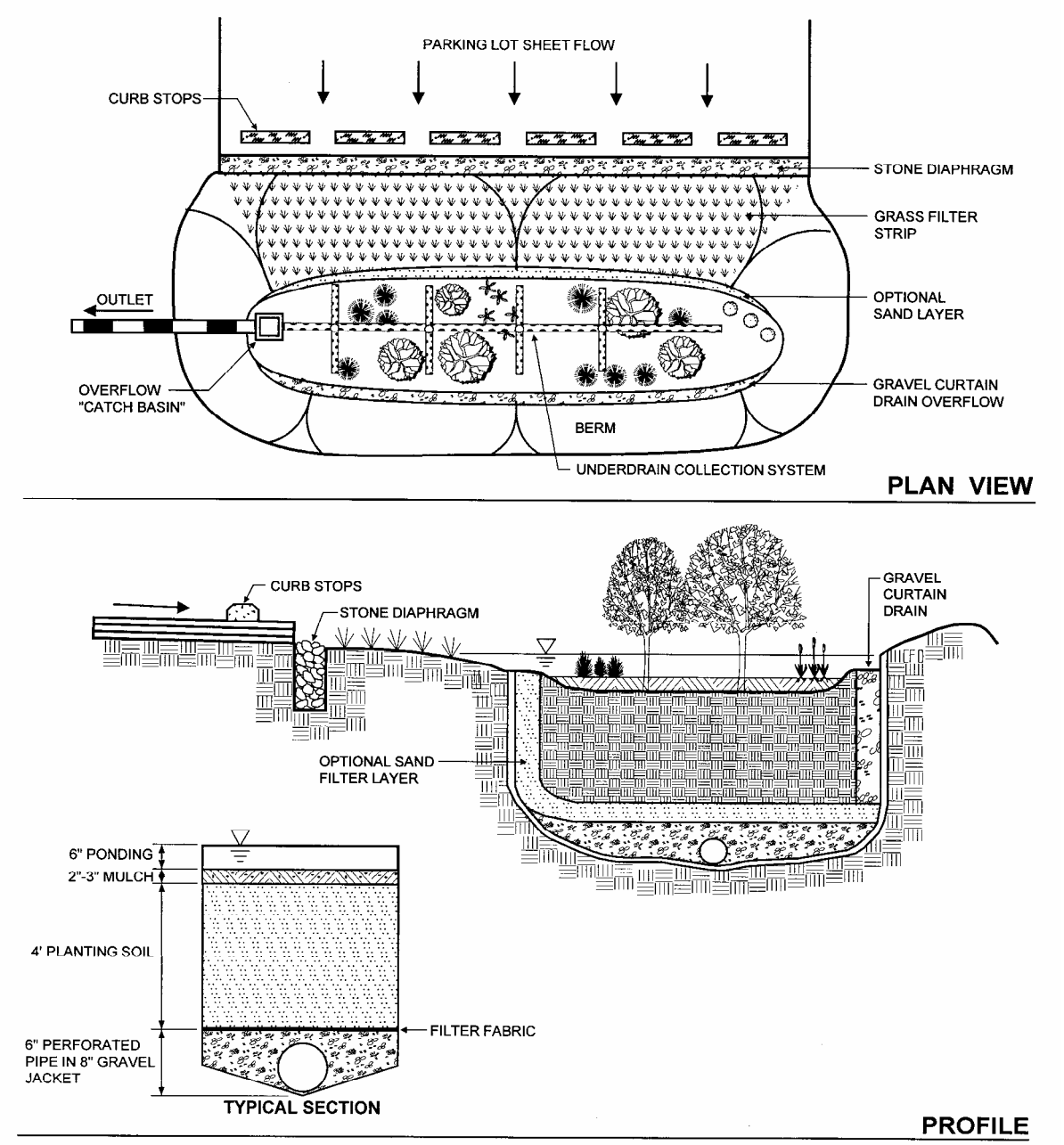
Kim, H., Seagren, E.A., and Davis, A.P., "Engineered Bioretention for Removal of Nitrate from Stormwater Runoff," *WEFTEC 2000 Conference Proceedings on CDROM Research Symposium, Nitrogen Removal*, Session 19, Anaheim CA, October 2000.

Hsieh, C.-h. and Davis, A.P. "Engineering Bioretention for Treatment of Urban Stormwater Runoff," *Watersheds 2002, Proceedings on CDROM Research Symposium*, Session 15, Ft. Lauderdale, FL, Feb. 2002.

Prince George's County Department of Environmental Resources (PGDER), 1993. Design Manual for Use of *Bioretention in Stormwater Management*. Division of Environmental Management, Watershed Protection Branch. Landover, MD.

U.S. EPA Office of Water, 1999. Stormwater Technology Fact Sheet: Bioretention. EPA 832-F-99-012.

Weinstein, N. Davis, A.P. and Veeramachaneni, R. "Low Impact Development (LID) Stormwater Management Approach for the Control of Diffuse Pollution from Urban Roadways," *5th International Conference Diffuse/Nonpoint Pollution and Watershed Management Proceedings*, C.S. Melching and Emre Alp, Eds. 2001 International Water Association



Schematic of a Bioretention Facility (MDE, 2000)