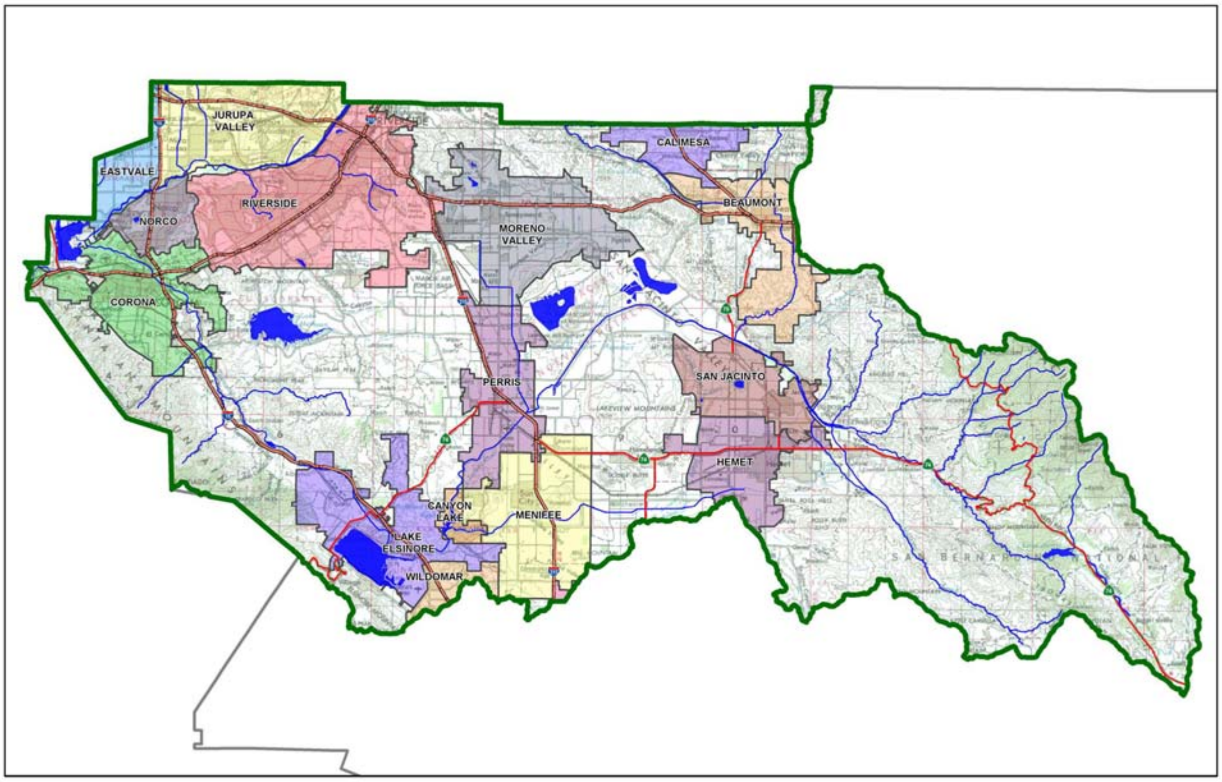
Project Specific Water Quality Management Plan

Project Title: Legacy Park

Development No: Tract 36760

Design Review/Case No: PA 14-0053



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☒ **Preliminary**
☐ **Final**

Original Date Prepared: June 18, 2015

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

OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for MPLC Legacy 75 Partners, LLP by Rick Engineering Company for the Legacy Park project.

This WQMP is intended to comply with the requirements of City of Moreno Valley for Ordinance 827 which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

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

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

[signature]	1-4-17
Owner's Signature	Date
R. Luce	Authorized Signer
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
Richard O'Neill	Associate
Preparer's Printed Name	Preparer's Title/Position

Preparer's Licensure:

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT **CIVIL CODE § 1189**

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California)
County of Orange)

On January 4, 2017 before me, Angelita O. Mason, Notary Public,
Date *Here Insert Name and Title of the Officer*

personally appeared Randall C. Luce
Name(s) of Signer(s)

who proved to me on the basis of satisfactory evidence to be the person~~(s)~~ whose name~~(s)~~ is/~~are~~ subscribed to the within instrument and acknowledged to me that he/~~she~~/~~they~~ executed the same in his/~~her~~/~~their~~ authorized capacity~~(ies)~~, and that by his/~~her~~/~~their~~ signature~~(s)~~ on the instrument the person~~(s)~~, or the entity upon behalf of which the person~~(s)~~ acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

ANGELITA O. MASON
COMM. #2056933
Notary Public - California
Orange County
My Comm. Expires Mar. 4, 2018
NR01

Signature Angelita O. Mason
Signature of Notary Public

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Section A: Project and Site Information

PROJECT INFORMATION			
Type of Project:	Residential		
Planning Area:	None		
Community Name:			
Development Name:	Legacy Park		
PROJECT LOCATION			
Latitude & Longitude (DMS): 33°53'37"N, 117°13'54"W			
Project Watershed and Sub-Watershed: Santa Ana River Watershed San Jacinto HU, Perris HA, Perris Valley HSA			
APN(s): 485-220-023, 485-220-032, 485-220-040			
Map Book and Page No.: MB 8/23			
PROJECT CHARACTERISTICS			
Proposed or Potential Land Use(s)		Residential: Max 5 du/ac	
Proposed or Potential SIC Code(s)		None	
Area of Impervious Project Footprint (SF)		1,397,321	
Total Area of <u>proposed</u> Impervious Surfaces within the Project Limits (SF)/or Replacement		1,397,321	
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 <u>existing</u> Impervious Surfaces within the project limits (SF)		None	
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)		N/A	
What is the Water Quality Design Storm Depth for the project?		0.65	

A.1 Maps and Site Plans

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

- Drainage Management Areas
- Proposed Structural BMPs
- Drainage Path
- Drainage Infrastructure, Inlets, Overflows
- Source Control BMPs
- Buildings, Roof Lines, Downspouts
- Impervious Surfaces
- Standard Labeling

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

A.2 Identify Receiving Waters

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

Table A.1 Identification of Receiving Waters

Receiving Waters	EPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
Perris North	N/A	MUN, AGR, IND, PROC	N/A
San Jacinto River Reach 4	N/A	AGR*, WILD*, GWR*, MUN*, REC1*, REC2*, WARM*	N/A
San Jacinto River Reach 3	N/A	AGR*, GWR*, MUN**, REC1*, REC2*, WARM*, WILD*	N/A
San Jacinto River Reach 2 & Canyon Lake	Nutrients, pathogens	AGR, GWR, WILD, MUN, REC1, REC2, WARM	N/A
San Jacinto River Reach 1	N/A	AGR*, GWR*, MUN*, REC1*, REC2*, WARM*, WILD*	N/A
Lake Elsinore	Nutrients, organic enrichment/low DO, PCBs, sediment toxicity, unknown toxicity.	MUN**, REC1, REC2, WARM, WILD	N/A

*Intermittent Beneficial Use
**Exempted from MUN

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

Table A.2 Other Applicable Permits

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

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

Section B: Optimize Site Utilization (LID Principles)

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

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

Site Optimization

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

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

Yes, the existing site drainage pattern splits flows, with the majority of the site draining to the southwest corner before entering the street and flowing to an existing storm drain. A portion on the east side of the site drains to the southeast corner. The proposed development will drain through the streets into proposed storm drains, then into our proposed water quality and bioretention basins at the southwest and southeast corners of the site. The proposed drainage split is similar to that of the existing condition. The water in the basins will drain through proposed storm drain and tie into the existing storm drain southwest and southeast of the project site.

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

Any existing vegetation will be removed when the mass grading occurs.

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

The natural infiltration capacity is 0.45 in/hr (see Appendix 3), therefore infiltration is not feasible onsite.

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

Yes, the sidewalk and street design will adhere to city standards for appropriate widths required.

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

Yes, runoff from this site will disperse to landscaped areas when possible. The project will disperse the remainder of the runoff to the bioretention basin.

Section C: Delineate Drainage Management Areas (DMAs)

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

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s)[1]	Area (Sq. Ft.)	DMA Type
D-100 Impervious	Concrete or Asphalt	320,442	Type D – Area that drains to BMP
D-100 Roofs	Roofs	727,285	Type D – Area that drains to BMP
D-100 Landscape	Ornamental Landscaping	571,926	Type D – Area that drains to BMP
D-200 Impervious	Concrete or Asphalt	118,702	Type D – Area that drains to BMP
D-200 Roofs	Roofs	230,892	Type D – Area that drains to BMP
D-200 Landscape	Ornamental Landscaping	193,462	Type D – Area that drains to BMP

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

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

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

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

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

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

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

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

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

DMA Name or ID	BMP Name or ID
D-100 Impervious	D-100 Bioretention Basin
D-100 Roofs	D-100 Bioretention Basin
D-100 Landscape	D-100 Bioretention Basin
D-200 Impervious	D-200 Bioretention Basin
D-200 Roofs	D-200 Bioretention Basin
D-200 Landscape	D-200 Bioretention 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. 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: D-100 and D-200 (Infiltration rate = 0.45 inches/hour)		
…have significant cut and/or fill conditions that would preclude in-situ testing of infiltration rates at the final infiltration surface?		X
If Yes, list affected DMAs:		
…geotechnical report identify other site-specific factors that would preclude effective and safe infiltration?		X
Describe here:		

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

D.2 Harvest and Use Assessment

Please check what applies*:*

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

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

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

If any of the above boxes have been checked, Harvest and Use BMPs need not be assessed for the site. If neither of the above criteria applies, follow the steps below to assess the feasibility of irrigation use, toilet use and other non-potable uses (e.g., industrial use).

Irrigation Use Feasibility

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

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

Total Area of Irrigated Landscape: 0.41 acres*

*This area does not include: homeowner maintained landscaping/slopes within the private lots or parkway. The homeowner will be required to maintain landscaping/slope off of each individual meter. The basins, which will be maintained by the City of Moreno Valley, are also not included.

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

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

Total Area of Impervious Surfaces: 32.1 acres

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: 1.05

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: 33.7 acres

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)
33.7 acres	0.41 acres

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: 660

Project Type: Residential

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

Total Area of Impervious Surfaces: 32.1 acres

Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-1 in Chapter 2 to determine the minimum number or toilet users per tributary impervious acre (TUTIA).

Enter your TUTIA factor: 108

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

Minimum number of toilet users: 3,467

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)**
3,467	660

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: Projected Average Daily Use (gpd)

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: Insert Area (Acres)

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

Enter the factor from Table 2-3: Enter Value

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

Minimum required use: Minimum use required (gpd)

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

Minimum required non-potable use (Step 4)	**Projected average daily use (Step 1)**
Minimum use required (gpd)	Projected Average Daily Use (gpd)

If Irrigation, Toilet and Other Use feasibility anticipated demands are less than the applicable minimum values, Harvest and Use BMPs are not required and you should proceed to utilize LID Bioretention and Biotreatment, unless a site-specific analysis has been completed that demonstrates technical infeasibility as noted in D.3 below.

D.3 Bioretention and Biotreatment Assessment

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

Select one of the following:

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

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

D.4 Feasibility Assessment Summaries

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

Table D.2 LID Prioritization Summary Matrix

DMA Name/ID	LID BMP Hierarchy				No LID (Alternative Compliance)
	1. Infiltration	2. Harvest and use	3. Bioretention	4. Biotreatment	
D-100 Impervious	☐	☐	☒	☐	☐
D-100 Roofs	☐	☐	☒	☐	☐
D-100 Landscape	☐	☐	☒	☐	☐
D-200 Impervious	☐	☐	☒	☐	☐
D-200 Roofs	☐	☐	☒	☐	☐
D-200 Landscape	☐	☐	☒	☐	☐

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.

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	*Bioretention Basin D-100*		
	[A]		[B]	[C]	[A] x [C]	*Design Storm Depth (in)*	*Design Capture Volume, **V_{BMP}** (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
D-100 Impervious	*320,442*	*AC Pavement*	*1.0*	*0.89*	*285,834.3*			
D-100 Roofs	*727,285*	*Roofs*	*1.0*	*0.89*	*648,738.2*			
D-100 Landscape	*571,926*	*Ornamental Landscaping*	*0.1*	*0.11*	*63,173.8*			
	1,619,653				997,746.3.	0.65	54,044.6	**54,045**

[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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Bioretention Basin D-200*		
	[A]		[B]	[C]	[A] x [C]	*Design Storm Depth (in)*	*Design Capture Volume, **V_{BMP}** (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
D-200 Impervious	*118,702*	*AC Pavement*	*1.0*	*0.89*	*105,882.2*			
D-200 Roofs	*230,892*	*Roofs*	*1.0*	*0.89*	*205,955.7*			
D-200 Landscape	*193,462*	*Ornamental Landscaping*	*0.1*	*0.11*	*21.369.4*			
	543,056				333,207.3	0.65	18,048.7	**18,049**

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]
n/a	
Total Credit Percentage[1]	

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

E.3 Sizing Criteria

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

Table E.3 Treatment Control BMP Sizing

DMA Type/ ID	**DMA Area (square feet)**	**Post-Project Surface Type**	**Effective Impervious Fraction, I_f**	**DMA Runoff Factor**	**DMA Area x Runoff Factor**		***Enter BMP Name / Identifier Here***		
	[A]		[B]	[C]	[A] x [C]				
n/a						*Design Storm Depth (in)*	*Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs)*	*Total Storm Water Credit % Reduction*	*Proposed Volume or Flow on Plans (cubic feet or cfs)*

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

E.4 Treatment Control BMP Selection

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

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

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

Table E.4 Treatment Control BMP Selection

Selected Treatment Control BMP Name or ID[1]	Priority Pollutant(s) of Concern to Mitigate[2]	Removal Efficiency Percentage[3]
Bioretention Basin	Nutrients	70%
Bioretention Basin	Bacteria, T.O.C	90%
Bioretention Basin	Pesticides	>80%
Bioretention Basin	Sediments	>80%

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

Section F: Hydromodification

F.1 Hydrologic Conditions of Concern (HCOC) Analysis

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

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

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

If Yes, HCOC criteria do not apply.

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

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

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

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

Table F.1 Hydrologic Conditions of Concern Summary

	2 year – 24 hour		
	Pre-condition	**Post-condition**	**% Difference**
Time of Concentration	n/a	n/a	n/a
Volume (Cubic Feet)	n/a	n/a	n/a

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

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

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

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

Lake Elsinore

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 951.995.1200 to verify.	Maintain and periodically repaint or replace inlet markings. Provide stormwater pollution prevention information to new site owners, leases, 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.”
Landscape/Outdoor Pesticide Use	All final landscape plans will accomplish the following: 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/Downloads/LandscapeGardenBrochure.pdf Provide IPM information to new owners, lessees and operators
Miscellaneous Drain or Wash Water or Other Sources	Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.	

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)
D-100 Impervious	320,442 sf draining to D-100 Bioretention Basin	Tentative Map Sheet 1
D-100 Roofs	727,285 sf draining to D-100 Bioretention Basin	Tentative Map Sheet 1
D-100 Landscaping	571,926 sf draining to D-100 Bioretention Basin	Tentative Map Sheet 1
D-200 Impervious	118,702 sf draining to D-200 Bioretention Basin	Tentative Map Sheet 1
D-200 Roofs	230,892 sf draining to D-200 Bioretention Basin	Tentative Map Sheet 1
D-200 Landscaping	193,462 sf draining to D-200 Bioretention Basin	Tentative Map Sheet 1

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: Home Owner's Association

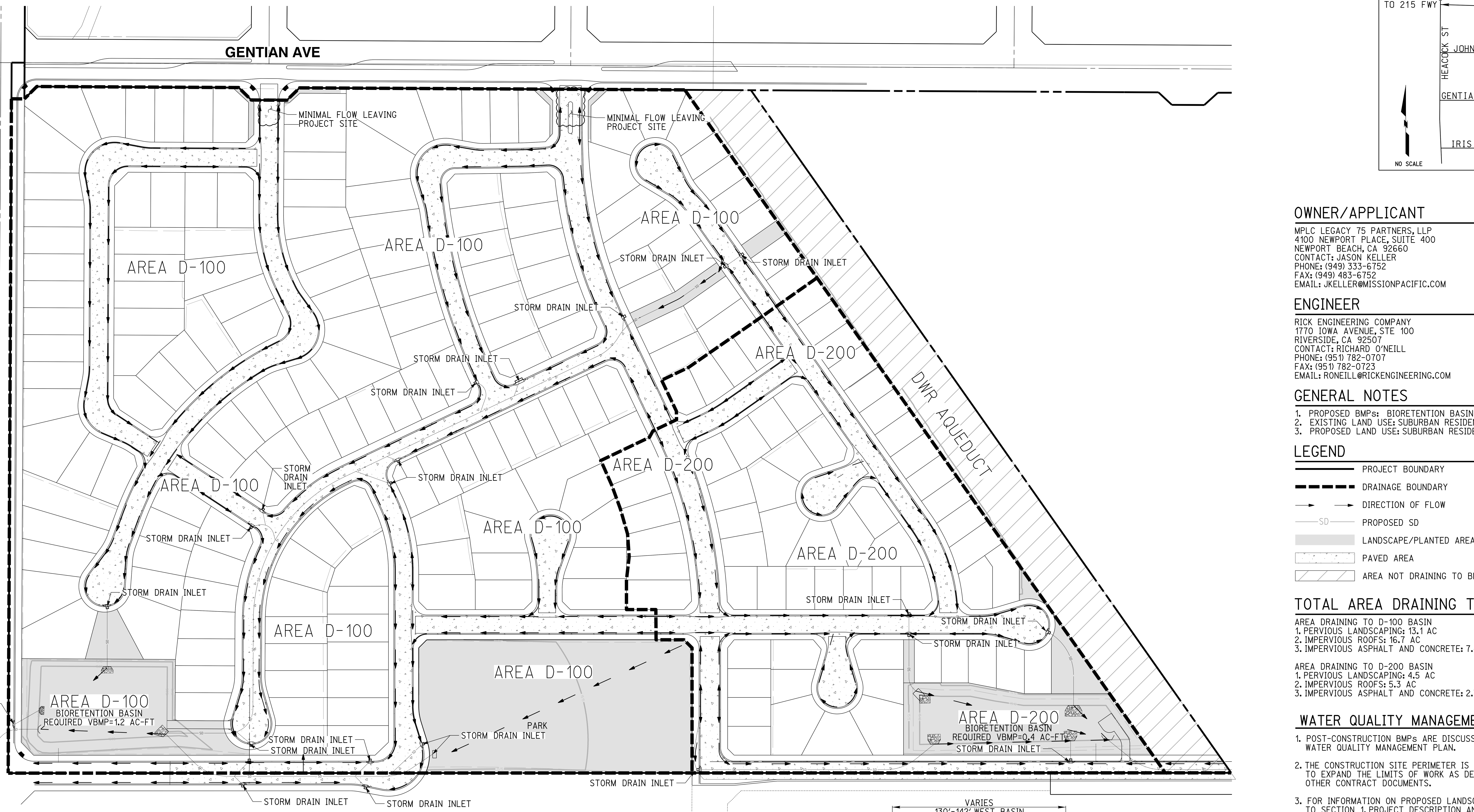
Will the proposed BMPs be maintained by a Home Owners' Association (HOA) or Property Owners Association (POA)?

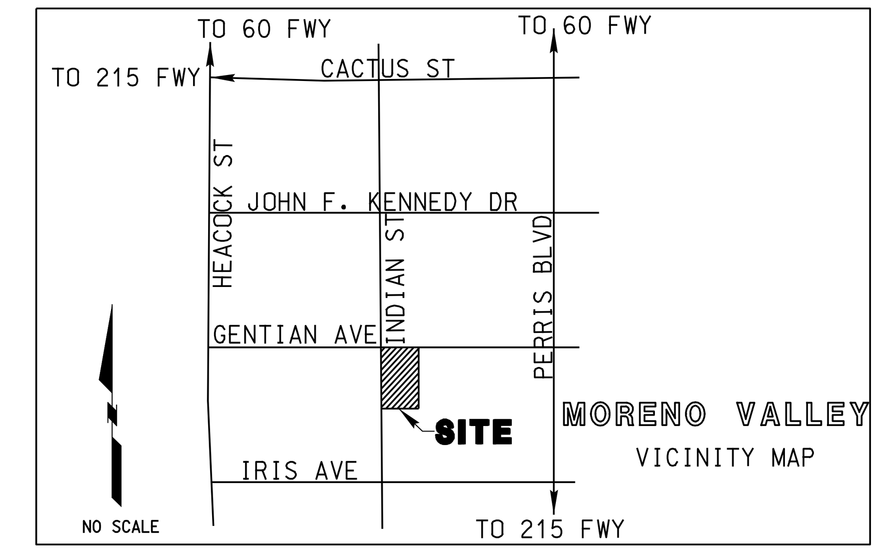
☐ Y ☒ N

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





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FAX: (951) 782-0723
EMAIL: RONEILL@RICKENGINEERING.COM

GENERAL NOTES

1. PROPOSED BMPs: BIORETENTION BASINS
2. EXISTING LAND USE: SUBURBAN RESIDENTIAL
3. PROPOSED LAND USE: SUBURBAN RESIDENTIAL

LEGEND

- PROJECT BOUNDARY
- DRAINAGE BOUNDARY
- DIRECTION OF FLOW
- SD — PROPOSED SD
- LANDSCAPE/PLANTED AREA
- PAVED AREA
- AREA NOT DRAINING TO BMPS

TOTAL AREA DRAINING TO BMP'S

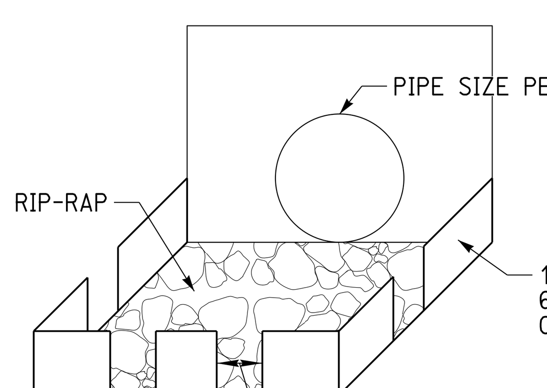
AREA DRAINING TO D-100 BASIN
1. PERVIOUS LANDSCAPING: 13.1 AC
2. IMPERVIOUS ROOFS: 16.7 AC
3. IMPERVIOUS ASPHALT AND CONCRETE: 7.4 AC

AREA DRAINING TO D-200 BASIN
1. PERVIOUS LANDSCAPING: 4.5 AC
2. IMPERVIOUS ROOFS: 5.3 AC
3. IMPERVIOUS ASPHALT AND CONCRETE: 2.7 AC

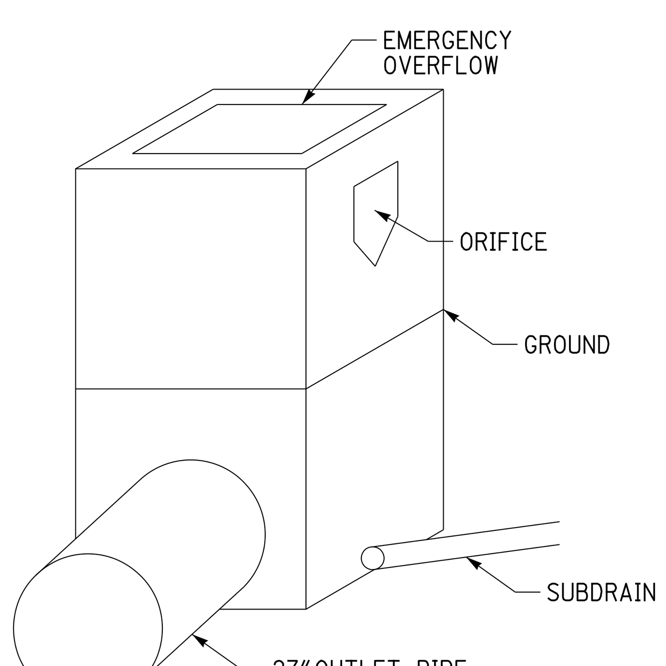
WATER QUALITY MANAGEMENT PLAN NOTES:

1. POST-CONSTRUCTION BMPs ARE DISCUSSED IN MORE DETAIL WITHIN THIS WATER QUALITY MANAGEMENT PLAN.
2. THE CONSTRUCTION SITE PERIMETER IS A SCHEMATIC AND NOT INTENDED TO EXPAND THE LIMITS OF WORK AS DELINEATED MORE PRECISELY ON OTHER CONTRACT DOCUMENTS.
3. FOR INFORMATION ON PROPOSED LANDSCAPED AND PAVED AREAS, REFER TO SECTION 1, PROJECT DESCRIPTION AND THE TEXT.
4. THE MPLC LEGACY 75 PARTNERS, LLC. WILL INSTALL STENCILS ON EVERY STORM DRAIN INLET. THE MPLC LEGACY 75 PARTNERS, LLC. WILL CONTACT THE CITY OF MORENO VALLEY PRIOR TO COMPLETING CONSTRUCTION OF THE INLETS TO DETERMINE THE MOST CURRENT STENCILING REQUIREMENTS AND INCOPORATE THOSE REQUIREMENTS AT THE INLETS.

SCALE: 1" = 100'
100 0 100 200



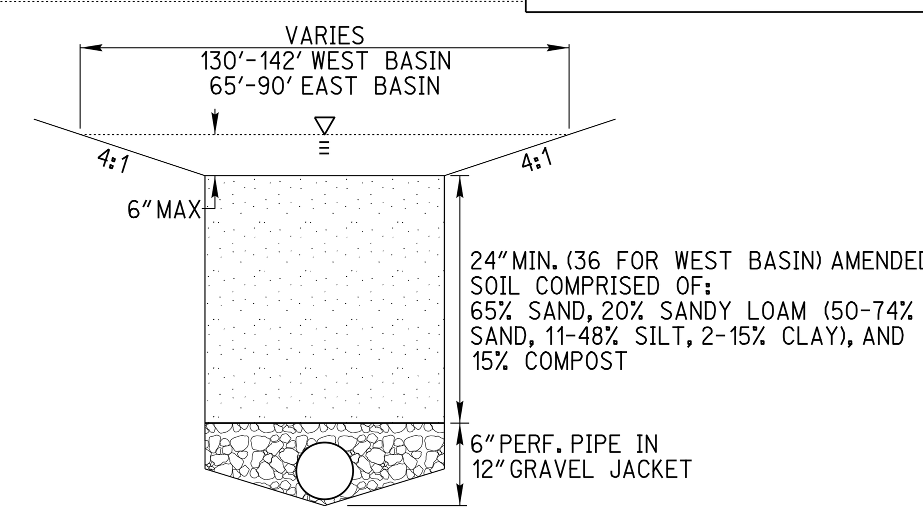
TYPICAL BASIN INLET DETAIL
N.T.S.



TYPICAL BASIN OUTLET DETAIL
N.T.S.

NOTE: INLET/OUTLET DETAILS WILL BE FINALIZED IN THE FINAL WQMP REPORT.

TYPICAL STORM DRAIN INLET SIGNAGE
PER CASQA BMP STANDARD SD-13
N.T.S.



TYPICAL BIORETENTION BASIN SECTION
N.T.S.

NOTE: UNDERDRAIN LAYOUT WILL BE SHOWN IN THE FINAL WQMP AND WILL CONFIGURE TO REQUIREMENTS OUTLINED IN THE LID HANDBOOK.

NOT FOR CONSTRUCTION
FOR WQMP EXHIBIT ONLY

WQMP EXHIBIT:

THIS PLAN PRESENTS THE RECOMMENDATIONS OF RICK ENGINEERING COMPANY FOR THE TITLE PROJECT BASED ON COMPLETED PHASES OF CONSTRUCTION. STORM WATER POLLUTION PREVENTION IS THE RESPONSIBILITY OF THE PROPERTY OWNER OR THEIR DELEGATED RESPONSIBLE PARTY. THE RECOMMENDATIONS PRESENTED ON THIS PLAN SHOULD BE CONSTANTLY REVIEWED AND AMENDED AS APPROPRIATE BY THE PROPERTY OWNER OR THEIR DELEGATED RESPONSIBLE PARTY AS SITE CONDITIONS CHANGE.

DATE	BY	REVISIONS

WATER QUALITY MANAGEMENT PLAN
SITE PLAN EXHIBIT
TRACT 36760
APN'S 485-220-023, 485-220-032

SHEET NO. 1 OF 1 SHEETS

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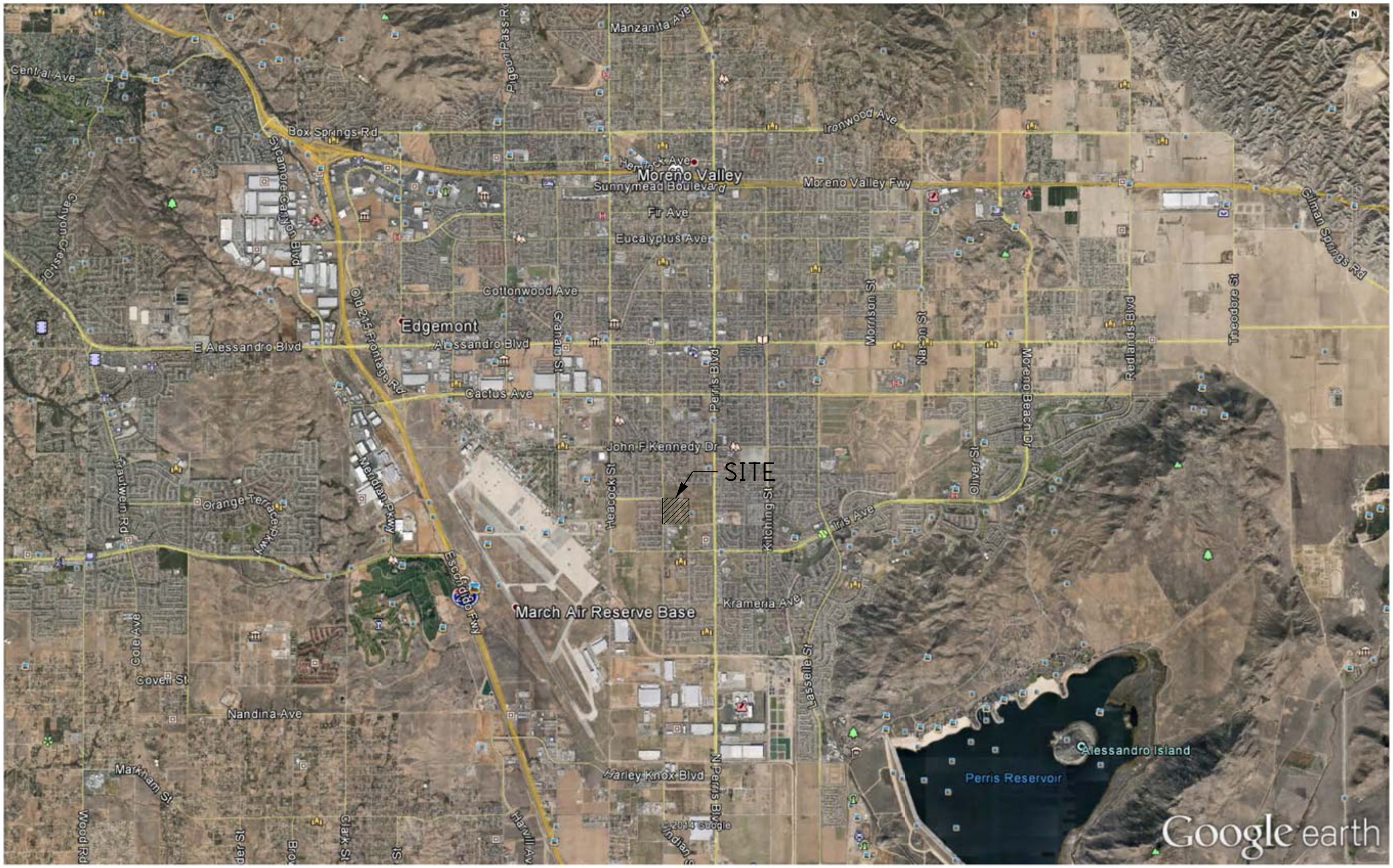

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LEGACY PARK DEVELOPMENT
APN'S: 485-220-023,
485-220-032, 485-220-040
LOCATION MAP

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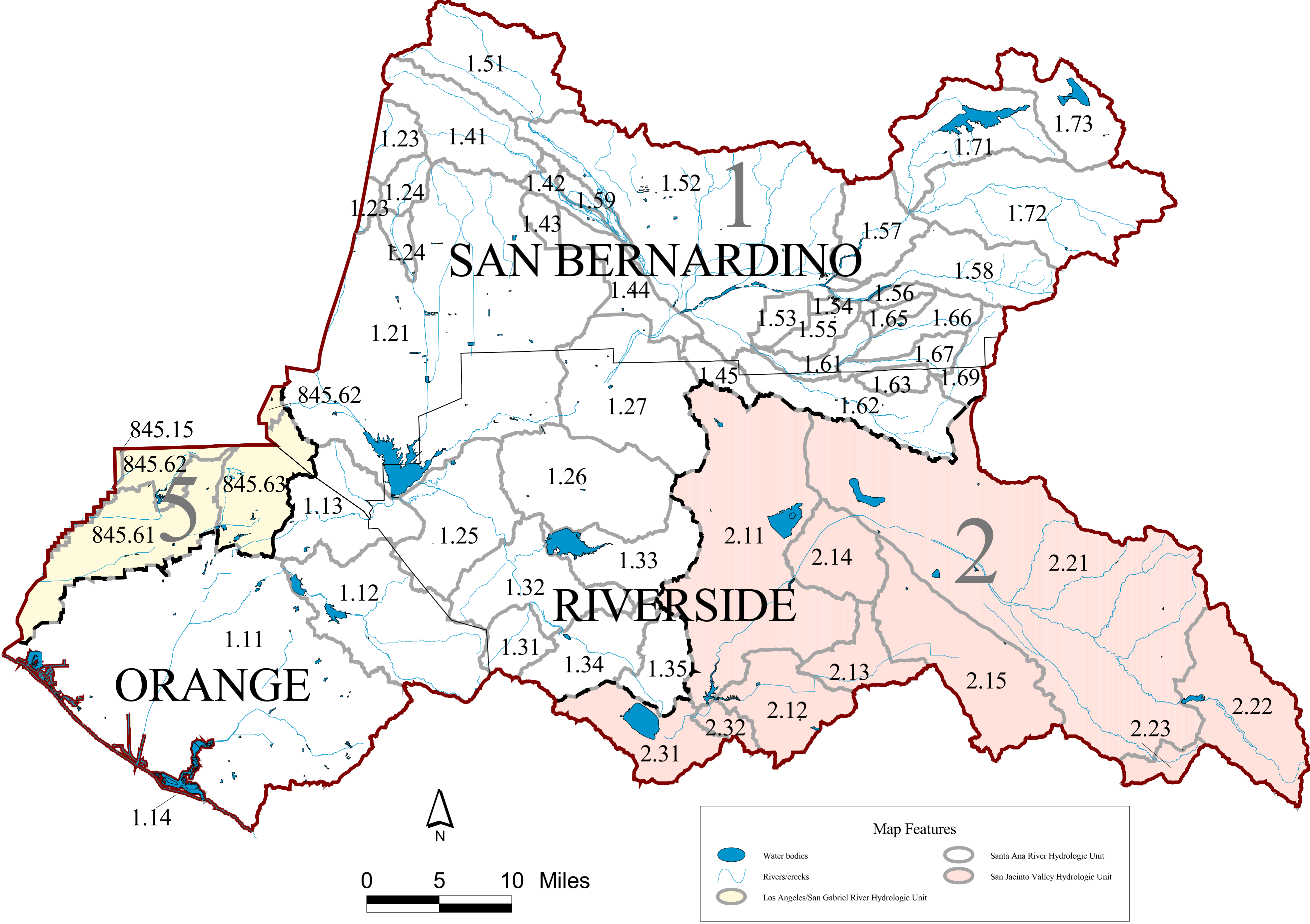
PLOT DATE: 19-OCT-2016 JN 16464B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ORANGE
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2.12
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2.32
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N
0
5
10
Miles
Map Features
Water bodies
Rivers/creeks
Los Angeles/San Gabriel River Hydrologic Unit
Santa Ana River Hydrologic Unit
San Jacinto Valley Hydrologic Unit

Index to map of the Santa Ana Hydrologic Basin Planning Area (SA), 1986

Abbreviations Used:

HA – Hydrologic Area
HSA - Hydrologic Subarea

801.0	SANTA ANA RIVER HYDROLOGIC UNIT
801.10	Lower Santa Ana River HA
801.11	East Coastal Plain HSA
801.12	Santiago HSA
801.13	Santa Ana Narrows HSA
801.14	(not included in Basin Plan)
801.20	Middle Santa Ana River HA Split
801.21	Chino HSA Split
481.21	Chino HSA Split
481.22	Harrison HSA
801.23	Claremont Heights HSA Split
481.23	Claremont Heights HSA Split
801.24	Cucamonga HSA
801.25	Temescal HSA
801.26	Arlington HSA
801.27	Riverside HSA
801.30	Lake Mathews HSA
801.31	Coldwater HSA
801.32	Bedford HSAS
801.33	Cajalco HSA
801.34	Lee Lake HSA
801.35	Terra Cotta HSA
801.40	Colton- Rialto HA
801.41	Upper Lytle HSA
801.42	Lower Lytle HSA
801.43	Rialto HSA
801.44	Colton HSA
801.50	Upper Santa Ana River HA
801.51	Cajon HSA
801.52	Bunker Hill HSA
801.53	Redlands HSA
801.54	Mentone HSA
801.55	Reservoir HSA
801.56	Crafton HSA

801.57	Santa Ana Canyon HSA
801.58	Mill Creek HSA
801.59	Sycamore HAS
801.60	San Timoteo HA
801.61	Yucaipa HSA
801.62	Beaumont HSA
801.63	Cherry Valley HSA
801.64	Chicken Hill HSA
801.65	Gateway HSA
801.66	Oak Glen HSA
801.67	South Mesa HSA
801.68	Triple Falls Creek HSA
801.69	Noble Creek HAS
801.70	San Bernardino Mountain HA
801.71	Bear Valley HSA
801.72	Seven Oaks HSA
801.73	Baldwin HSA
802.0	SAN JACINTO VALLEY HYDROLOGIC UNIT
802.10	Perris HA
802.11	Perris Valley HSA
802.12	Menifee HSA
802.13	Winchester HSA
802.14	Lakeview HSA
802.15	Hemet HAS
802.20	San Jacinto HA
802.21	Gilman Hot Springs HSA
802.22	Hemet Lake HSA
802.23	Bautista HAS
802.30	Elsinore Valley HA
802.31	Elsinore HSA
802.32	Railroad HSA
805.0	LOS ANGELES-SAN GABRIEL RIVER HYDROLOGIC UNIT
805.10	Coastal Plain of Los Angeles County HA split
845.15	Central HSA Split
845.60	Anaheim HA Split
845.61	Anaheim HSA Split
845.62	La Habra HSA Split
845.63	Yorba Linda HSA Split

Notes:

1. The .pdf version of the map that this index accompanies was prepared from an August 1986 revision of a map entitled, “Santa Ana Hydrologic Basin Planning Area (SA),” State of California Regional Water Quality Control Board, Santa Ana Region (8), that was included in the Water Quality Control Plan for the Santa Ana River Basin – Region 8, 1994.

2. The naming conventions used in this index are the same as used by the Department of Water Resources in their Bulletin 130 series. Bulletin 130 was last published in May 1988, for the 1982-85 water year. The numbering system used on the accompanying map is an adaptation of the numbering system used in Bulletin 130.

3. The boundary between Regional Water Quality Control Boards 4 and 8 is specified in California Water Code Section 13200 as coinciding with the southeasterly boundary of Los Angeles County from the Pacific Ocean to San Antonio Peak. Therefore, the boundary between these two regions is not a hydrologic boundary, but a political one. Consequently, some, or parts of some, of the hydrologic subunits shown in the Santa Ana River watershed are within the jurisdiction of the RWQCB 4, and some, or parts of some, hydrologic units are in the San Gabriel River watershed of RWQCB 4, but are legally in Region 8.

4. Parts of the southwestern boundary shown for HSA 801.11 East Coastal Plain do not conform exactly to the boundary shown for this area in the Calwater hydrologic mapping project Version 2.2. This lack of conformity affects the area of Laguna Hills, but is insignificant at the scale of this map.

5. The boundary of Region 8 at southwestern tip of HSA 802.24 Bautista shown has been modified as a result of the construction of Diamond Valley Reservoir. This modification affects the area of Goodhart Canyon, but is insignificant at the scale of this map.

Appendix 2: Construction Plans

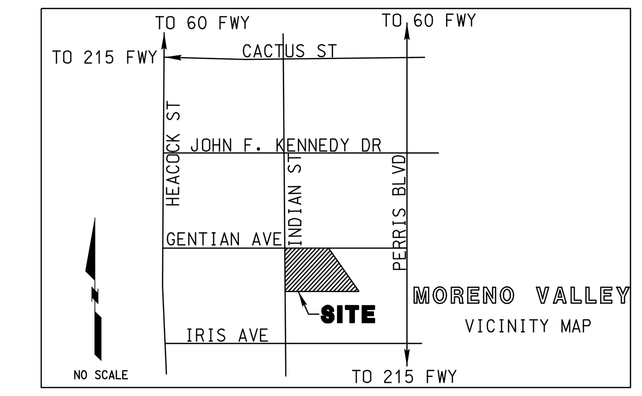
Grading and Drainage Plans

IN THE CITY OF MORENO VALLEY, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA

TENTATIVE TRACT 36760
PLANNED UNIT DEVELOPMENT

APN'S: 485-220-023, 485-220-032, 485-220-040

MARCH 8, 2016; REVISED: SEPTEMBER 19, 2016



UTILITY PURVEYORS

SEWER AND WATER: EASTERN MUNICIPAL WATER DISTRICT
2270 TRUMBLE ROAD
PERRIS, CA 92570
(951) 928-3777

GAS: SOUTHERN CALIFORNIA GAS COMPANY
(800) 427-2200

ELECTRIC: MORENO VALLEY ELECTRIC UTILITY
14331 FREDERICK STREET, SUITE 2
MORENO VALLEY, CA 92553
(877) 811-8700

TELEPHONE: VERIZON
(800) 483-400

CABLE TV: TIME WARNER
1500 AUTO CENTER DRIVE
ONTARIO, CA 91761

STORM DRAIN: RIVERSIDE COUNTY FLOOD CONTROL DISTRICT
1995 MARKET STREET
RIVERSIDE, CA 92501
(951) 955-1200
CITY OF MORENO VALLEY
14177 FREDERICK STREET
MORENO VALLEY, CA 92553

TRASH: WASTE MANAGEMENT OF INLAND VALLEY
17700 INDIAN AVENUE
MORENO VALLEY, CA 92551
(800) 423-9986

LEGEND

TRACT MAP BOUNDARY
CENTERLINE
RIGHT-OF-WAY/ LOT LINE
PROPOSED CURB
EXISTING EASEMENT
EXISTING SPOT ELEVATION — X 1514.7
ACCESS GATE
BLOCK WALL
TUBULAR STEEL FENCE
PROPOSED STORM DRAIN — SD
PROPOSED WATERLINE — W
PROPOSED SEWER/MANHOLE — S
TOP OF SLOPE / TOE OF SLOPE
DIRECTION OF FLOW
CENTERLINE RADIUS — R= 50'
POINT OF INTERSECTION — PI
FINISHED SURFACE — FS
GRADE BREAK — GB
STREET GRADE — 2%
LAST LOT NUMBER — 220
CURB RAMP
DECORATIVE CONCRETE

OWNER/APPLICANT

MPLC LEGACY 75 PARTNERS, LLP
4100 NEWPORT PLACE, SUITE 480
NEWPORT BEACH, CA 92660
CONTACT: JASON KELLER
PHONE: (949) 333-6752
FAX: (949) 483-6752
EMAIL: JKELLER@MISSIONPACIFIC.COM

ENGINEER

RICK ENGINEERING COMPANY
1770 IOWA AVENUE, STE 100
RIVERSIDE, CA 92507
CONTACT: RICHARD O'NEILL
PHONE: (951) 782-0707
FAX: (951) 782-0723
EMAIL: RONEILL@RICKENGINEERING.COM

GENERAL NOTES

1. EXISTING ZONING: R5, R30
2. EXISTING LAND USE: SUBURBAN RESIDENTIAL
3. EXISTING SURROUNDING LAND USE: PUBLIC FACILITIES, RESIDENTIAL, COMMERCIAL
4. PROPOSED ZONING: R5
5. PROPOSED LAND USE: SUBURBAN RESIDENTIAL
6. PROJECT ACREAGE: 52.9 AC. GROSS, 48.7 AC. NET
7. THOMAS BROS. MAP: 2009 SAN BERNARDINO/RIVERSIDE COUNTIES, PAGE 747, F-1 AND F-2
8. THIS IS NOT A GATED COMMUNITY
9. SCHOOL DISTRICT: VAL VERDE UNIFIED
10. AERIAL TOPOGRAPHY COMPILED AND PREPARED BY RICK ENGINEERING COMPANY ON 03/10/2011 AT 1' CONTOUR INTERVAL ACCURACY
11. AVERAGE RESIDENTIAL LOT SIZE: SEE TABULATION TABLE
12. FEMA FLOOD ZONE "X": NO AREAS OF FLOOD HAZARD, INUNDATION OR OVERFLOW WITHIN THE RESIDENTIAL LOTS OF THIS TENTATIVE TRACT MAP BOUNDARY
13. THERE ARE NO ADJACENT STRUCTURES OR PROPERTY IMPROVEMENTS WITHIN 50' OF THE PROJECT BOUNDARY
14. THERE ARE NO KNOWN EXISTING BUILDINGS OR STRUCTURES ABOVE GROUND WITHIN THE SUBDIVISION
15. THERE ARE NO KNOWN EXISTING WELLS, IRRIGATION LINES, CESSPOOLS, SEPTIC TANKS, SEWAGE LEACH FIELDS, SEWERS, CULVERTS, STORM DRAINS, OR UNDERGROUND STRUCTURES WITHIN THE SUBDIVISION
16. THERE ARE NO KNOWN PREVIOUSLY FILLED AREAS, INCLUDING LIQUID AND SOLID WASTE DISPOSAL SITES, WITHIN THE SUBDIVISION
17. THERE ARE NO EXISTING WATERCOURSES OR FLOOD CONTROL CHANNELS WITHIN THE PROJECT SITE
18. THERE ARE NO KNOWN EXISTING TREES OR ROCKS ON SITE
19. WATER QUALITY MEASURES ARE DESCRIBED IN PRELIMINARY WATER QUALITY MANAGEMENT PLAN.
20. WATER QUALITY BASINS AND PROPOSED PARK SITE TO BE MAINTAINED BY THE HOA OR PUBLIC ENTITY.
21. TRAFFIC SIGNAL INTERCONNECT WILL BE PROVIDED AT GENTIAN AVE.
22. PROJECT SITE IS IN HCOC EXEMPT AREA. OUTLET FROM BASINS WILL NOT MATCH PRE-PROJECT FLOWS, BUT WILL BE SIZED TO STORM DRAIN SYSTEM CAPACITIES.
23. APPLICANT RESERVES THE RIGHT TO RECORD THE FINAL MAP IN PHASES.

LEGAL DESCRIPTION

LOTS 18 AND 23 IN BLOCK 3 OF RIVERSIDE ALFALFA ACRES, AS SHOWN BY MAP ON FILE IN BOOK 8, PAGE 21 OF MAPS, RIVERSIDE COUNTY RECORDS.

EXCEPTING THEREFROM ANY PORTION LYING WITHIN TRACT NO. 22180-2 AS PER MAP RECORDED IN BOOK 207 OF MAPS, PAGES 97 THROUGH 103, INCLUSIVE, RIVERSIDE COUNTY RECORDS.

ALSO EXCEPTING THEREFROM ANY PORTION LYING WITHIN TRACT NO. 22180-3
AS PER MAP RECORDED IN BOOK 208, OF MAPS, PAGES 1 THROUGH 6, INCLUSIVE,
RIVERSIDE COUNTY RECORDS.

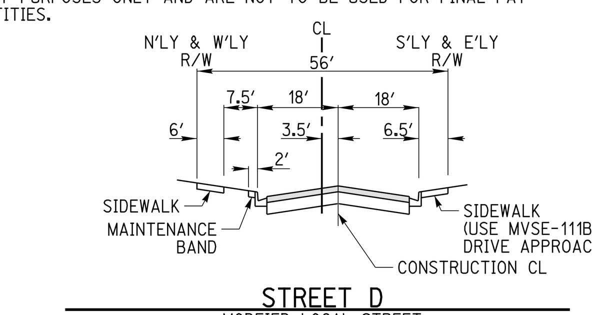
EASEMENTS

1. 100' CALIFORNIA DWR AQUEDUCT EASEMENT
2. 30' EMWD SEWER EASEMENT
3. PUBLIC UTILITY EASMENT 4' ON EACH SIDE OF LOT LINE REC 04/19.1977 # 67179
4. 6' PUBLIC UTLITY EASEMENT REC 04/19/1977
5. EASEMENT FOR ROADWAY PUBLIC UTILITY AND DRAINAGE, 04/06/2006 #0246722, 12/15/2006 #0919865

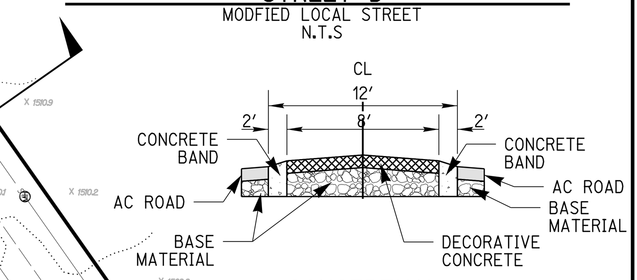
ESTIMATED GRADING QUANTITIES

ESTIMATED EXCAVATION: 108,000 C.Y.
ESTIMATED EMBANKMENT: 108,000 C.Y.

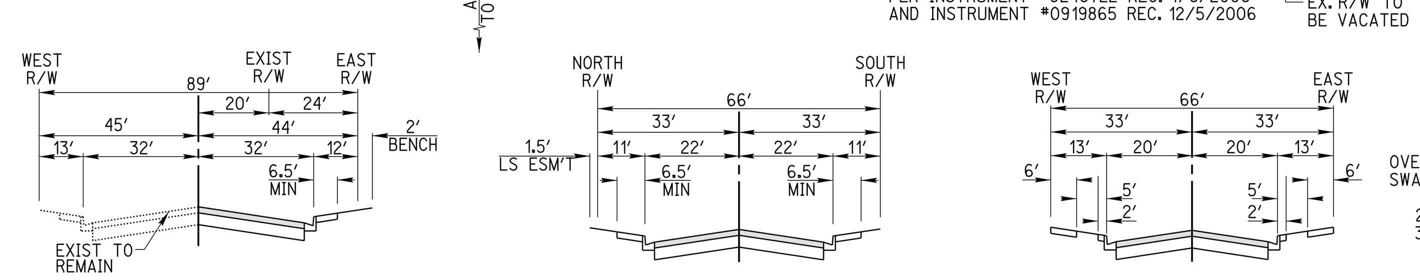
NOTE: THE GRADING QUANTITIES SHOWN HEREON ARE RAW QUANTITIES FOR PERMIT PURPOSES ONLY AND ARE NOT TO BE USED FOR FINAL PAY QUANTITIES.



STREET D
MODIFIED LOCAL STREET
N.T.S.



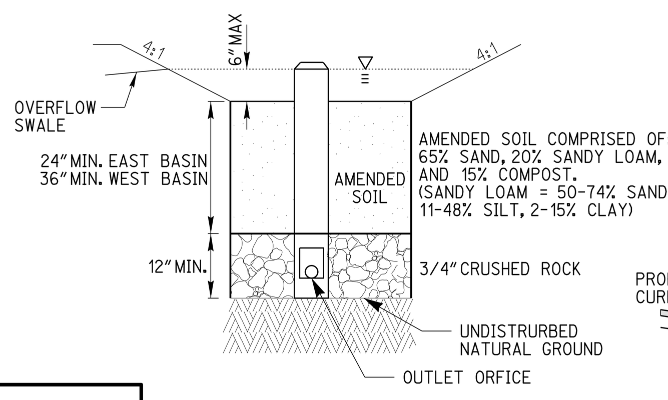
CONCEPTUAL
RAISED CROSSWALK
STREET L
N.T.S.



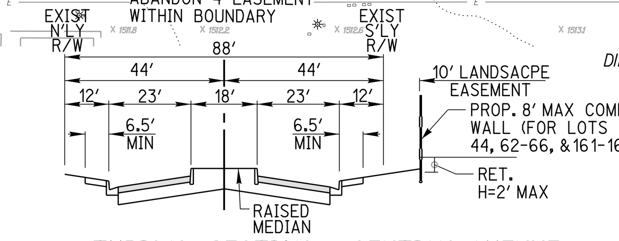
TYPICAL SECTION - INDIAN STREET
MINOR ARTERIAL (MVSI-105A-0)

SANTIAGO DRIVE (WEST)
COLLECTOR (MVSI-106B-0)
LOT Q

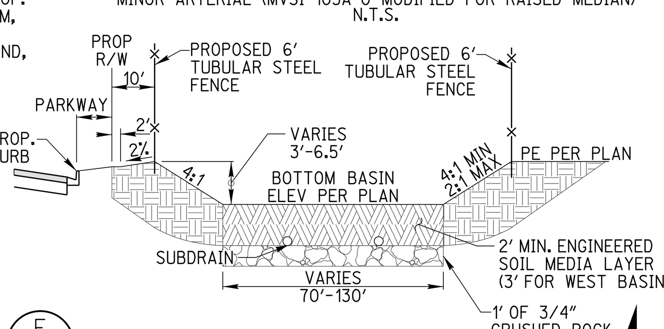
STREET L
MODIFIED COLLECTOR (MVSI-106B-0)
N.T.S.



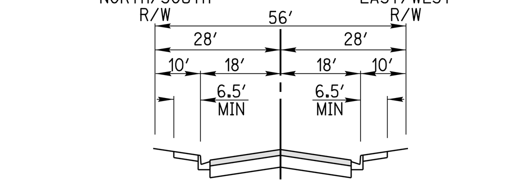
BASIN DETAIL AT OUTLET
N.T.S.



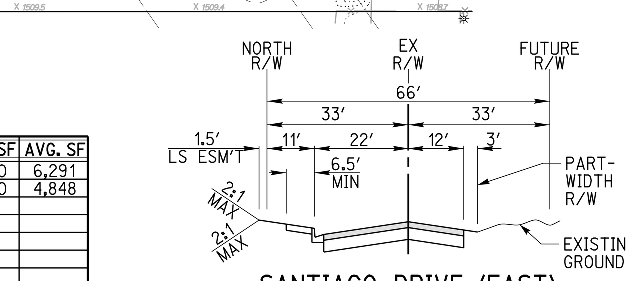
TYPICAL SECTION - GENTIAN AVENUE
MINOR ARTERIAL (MVSI-105A-0 MODIFIED FOR RAISED MEDIAN)
N.T.S.



BIO-RETENTION BASIN



TYPICAL SECTION - INTERIOR STREETS
LOCAL STREET (MVSI-107A-0)
STREETS A, B, C, E, G, H, I, J, K, M, N, O
N.T.S.



SANTIAGO DRIVE (EAST)
N.T.S.

LAND USE

	LAND USE	LOT NO.	MAINTAINED BY	# OF LOTS	AREA	LOT SIZE	DENSITY	MIN. SF	AVG. SF
50x100 NEIGHBORHOOD	RESIDENTIAL	1-145		145	34.6 AC	50'x100'	4.2 DU/AC	5,000	6,291
50x80 NEIGHBORHOOD	RESIDENTIAL	146-221		76	18.3 AC	50'x80'	4.2 DU/AC	4,000	4,848
OPEN SPACE	BASIN	AA	HOA		1.32 AC				
OPEN SPACE	SD ESM'T/COMMON AREA	BB	HOA		6,426 SF				
OPEN SPACE	PARK	CC	CITY		2.83 AC				
OPEN SPACE	BASIN	DD	HOA		1.19 SF				
OPEN SPACE	SD ESM'T/COMMON AREA	EE	HOA		1,600 SF				
OPEN SPACE	COMMON AREA	FF	HOA		8,008 SF				
OPEN SPACE	COMMON AREA	GG	HOA		1,558 SF				
OPEN SPACE	AQUEDUCT/TRAIL	HH	CITY		3.46 AC				
OPEN SPACE	PASEO	II	HOA		2,400 SF				
OPEN SPACE	PASEO	JJ	HOA		5,688 SF				
OPEN SPACE	COMMON AREA	KK	HOA		704 SF				
OPEN SPACE	COMMON AREA	LL	HOA		669 SF				
OPEN SPACE	COMMON AREA	MM	HOA		1,037 SF				
OPEN SPACE	COMMON AREA	NN	HOA		931 SF				
INDIAN STREET	ROAD	S	CITY		0.73 AC				
SANTIAGO DR (WEST)	ROAD	Q	CITY		0.56 AC				
SANTIAGO DR (EAST)	ROAD	R	CITY		0.73 AC				
ONSITE ROADS					12.0 AC				
NET					48.8 AC				
GROSS					52.9 AC		4.2 DU/AC		5,801

NOTE: ALL DENSITY CALCULATIONS ARE BASED ON GROSS ACREAGE.

ENGINEER OF WORK
RICHARD C. O'NEILL R.C.E. 63285 DATE

LAND SURVEYOR
WILLIAM ROHAL L.S. 8805 DATE

DRAWN BY: ELB | DESIGNED BY: ELB | CHECKED BY: NCS | APPROVED BY:

PRELIMINARY
NOT FOR CONSTRUCTION

DATE	BY	REVISIONS

TTM 36760 (PUD)
PA14-0052, PA14-0053
MARCH 8, 2016
REVISED: OCTOBER 20, 2016

RICK ENGINEERING COMPANY
1770 IOWA AVENUE - SUITE 100
RIVERSIDE, CA 92507
951.782.0707
FAX 951.782.0723
rickengineering.com

Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data

Leighton and Associates, Inc.
A LEIGHTON GROUP COMPANY

September 14, 2016

Project No. 11427.001

MISSION PACIFIC LAND COMPANY
4100 Newport Place, Suite 480
Newport Beach, California 92660

Attention: Mr. Jason Keller, P.E.

Subject: Results of Onsite Percolation Testing
Proposed Storm Water Quality Basin, TTM 36760
Moreno Valley, California

References: Riverside County Flood Control District, Design Handbook for Low Impact Development Best Management Practices, dated September 2011.

Rick Engineering Company, 2016, Tentative Tract 36760, Planned Unit Development, dated March 8, 2016, revised July 26, 2016, 60-scale, 1 sheet.

In accordance with your request and authorization, Leighton and Associates, Inc. (Leighton) is pleased to present this percolation testing report for the proposed storm water basin located within Tract 36760. The proposed residential development (APNs 485-220-023, -032, -040) is located southeast of the intersection of Indian Street and Gentian Avenue in the City of Moreno Valley, California (See Figure 1, Site Location Map).

PURPOSE AND SCOPE OF WORK

The purpose of our testing was to determine general infiltration rates of onsite soils, depth to bedrock and/or groundwater with respect to one proposed storm water quality basin location as depicted on the referenced plan. Services provided for this study consisted of the following:

- Drilling, sampling and logging of 1 exploratory deep boring in the area of the proposed storm water basin;
- Field testing of percolation tests in accordance with the procedures outlined in the above referenced County Design Handbook; and

41715 Enterprise Circle N., Suite 103 ▪ Temecula, CA 92590-5661
951.296.0530 ▪ Fax 951.296.0534

- Compilation of this report that presents the results of our percolation/infiltration testing and laboratory test results.

SITE DESCRIPTION

The overall site consists of approximately 53 acres of vacant relatively flat land. Based on the referenced basin plan (Rick Engineering), the proposed storm water quality basin will be located in the general area depicted on Figure 2. We understand that the planned basin will have a maximum depth of 0.5 to 2.5 feet BGS.

SUBSURFACE INVESTIGATION

Our field investigation consisted of excavating 1 deep exploratory boring up to 21.5 feet deep and 5 percolation test holes (3 feet deep) on September 9, 2016. The boring and test holes were excavated utilizing a truck mounted CME 75 drill rig equipped with an 8-inch hollow-stem auger. The exploratory borings were continuously logged to a depth of deeper than 10 feet below bottom of the proposed basin. A geologist from our office logged and observed all excavations. The locations of the exploratory boring and percolation test holes are shown on Figure 2. The logs of the exploratory boring and percolation test holes are included in Appendix A.

SOILS AND GROUNDWATER CONDITIONS

Based on the results of this study, the site is underlain by younger alluvial soil. The encountered younger alluvium is classified as loose to medium dense, silty sand (SM) with varying amounts of gravel. Groundwater was not encountered to the depth explored of 21.5 feet.

PERCOLATION TEST RESULTS

Percolation tests were performed at the corresponding depths shown in table below. The percolation tests were performed in accordance with the procedures of Section 2.3 of the County Design Handbook referenced above. Results reported below are the most conservative reading in minutes per inch drop and converted to inches per hour per the Porchet method. Field test data are included in Appendix A.

Summary of Percolation/Infiltration Test Results

Test Hole #	Ex. Ground Surface Elev. (ft)	Depth BGS (ft)	Percolation Rate (min/in)	Infiltration Rate (in/hr)	Soil Description/Notes
P-1	1511.5	3	10.0	0.56	Silty Sand (SM) Younger Alluvium
P-2	1512.0	3	6.7	0.85	Silty Sand (SM) Younger Alluvium
P-3	1511.5	3	6.7	0.85	Silty Sand (SM) Younger Alluvium
P-4	1510.5	3	8.6	0.69	Silty Sand (SM) Younger Alluvium
P-5	1510.5	3	6.7	0.85	Silty Sand (SM) Younger Alluvium

CONCLUSIONS AND RECOMMENDATIONS

For preliminary design purposes, an infiltration rate of 0.56 in/hr may be used for the southeast basin.

LIMITATIONS

The above findings and recommendations are based on a general interpretation of soils conditions between test locations, utilizing contemporary engineering principles and practice. We make no other warranty, either expressed or implied. Please notify the engineer in the event conditions are encountered that are not reflected in this report.

If you have any question, please do not hesitate to contact this office. We appreciate this opportunity to be of service.

Respectfully submitted,
LEIGHTON AND ASSOCIATES, INC.

PROFESSIONAL ENGINEER KENNETH EDWIN COX 2793 GEOTECHNICAL STATE OF CALIFORNIA

Kenneth E. Cox, GE 2793
Senior Project Engineer

REGISTERED GEOLOGIST ROBERT F. RIHA No. 1921 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

Robert F. Riha, CEG 1921
Vice President / Senior Principal Geologist

Attachments: Figure 1 – Site Location Map
Figure 2 – Percolation Test Locations
Appendix A – Perc Data Test Sheets & Log of Exploratory Borings

Distribution: (1) addressee (PDF copy via email)

Leighton

Project: 11427.001	Eng/Geol: KC/RFR
Scale: 1 " = 2,000 '	Date: September 2016

Base Map: ESRI ArcGIS Online 2016
Thematic Information: Leighton
Author: Leighton Geomatics (mmurphy)

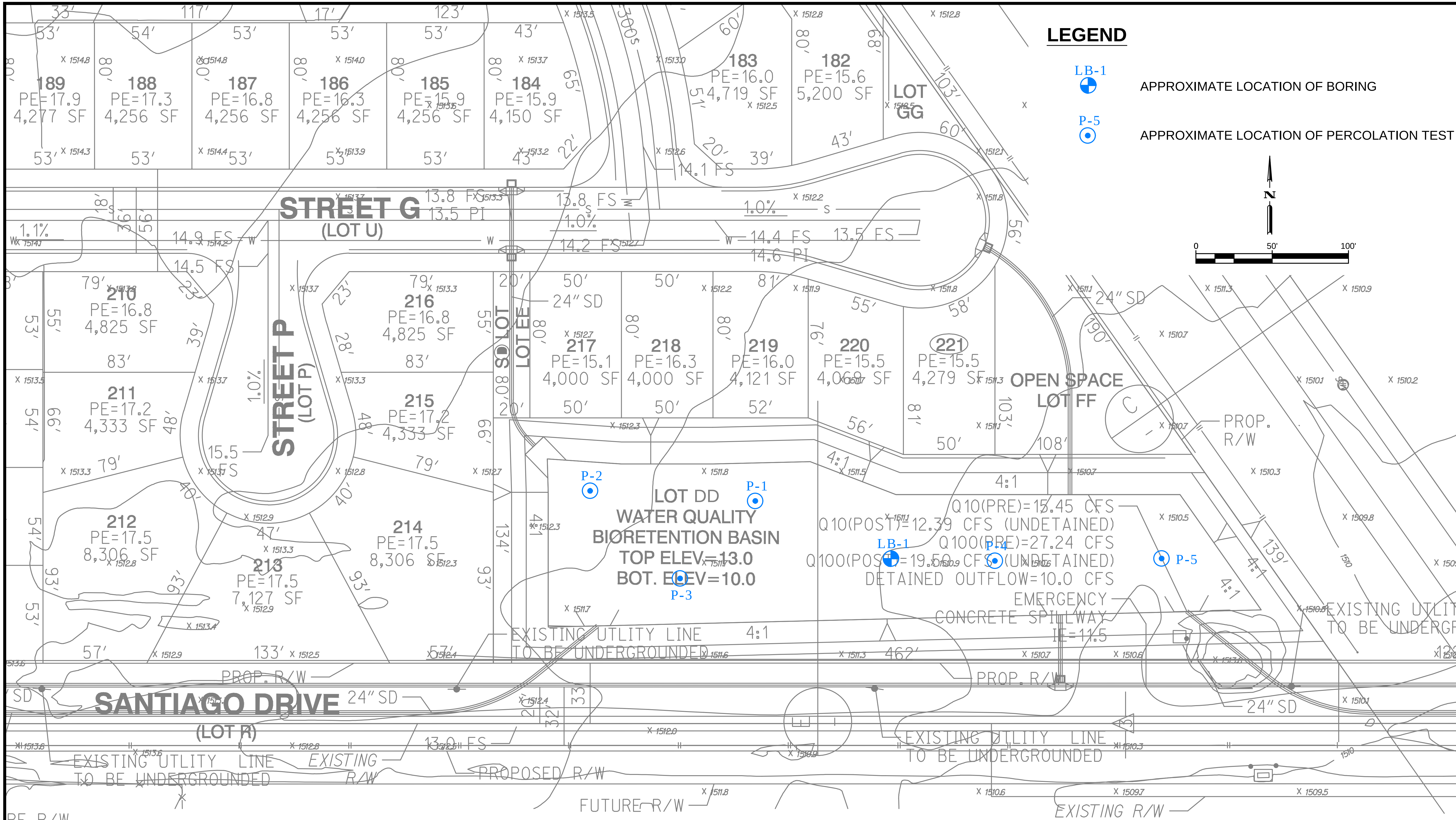
SITE LOCATION MAP

Residential Development, Tentative Tract Map 36760
APNs: 485-220-023, 485-220-032, 485-220-040
Moreno Valley, California

Figure 1

Leighton

Map Saved as V:\Drafting\11427\001\Maps\11427-001_F01_SLM_2016-08-29.mxd on 8/29/2016 9:02:07 AM



Proj: 11427.001	Geo/Eng: KEC/RFR
Scale: 1"=50'	Date: September 2016
Reference:	

BORING/PERCOLATION TEST LOCATION MAP

Residential Development, Tentative Tract Map 36760
APN's 485-220-023, 485-220-032, 485-220-040
Moreno Valley, California

Figure-2

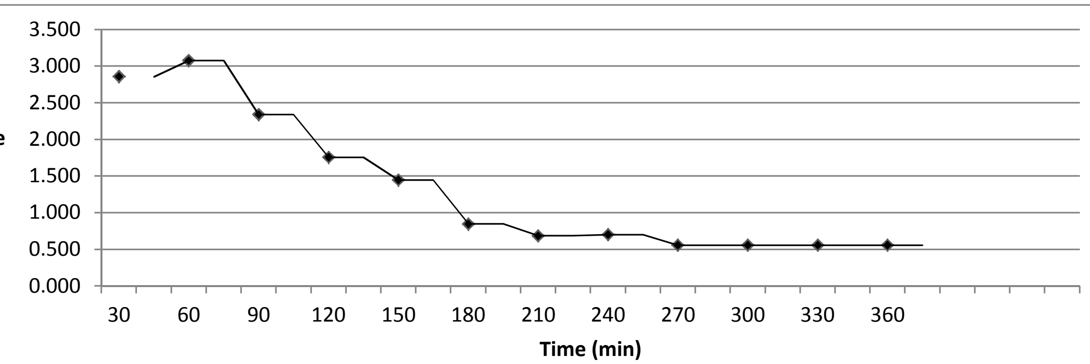
Leighton

APPENDIX A

Percolation Data Sheets & Log of Exploratory Borings

Test Hole Number:	P-1	Project	TTM 36760 Perc	
Date Excavated:	9/9/2016	Project Number	11427.001	
Tested by:	JTD	Date Tested	9/12/2016	
Soil Unit:	Alluvium (Qal)	Depth of Test Hole (in.)	36	
USCS Soil Type:	Brown Silty SAND	Diameter (in.)	8	Cloudy ~70 °

Time	Δt (min)	Initial Water Depth (inches)	Final Water Depth (inches)	Change In Water Level (inches)	Infiltration/Percolation Rate	
					inches/hour*	minute/inch
9:28:00 9:38:00	10.00	14.50	19.50	5.00	2.857	2.000
9:38:00 9:48:00	10.00	16.00	21.00	5.00	3.077	2.000
9:48:00 9:58:00	10.00	15.50	19.50	4.00	2.341	2.500
9:58:00 10:08:00	10.00	16.00	19.00	3.00	1.756	3.333
10:08:00 10:18:00	10.00	16.00	18.50	2.50	1.446	4.000
10:18:00 10:28:00	10.00	16.00	17.50	1.50	0.847	6.667
10:28:00 10:38:00	10.00	15.50	16.75	1.25	0.686	8.000
10:38:00 10:48:00	10.00	16.00	17.25	1.25	0.702	8.000
10:48:00 10:58:00	10.00	16.00	17.00	1.00	0.558	10.000
10:58:00 11:08:00	10.00	16.00	17.00	1.00	0.558	10.000
11:08:00 11:18:00	10.00	16.00	17.00	1.00	0.558	10.000
11:18:00 11:28:00	10.00	16.00	17.00	1.00	0.558	10.000

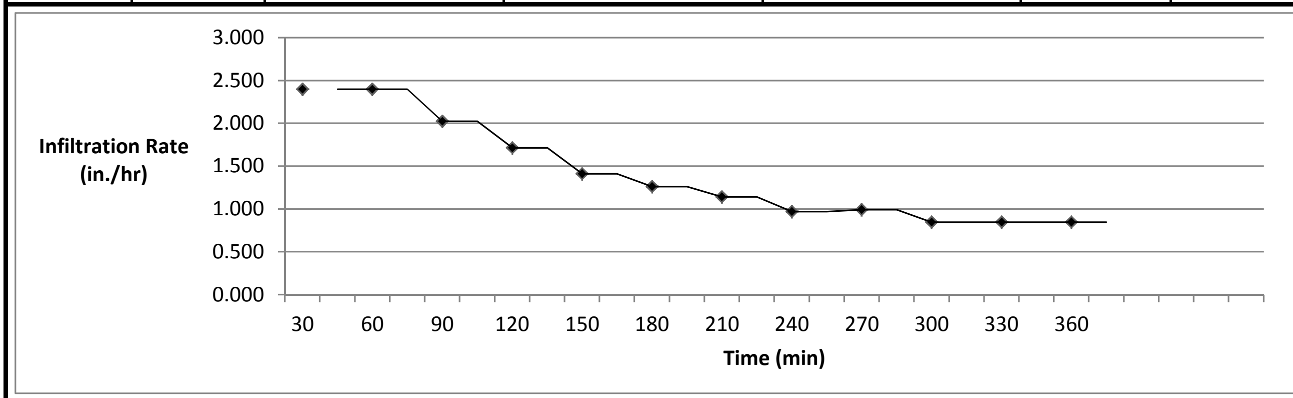


* Based on Prochet Method

Percolation Test Data **P- 1**	***Project Number:*** 11427.001 ***Project Name:*** *TTM 36760* ***Date:*** Sep-16	Leighton

Test Hole Number:	P-2	Project	TTM 36760 Perc	
Date Excavated:	9/9/2016	Project Number	11427.001	
Tested by:	JTD	Date Tested	9/12/2016	
Soil Unit:	Alluvium (Qal)	Depth of Test Hole (in.)	36	
USCS Soil Type:	Brown Silty SAND	Diameter (in.)	8	Cloudy ~70 °

Time	Δt (min)	Initial Water Depth (inches)	Final Water Depth (inches)	Change In Water Level (inches)	Infiltration/Percolation Rate inches/hour*	Infiltration/Percolation Rate minute/inch
9:29:00 9:39:00	10.00	16.00	20.00	4.00	2.400	2.500
9:39:00 9:49:00	10.00	16.00	20.00	4.00	2.400	2.500
9:49:00 9:59:00	10.00	15.50	19.00	3.50	2.024	2.857
9:59:00 10:09:00	10.00	15.50	18.50	3.00	1.714	3.333
10:09:00 10:19:00	10.00	15.50	18.00	2.50	1.412	4.000
10:19:00 10:29:00	10.00	15.50	17.75	2.25	1.263	4.444
10:29:00 10:39:00	10.00	16.00	18.00	2.00	1.143	5.000
10:39:00 10:49:00	10.00	15.50	17.25	1.75	0.971	5.714
10:49:00 10:59:00	10.00	16.00	17.75	1.75	0.994	5.714
10:59:00 11:09:00	10.00	16.00	17.50	1.50	0.847	6.667
11:09:00 11:19:00	10.00	16.00	17.50	1.50	0.847	6.667
11:19:00 11:29:00	10.00	16.00	17.50	1.50	0.847	6.667



* Based on Prochet Method

Percolation Test Data

P-2

Project Number: 11427.001

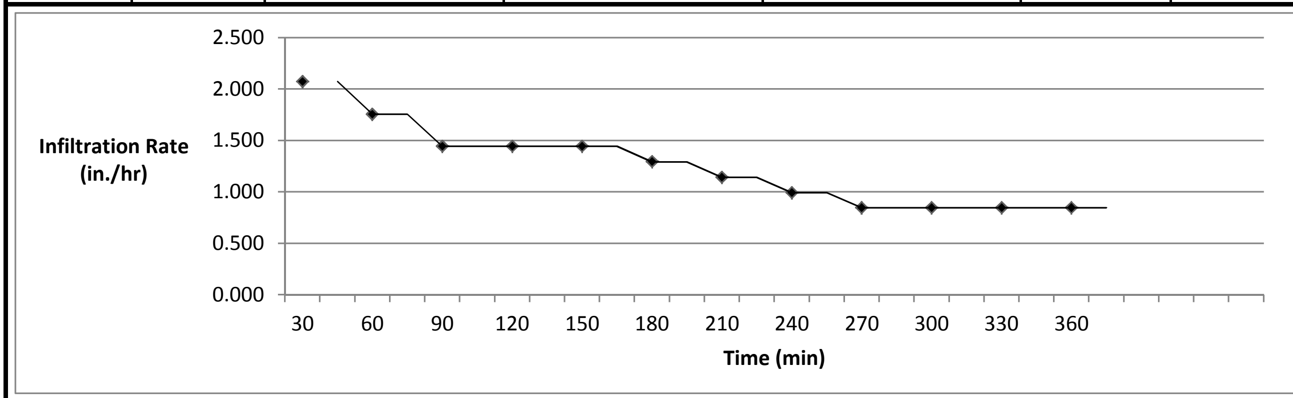
Project Name: *TTM 36760*

Date: Sep-16

Leighton

Test Hole Number:	P-3	Project	TTM 36760 Perc	
Date Excavated:	9/9/2016	Project Number	11427.001	
Tested by:	JTD	Date Tested	9/12/2016	
Soil Unit:	Alluvium (Qal)	Depth of Test Hole (in.)	36	
USCS Soil Type:	Brown Silty SAND	Diameter (in.)	8	Cloudy ~70 °

Time	Δt (min)	Initial Water Depth (inches)	Final Water Depth (inches)	Change In Water Level (inches)	Infiltration/Percolation Rate	
					inches/hour*	minute/inch
9:30:00 9:40:00	10.00	16.00	19.50	3.50	2.074	2.857
9:40:00 9:50:00	10.00	16.00	19.00	3.00	1.756	3.333
9:50:00 10:00:00	10.00	16.00	18.50	2.50	1.446	4.000
10:00:00 10:10:00	10.00	16.00	18.50	2.50	1.446	4.000
10:10:00 10:20:00	10.00	16.00	18.50	2.50	1.446	4.000
10:20:00 10:30:00	10.00	16.00	18.25	2.25	1.293	4.444
10:30:00 10:40:00	10.00	16.00	18.00	2.00	1.143	5.000
10:40:00 10:50:00	10.00	16.00	17.75	1.75	0.994	5.714
10:50:00 11:00:00	10.00	16.00	17.50	1.50	0.847	6.667
11:00:00 11:10:00	10.00	16.00	17.50	1.50	0.847	6.667
11:10:00 11:20:00	10.00	16.00	17.50	1.50	0.847	6.667
11:20:00 11:30:00	10.00	16.00	17.50	1.50	0.847	6.667

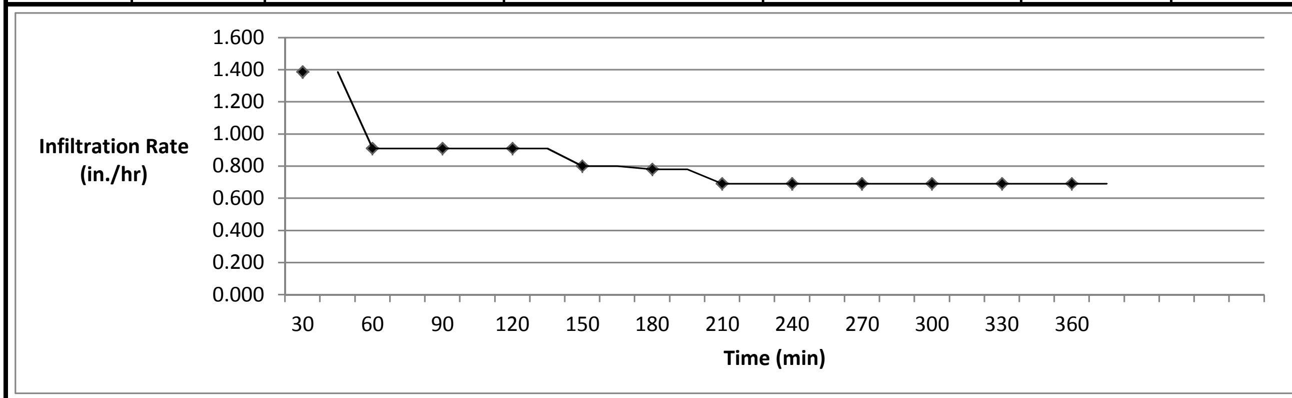


* Based on Prochet Method

Percolation Test Data P-3	***Project Number:*** 11427.001 ***Project Name:*** *TTM 36760* ***Date:*** Sep-16	Leighton

Test Hole Number:	P-4	Project	TTM 36760 Perc	
Date Excavated:	9/9/2016	Project Number	11427.001	
Tested by:	JTD	Date Tested	9/12/2016	
Soil Unit:	Alluvium (Qal)	Depth of Test Hole (in.)	36	
USCS Soil Type:	Brown Silty SAND	Diameter (in.)	8	Cloudy ~70 °

Time	Δt (min)	Initial Water Depth (inches)	Final Water Depth (inches)	Change In Water Level (inches)	Infiltration/Percolation Rate	
					inches/hour*	minute/inch
6:59:00 7:09:00	30.00	16.00	22.50	6.50	1.387	4.615
7:09:00 7:19:00	30.00	16.00	20.50	4.50	0.911	6.667
7:19:00 7:29:00	30.00	16.00	20.50	4.50	0.911	6.667
7:29:00 7:39:00	30.00	16.00	20.50	4.50	0.911	6.667
7:39:00 7:49:00	30.00	16.00	20.00	4.00	0.800	7.500
7:49:00 7:59:00	30.00	15.50	19.50	4.00	0.780	7.500
7:59:00 8:09:00	30.00	16.00	19.50	3.50	0.691	8.571
8:09:00 8:19:00	30.00	16.00	19.50	3.50	0.691	8.571
8:19:00 8:29:00	30.00	16.00	19.50	3.50	0.691	8.571
8:29:00 8:39:00	30.00	16.00	19.50	3.50	0.691	8.571
8:39:00 8:49:00	30.00	16.00	19.50	3.50	0.691	8.571
8:49:00 8:59:00	30.00	16.00	19.50	3.50	0.691	8.571



* Based on Prochet Method

Percolation Test Data

P-4

Project Number: 11427.001

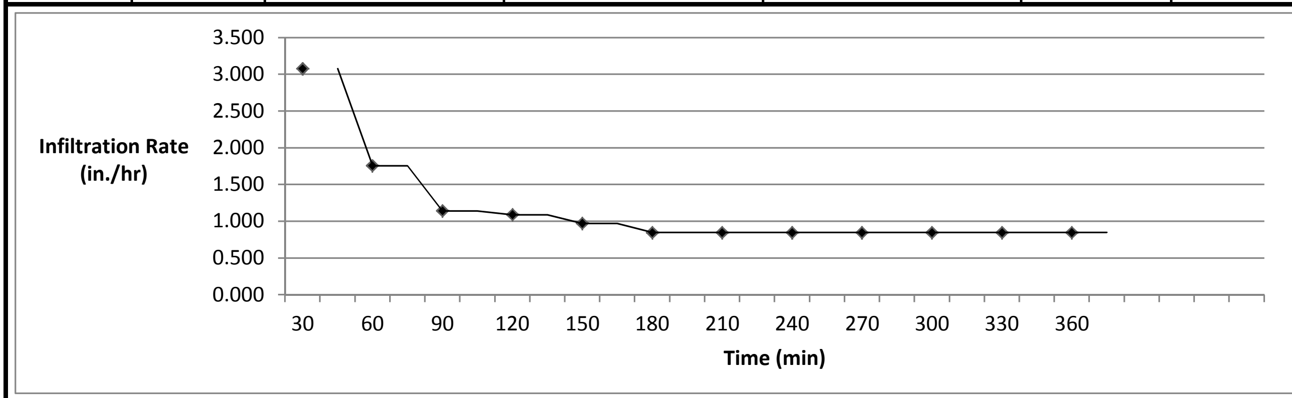
Project Name: *TTM 36760*

Date: Sep-16

Leighton

Test Hole Number:	P-5	Project	TTM 36760 Perc	
Date Excavated:	9/9/2016	Project Number	11427.001	
Tested by:	JTD	Date Tested	9/12/2016	
Soil Unit:	Alluvium (Qal)	Depth of Test Hole (in.)	36	
USCS Soil Type:	Brown Silty SAND	Diameter (in.)	8	Cloudy ~70 °

Time	Δt (min)	Initial Water Depth (inches)	Final Water Depth (inches)	Change In Water Level (inches)	Infiltration/Percolation Rate	
					inches/hour*	minute/inch
7:00:00 7:10:00	10.00	16.00	21.00	5.00	3.077	2.000
7:10:00 7:20:00	10.00	16.00	19.00	3.00	1.756	3.333
7:20:00 7:30:00	10.00	16.00	18.00	2.00	1.143	5.000
7:30:00 7:40:00	10.00	15.00	17.00	2.00	1.091	5.000
7:40:00 7:50:00	10.00	15.50	17.25	1.75	0.971	5.714
7:50:00 8:00:00	10.00	16.00	17.50	1.50	0.847	6.667
8:00:00 8:10:00	10.00	16.00	17.50	1.50	0.847	6.667
8:10:00 8:20:00	10.00	16.00	17.50	1.50	0.847	6.667
8:20:00 8:30:00	10.00	16.00	17.50	1.50	0.847	6.667
8:30:00 8:40:00	10.00	16.00	17.50	1.50	0.847	6.667
8:40:00 8:50:00	10.00	16.00	17.50	1.50	0.847	6.667
8:50:00 9:00:00	10.00	16.00	17.50	1.50	0.847	6.667



* Based on Prochet Method

Percolation Test Data

P-5

Project Number: 11427.001

Project Name: *TTM 36760*

Date: Sep-16

Leighton

GEOTECHNICAL BORING LOG LB-1

Project No.	11427.001	**Date Drilled**	9-9-16
Project	TTM 36760 Perc	**Logged By**	JTD
Drilling Co.	2-R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	~1511'
Location	See Boring Location Map	**Sampled By**	JTD

SOIL DESCRIPTION

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

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0							SM	**Quaternary Alluvium (Qal)**; SILTY SAND, brown, dry to moist, fine to coarse grained sand	
									becomes dark yellowish brown, moist	
	5			S-1	12 11 11				becomes, medium dense, moist	
									becomes SILTY SAND with GRAVEL	
	10			S-2	5 6 8				becomes SILTY SAND, dark grayish brown	
	15			S-3	6 8 13					
	20			S-4	5 7 7				becomes SILTY SAND with gravel, brown, fine to coarse grained sand with fine gravel	
									Drilled to 21.5' Sampled to 21.5' Groundwater not encountered Backfilled with cuttings	
	25									
	30									

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

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

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

GEOTECHNICAL BORING LOG P-1

Project No.	11427.001	**Date Drilled**	9-9-16
Project	TTM 36760 Perc	**Logged By**	JTD
Drilling Co.	2-R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	~1511.5'
Location	See Boring Location Map	**Sampled By**	JTD

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
	0							SM	**Quaternary Alluvium (Qal)**; SILTY SAND with GRAVEL, brown, dry to moist, fine to coarse grained sand with fine gravel	
				S-1	6 8 8				becomes SILTY SAND, medium dense	
									Drilled to 3' Sampled to 3' Groundwater not encountered Backfilled with cuttings	
	5									
	10									
	15									
	20									
	25									
	30									

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

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

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

GEOTECHNICAL BORING LOG P-2

Project No.	11427.001	**Date Drilled**	9-9-16
Project	TTM 36760 Perc	**Logged By**	JTD
Drilling Co.	2-R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	~1512'
Location	See Boring Location Map	**Sampled By**	JTD

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0							SM	**Quaternary Alluvium (Qal)**; SILTY SAND with GRAVEL, brown, dry to moist, fine to coarse grained sand with fine gravel	
				S-1	7 7 7				becomes SILTY SAND, medium dense	
									Drilled to 3' Sampled to 3' Groundwater not encountered Backfilled with cuttings	
	5									
	10									
	15									
	20									
	25									
	30									

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

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

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

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

GEOTECHNICAL BORING LOG P-3

Project No.	11427.001	**Date Drilled**	9-9-16
Project	TTM 36760 Perc	**Logged By**	JTD
Drilling Co.	2-R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	~1511.5'
Location	See Boring Location Map	**Sampled By**	JTD

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0							SM	**Quaternary Alluvium (Qal)**; SILTY SAND with GRAVEL, brown, dry to moist, fine to coarse grained sand with fine gravel	
				S-1	6 6 3				becomes SILTY SAND, loose, dark brown, moist, fine to coarse grained sand	
	5								Drilled to 3' Sampled to 3' Groundwater not encountered Backfilled with cuttings	
	10									
	15									
	20									
	25									
	30									

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

TYPE OF TESTS:

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

GEOTECHNICAL BORING LOG P-4

Project No.	11427.001	**Date Drilled**	9-9-16
Project	TTM 36760 Perc	**Logged By**	JTD
Drilling Co.	2-R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	~1510.5'
Location	See Boring Location Map	**Sampled By**	JTD

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0							SM	**Quaternary Alluvium (Qal)**; SILTY SAND with GRAVEL, brown, dry to moist, fine to coarse grained sand with fine gravel	
				S-1	8 8 9				becomes SILTY SAND, medium dense, fine to coarse grained sand	
	5								Drilled to 3' Sampled to 3' Groundwater not encountered Backfilled with cuttings	
	10									
	15									
	20									
	25									
	30									

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

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

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

GEOTECHNICAL BORING LOG P-5

Project No.	11427.001	**Date Drilled**	9-9-16
Project	TTM 36760 Perc	**Logged By**	JTD
Drilling Co.	2-R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	~1510.5'
Location	See Boring Location Map	**Sampled By**	JTD

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
	0							SM	**Quaternary Alluvium (Qal)**; SILTY SAND with GRAVEL, brown, dry to moist, fine to coarse grained sand with gravel to 1"	
				S-1	5 4 4				becomes SILTY SAND, loose, very fine to medium grained sand	
	5								Drilled to 3' Sampled to 3' Groundwater not encountered Backfilled with cuttings	
	10									
	15									
	20									
	25									
	30									

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

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

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

PRELIMINARY GEOTECHNICAL INVESTIGATION, PROPOSED 104-ACRE RESIDENTIAL DEVELOPMENT, NORTHWEST OF PERRIS BOULEVARD AND IRIS AVENUE, CITY OF MORENO VALLEY, CALIFORNIA

Prepared for:

YOUNG HOMES
10370 Trademark Street
Rancho Cucamonga, California 91730

Project No. 021164-001

June 9, 2004

Leighton and Associates, Inc.
A LEIGHTON GROUP COMPANY

Leighton and Associates, Inc.
A LEIGHTON GROUP COMPANY

June 9, 2004

Project No. 021164-001

To: Young Homes
10370 Trademark Street
Rancho Cucamonga, California 91730

Attention: Mr. Thomas Owen

Subject: Preliminary Geotechnical Investigation, Proposed 104-Acre Residential Development, Northwest of Perris Boulevard and Iris Avenue, City of Moreno Valley, California

In response to your request, Leighton and Associates, Inc. has conducted a preliminary geotechnical investigation of the proposed residential development to be located northwest of Perris Boulevard and Iris Avenue in the City of Moreno Valley, California. The purpose of our investigation has been to explore the subsurface conditions at the site, to evaluate the general soil characteristics, and to provide preliminary geotechnical recommendations for the design and construction of the proposed improvements.

Based upon our investigation, the proposed development is feasible from a geotechnical viewpoint, provided our recommendations are incorporated in the design and construction of the project. The following report presents our geotechnical findings, conclusions, and preliminary recommendations. Additional geotechnical investigation and analysis may be necessary, based on the actual development plans for submittal with the project grading plans.

10532 Acacia Street, Suite B-6 ▪ Rancho Cucamonga, CA 91730
909.484.2205 ▪ Fax 909.484.2170 ▪ www.leightongeo.com

We appreciate the opportunity to work with you on this project. If you have any questions, or if we can be of further service, please call us at your convenience.

Respectfully submitted,

LEIGHTON AND ASSOCIATES, INC.

REGISTERED PROFESSIONAL ENGINEER
JASON D. HERTZBERG
No. 61778
Exp. 6-30-05
CIVIL
STATE OF CALIFORNIA

Jason Hertzberg, RCE 61778
Project Engineer

Philip A. Buchiarelli, CEG 1715
Senior Associate Geologist

David C. Smith, RCE 46222
Vice President/Principal Engineer

DAG/JDH/PB/DCS/rsh

Distribution: (4) Addressee

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Figure 1 - Site Location Map - Page 2
Figure 2 - Geotechnical Map - Rear of Text
Figure 3 - Retaining Wall Backfill and Subdrain Detail - Rear of Text

1.0 INTRODUCTION

1.1 Site Location and Project Description

The site is located northwest of Perris Boulevard and Iris Avenue in the City of Moreno Valley, California (see Figure 1, Site Location Map). The project area is bounded on the east by Perris Boulevard and the Home Depot shopping center, on the south by Iris Avenue, on the west by Indian Street and an elementary school, and on the north by vacant land. March Air Reserve Base is approximately one mile west. The East Branch California Aqueduct crosses the eastern portion of the site. The approximately 104-acre flat site is irregular in shape and is currently vacant. Vegetation consists of seasonal grasses, brush, and several scattered small trees.

Based on our review of historic aerial photographs, the site was used for agricultural purposes within the period of at least 1953 to 1980, and was otherwise vacant.

It is our understanding that the intended use of the site is a residential development. Although grading and construction plans are not yet available, we anticipate that minor cuts and fills will be required to attain the desired finish grades. We anticipate the one- and two-story single-family residences will be constructed. A parcel map provided by you was used as the base map for our Geotechnical Map, Figure 2 (rear of text).

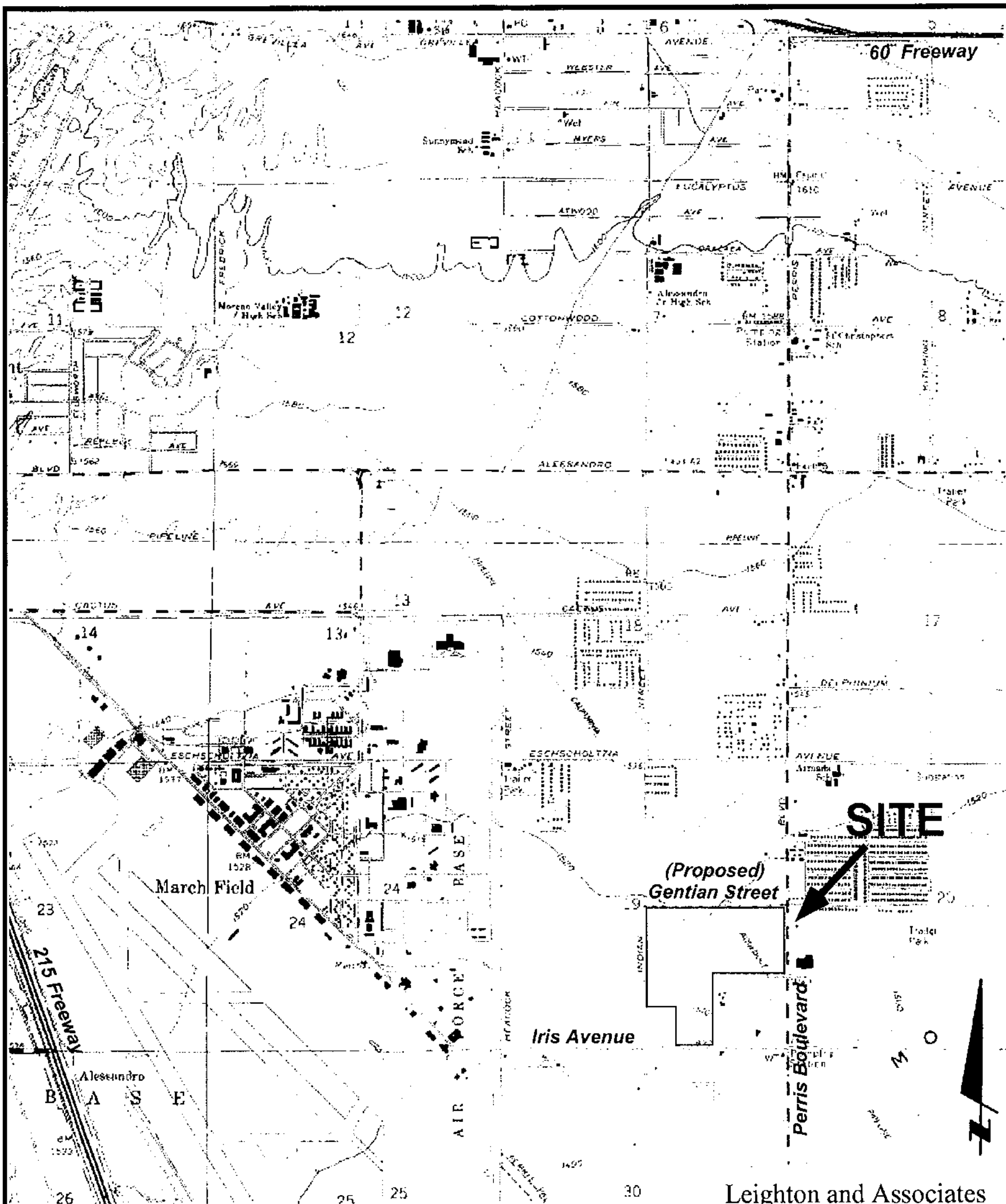
1.2 Purpose of Investigation

The purpose of this study has been to evaluate the general geotechnical conditions at the site, to identify significant geotechnical or geologic issues that would impact site development, and to provide preliminary geotechnical recommendations for design and construction.

1.3 Scope of Investigation

The scope of our investigation has included the following tasks:

- Background Review - A background review of readily available, relevant, in-house geotechnical literature, and aerial photographs was performed.
- Pre-field Investigation Activities - Coordinated with Underground Service Alert (USA) to have existing underground utilities located and marked prior to our subsurface investigation.



Proposed 104-Acre Residential Development Northwest of Perris Boulevard and Iris Avenue, City of Moreno Valley, California	**Site Location Map**	Project No. 021164-001 Date June, 2004 Figure 1

- Field Investigation - Our field investigation consisted of the excavation of borings and test pits as follows:

  Borings
  Eight hollow-stem auger borings were excavated, logged and sampled at representative locations within the site. One boring was excavated to a depth of 51.5 feet and seven borings were excavated to depths of 21.5 feet below the existing ground surface. Each boring was logged by a member of our technical staff. Relatively undisturbed soil samples were obtained at selected intervals within the borings using Standard Penetration Testing and a California Ring Sampler. Logs of the geotechnical borings are presented in Appendix B. Approximate boring locations are shown on the accompanying Geotechnical Map, Figure 2.

  Test Pits
  Eight backhoe test pits were excavated and logged at representative locations within the site to a maximum depth of 5.5 feet below the existing ground surface. Each test pit was logged by a member of our technical staff. Bulk soil samples were obtained from the test pits. Logs of the test pits are presented in Appendix C. Approximate test pit locations are shown on the accompanying Geotechnical Map, Figure 2.

- Laboratory Tests - Laboratory tests were conducted on selected relatively undisturbed and bulk soil samples obtained during our field investigation. The laboratory testing program was designed to evaluate the engineering characteristics of the onsite soil. Results of the laboratory testing are presented in Appendix D. The laboratory tests conducted during this investigation include:

  - In situ moisture content and dry density.
  - Sieve analysis for grain size distribution.
  - Consolidation and hydrocollapse characteristics.
  - Expansion Index.
  - Maximum dry density and optimum moisture content.
  - R-value for pavement recommendations.

- Water-soluble sulfate concentration in the soil for cement type recommendations.

- Resistivity, chloride content and pH to evaluate corrosion potential.

- Engineering Analysis - The data obtained from our background review and field exploration was evaluated and analyzed in order to provide the conclusions and preliminary recommendations in the following sections.

- Report Preparation - The results of our geotechnical investigation have been summarized in this report, presenting our findings, conclusions and preliminary recommendations.

2.0 FINDINGS

2.1 Site Geology

The site is located in the Perris block of the Peninsular Ranges Geomorphic Province of southern California. The Perris block is a structural block bounded on the north by the San Jacinto Fault Zone (located 8 kilometers northeast of the site) and on the south by the Elsinore Fault Zone (located 29 kilometers southwest of the site). These faults have experienced significant activity in the recent geologic past. These and other northwest-trending right lateral strike slip faults dominate the structure of the Peninsular Ranges. Cretaceous igneous rocks of the Southern California Batholith underlie the Peninsular Ranges in this area. Locally, the site vicinity is underlain by older alluvial soil deposits of clay, silt, sand and gravel (SCGS, 1982; Morton, 1978). Bedrock outcrops of quartz diorite are present approximately ¾ mile east of the site.

2.2 Subsurface Soil Conditions

Based upon our review of pertinent geotechnical literature, and our subsurface exploration, the site is underlain by alluvial soil deposits. The soil encountered during our subsurface exploration in the upper 15 feet generally consisted of loose to medium dense silty sand to gravelly sand and soft to stiff sandy silt. Below a depth of 15 feet, the soil generally consisted of stiff to very stiff sandy silt to clay. These soils were typically characterized as slightly moist to very moist to the depths excavated. Moisture contents in the upper 10 feet ranged from 2 to 10 percent.

2.3 Groundwater

Groundwater was not encountered in any of our borings performed during this investigation to a depth of 51.5 feet. Based on our review of regional groundwater data, groundwater is expected to be on the order of 120 to 140 feet below the ground surface in the site vicinity (CDWR, 2000). However, relatively shallow perched ground water may occur locally (WMWD, 2003).

2.4 Faulting and Seismicity

The two principal seismic considerations for most sites in southern California are surface rupture along active fault traces and damage to structures due to seismically-induced ground shaking. An active fault is one that has moved in the Holocene (last 11,000 years). The closest mapped active fault that could affect the site is the San Jacinto (San

Jacinto Valley) fault, located approximately 9 kilometers northeast of the site. The San Jacinto fault is capable of producing a maximum moment magnitude of 6.9 and an average slip rate of 12 millimeter per year (CDMG, 1998). Other known regional active faults that could affect the site include the San Jacinto (San Bernardino), San Andreas, Elsinore, Chino-Central Avenue and Cucamonga faults.

No traces of active or potentially active faults have been observed to cross the project site. The site is not within an Alquist-Priolo Earthquake Fault Zone (CDMG, 2000). The potential for fault ground rupture at the site is considered very low.

Peak Horizontal Ground Accelerations (PHGA) for the site were estimated using a deterministic seismic hazard analysis, based on currently available earthquake and fault information. The analysis computes the site PHGA that could be expected to result from an earthquake on a specific fault using the estimated maximum magnitude earthquake event. PHGA's were estimated using the EQFAULT computer program (Blake, 2000), based on the attenuation relationship by Sadigh et al. (1997). Based on the analysis, the San Jacinto (San Jacinto Valley) Fault Zone is potentially capable of producing the greatest PHGA at the site, due to its proximity, fault type, and its maximum earthquake magnitude of 6.9 (M_W). It is estimated that such an earthquake on this fault near the site could produce seismic shaking with a PHGA of 0.32g.

The PHGA was also estimated using a probabilistic seismic hazard analsyis. The computer program FRISKSP (Blake, 2000) was used for the analysis. Attenuation relationships used in the computer analysis were developed by Abrahamson and Silva (1997) for soil, Campbell (1997 and 2000) for alluvium, and Sadigh et al. (1997) for deep soil deposits. The analysis indicated an average value of 0.59g for peak horizontal ground acceleration (PHGA) with a 10 percent probability of exceedance in 50 years. The predominant magnitude is approximately 6.8 (Mw) at a distance on the order of 10 kilometers.

2.5 Secondary Seismic Hazards

Liquefaction Potential

Liquefaction is the loss of soil strength or stiffness due to a buildup of excess pore-water pressure during strong ground shaking. Liquefaction is associated primarily with loose (low density), granular, saturated soil. Effects of severe liquefaction can include sand boils, excessive settlement, bearing capacity failures, and lateral spreading.

The Generalized Liquefaction Map for Riverside County (2003) indicates the site is located in an area of shallow groundwater with sediments considered highly susceptible to liquefaction. Our exploratory borings indicate that moderately dense soil underlies the site. In addition, regional groundwater data indicates that shallow groundwater conditions do not exist locally, nor have they existed historically. Based on these findings, the potential for liquefaction appears to be low.

Seismically Induced Settlement

During a strong seismic event, seismically induced settlement can occur within loose to moderately dense, dry or saturated granular soil. Settlement caused by ground shaking can be nonuniformly distributed, resulting in differential settlement. We have performed analyses to estimate seismically-induced settlement using the simplified method set forth by Tokimatsu and Seed (1987).

Based on this preliminary study, the potential total settlement resulting from seismic loading is estimated to be approximately 1½ inches. Differential settlement resulting from seismic loading is generally assumed to be one-half of the total seismically induced settlement over a distance of 40 feet. Seismic settlement is not considered a geotechnical constraint to the project.

2.6 Compressible and Collapsible Soil

Based on our investigation, the upper 5 to 15 feet of older alluvium is generally considered to be slightly to moderately compressible. Partial removal and recompaction of this material will be necessary to reduce the potential for excessive total and differential settlement of the proposed structures.

Hydrocollapse potential refers to the potential settlement of a soil under existing stresses upon being wetted. Representative samples of the upper 5 to 20 feet of the subsurface soil were tested for hydrocollapse potential. Test results indicate that the near-surface soil onsite has a negligible to minor hydrocollapse potential (1 percent or less).

2.7 Expansive Soils

Representative samples of the subsurface soil were tested for expansion potential. Test results indicate an Expansion Index of 0 to 5. Based on these results and the relatively granular nature of the near-surface soil, the onsite soil generally has a very low expansion potential.

2.8 Sulfate Content

Water-soluble sulfates in soil can react adversely with concrete. However, concrete in contact with soil containing sulfate concentrations of less than 0.10 percent are considered to have negligible sulfate exposure (UBC, 1997 edition, Chapter 19).

Near-surface soil samples were tested during this investigation for soluble sulfate content. The results of these tests indicated sulfate contents of less than 0.01 percent by weight, indicating negligible sulfate exposure. As such, the soils exposed at pad grade are not expected to pose a significant potential for sulfate reaction with concrete.

2.9 Resistivity, Chloride and pH

Soil corrosivity to ferrous metals can be estimated by the soil's pH level, electrical resistivity, and chloride content. In general, soil having a minimum resistivity less than 2,000 ohm-cm is considered corrosive. Soil with a chloride content of 500 ppm or more is considered corrosive to ferrous metals.

As a screening for potentially corrosive soil, representative soil samples were tested during this investigation to determine minimum resistivity, chloride content, and pH level. The tests indicated a chloride content of 42 ppm, a pH value of approximately 7.0, and a minimum resistivity of 7,000 ohm-cm. Based on the test results, the onsite soil is considered mildly corrosive to buried ferrous metals.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Based upon this study, the proposed improvements are feasible from a geotechnical standpoint. The recommendations presented below are preliminary. Additional geotechnical investigation and analysis may be necessary, based on the actual development plans for submittal with the project grading plans.

3.1 General Earthwork and Grading

All grading should be performed in accordance with the General Earthwork and Grading Specifications presented in Appendix D, unless specifically revised or amended below or by future recommendations based on final development plans.

Site Preparation

Prior to construction, the site should be cleared of vegetation, trash, and debris. Trees should be removed and grubbed out, and the excavations should be backfilled with compacted fill. Any underground obstructions onsite should be removed. The resulting cavities should be properly backfilled and compacted. Efforts should be made to locate any existing utility lines. Those lines should be removed or rerouted if they interfere with the proposed construction, and the resulting cavities should be properly backfilled and compacted. In addition, any uncontrolled artificial fill, if encountered, should be removed.

Overexcavation and Recompaction

To reduce the potential for adverse differential settlement of the proposed structures, the underlying subgrade soil should be prepared in such a manner that a uniform response to the applied loads is achieved. The soil underneath conventional shallow footings should be overexcavated and recompacted to a minimum depth of 3 feet below the bottom of the proposed foundations for residential structures or 3 feet below the existing grade, whichever is deeper. The overexcavation and recompaction should extend a minimum lateral distance of 5 feet from the footings. Local conditions may require that deeper overexcavation be performed; such areas should be evaluated by Leighton and Associates during grading.

Areas outside the overexcavation limits of buildings planned for asphalt or concrete pavement, flatwork, site walls, and retaining walls (less than 6 feet in height), and areas to receive fill should be overexcavated to a minimum depth of 12 inches below the existing ground surface or 12 inches below the proposed finish subgrade, whichever is deeper.

After completion of the overexcavation, and prior to fill placement, the exposed surfaces should be scarified to a minimum depth of 6 inches, moisture-conditioned to or slightly above optimum moisture content, and recompacted to a minimum 90 percent relative compaction.

Fill Placement and Compaction

The onsite soil is suitable for use as compacted structural fill, provided it is free of debris, and oversized material (greater than 8 inches in largest dimension). Any soil to be placed as fill, whether onsite or imported material, should be accepted by Leighton and Associates.

All fill soil should be placed in thin, loose lifts, moisture-conditioned, as necessary, to near optimum moisture content, and compacted to a minimum 90 percent relative compaction as determined by ASTM Test Method D1557. Aggregate base should be compacted to a minimum of 95 percent relative compaction.

Shrinkage and Subsidence

The change in volume of excavated and recompacted soil varies according to soil type and location. This volume change is represented as a percentage increase (bulking) or decrease (shrinkage) in volume of fill after removal and recompaction. Subsidence occurs as natural ground is moisture-conditioned and densified to receive fill. Field and laboratory data used in our calculations included laboratory-measured maximum dry densities for soil types encountered at the subject site and the measured in-place densities of soils encountered. We estimate the following earth volume changes will occur during grading:

Shrinkage	Approximately 15 percent
Subsidence	Approximately 0.15 foot

The level of fill compaction, variations in the dry density of the existing soils and other factors influence the amount of volume change. Some adjustments to earthwork volume should be anticipated during grading of the site.

3.2 Foundations

Based on our preliminary investigation and our experience in the region, conventional shallow or post-tensioned foundations may be used to support the loads of one- to two-story, frame-type structures. Overexcavation and recompaction of the footing subgrade soil should be performed as detailed in Section 3.1.

Conventional Shallow Foundations

Based on our preliminary investigation, the footings for 2-story structures should have an embedment depth of 18 inches, with a minimum width of 24 and 15 inches for isolated and continuous footings, respectively. The footings for 1-story residential structures should have an embedment depth of 12 inches, with a minimum width of 24 and 12 inches for isolated and continuous footings, respectively.

An allowable bearing capacity of 2,000 psf may be used for preliminary design, based on the minimum embedment depth and width. The allowable bearing value may be increased by 300 psf per foot increase in depth or width to a maximum allowable bearing pressure of 3,500 psf. The allowable bearing pressure is for the total dead load and frequently applied live loads.

The soil resistance available to withstand lateral loads on a shallow foundation is a function of the frictional resistance along the base of the footing and the passive resistance that may develop as the face of the structure tends to move into the soil. The frictional resistance between the base of the foundation and the subgrade soil may be computed using a coefficient of friction of 0.35. The passive resistance may be computed using an equivalent fluid pressure of 350 pounds per cubic foot (pcf), assuming there is constant contact between the footing and undisturbed soil.

The allowable bearing pressure and coefficient of friction values may be increased by one third when considering loads of short duration, such as those imposed by wind and seismic forces.

Footing reinforcement should be designed by the structural engineer.

The recommended allowable bearing capacity is generally based on a total allowable, post construction settlement of 1 inch. Differential settlement is estimated at ½ inch over a horizontal distance of 30 feet. Since settlement is a function of footing size and contact bearing pressure, differential settlement can be expected between adjacent columns or walls where a large differential loading condition exists. These settlement estimates should be reevaluated by Leighton and Associates when foundation plans for the proposed structures become available.

Post-Tensioned Foundations

As an alternative to conventional spread footings, post-tension foundation systems can be used. Post-tension slab foundations should be designed by the project structural engineer. The following table provides post-tension slab design information for soil with a low expansion potential. Post-tension slabs should be designed in accordance with Section 1816 of the current edition of the UBC.

Post-Tension Foundation Design Recommendations		
Very Low Expansion		
Edge Moisture Variation Distance, e_m	Center Lift	5.5 feet
	Edge Lift	3.0 feet
Differential Swell, Y_m	Center Lift	1.0 inch
	Edge Lift	0.4 inch
Modulus of subgrade Reaction		120 pci

Exterior footings (thickened edges) should have a minimum depth of 12 inches below the lowest adjacent soil grade and a minimum width of 12 inches. These footings may be designed for a maximum allowable bearing pressure of 2,000 pounds per square foot. The allowable bearing capacity may be increased by one-third for short-term loading.

These recommendations are based on preliminary data. Additional testing of the soil present near finish grade will be conducted to confirm the final foundation design information. Local agencies, the structural engineer or the Uniform Building Code may have requirements that are more stringent.

3.3 Slab-On-Grade

Concrete slabs subjected to special loads should be designed by the structural engineer. Where conventional light floor loading conditions exist, the following minimum recommendations, which are based on a very low soil expansion potential, should be used:

- A minimum slab thickness of 4 inches (nominal). Reinforcement steel should be design by the structural engineer, but as a minimum should be No. 3 rebar placed at 24 inches on center. Reinforcement should be supported on "chairs" to position the reinforcement within the middle third of the slab thickness.

- A moisture barrier consisting of 6-mil Visqueen (or equivalent) placed below slabs where moisture-sensitive floor coverings or equipment is planned. The moisture barrier should be covered with a minimum of 2 inches of sand.

- The subgrade soil should be moisture conditioned to at least optimum moisture content to a minimum depth of 12 inches prior to placing the moisture barrier, steel or concrete.

The use of reinforcement or post-tensioned cables in slabs and foundations can generally reduce the potential for concrete cracking. However, minor cracking of the concrete as it cures, due to drying and shrinkage, is normal and should be expected. However, cracking is often aggravated by a high water/cement ratio, high concrete temperature at the time of placement, small nominal aggregate size, and rapid moisture loss due to hot, dry, and/or windy weather conditions during placement and curing. Cracking due to temperature and moisture fluctuations can also be expected. The use of low slump concrete can reduce the potential for shrinkage cracking.

Moisture barriers can retard, but not eliminate moisture vapor movement from the underlying soils up through the slab. Floor covering manufacturers should be consulted for specific recommendations.

3.4 Seismic Design Parameters

Seismic parameters presented in this report should be considered during project design. In order to reduce the effects of ground shaking produced by regional seismic events, seismic design should be performed in accordance with the most recent edition of the Uniform Building Code (UBC). The following data should be considered for the seismic analysis of the subject site:

Seismic Design Parameters	
Seismic Source	San Jacinto (San Jacinto Valley) Fault
Distance	Approximately 9 km
Seismic Source Type (UBC, Table 16-U):	B
Seismic Zone Factor, Z (UBC, Table 16-I):	0.4
Soil Profile Type (UBC, 16-J):	S_D
Near-Source Factor N_a (UBC, Table 16-S):	1.0
Source Factor N_v (UBC, Table 16-T):	1.04

3.5 Retaining Walls

We recommend that retaining walls be backfilled with onsite, very low expansive soil and constructed with a backdrain in accordance with the recommendations provided on Figure 3 (rear of text). Using expansive soil as retaining wall backfill will result in higher lateral earth pressures exerted on the wall. Based on these recommendations, the following parameters may be used for the design of conventional retaining walls up to 6 feet tall:

Static Equivalent Fluid Weight (pcf)	
Conditions	Level
Active	35
At-Rest	55
Passive	350 (Maximum of 3,500 psf)

The above values do not contain an appreciable factor of safety, so the structural engineer should apply the applicable factors of safety and/or load factors during design.

Cantilever walls that are designed to yield at least 0.001H, where H is equal to the wall height, may be designed using the active condition. Rigid walls and walls braced at the top should be designed using the at-rest condition.

Passive pressure is used to compute soil resistance to lateral structural movement. In addition, for sliding resistance, a frictional resistance coefficient of 0.35 may be used at the concrete and soil interface. The lateral passive resistance should be taken into account only if it is ensured that the soil providing passive resistance, embedded against the foundation elements, will remain intact with time.

In addition to the above lateral forces due to retained earth, surcharge due to improvements, such as an adjacent structure or traffic loading, should be considered in the design of the retaining wall. Loads applied within a 1:1 projection from the surcharging structure on the stem of the wall should be considered in the design.

A soil unit weight of 120 pcf may be assumed for calculating the actual weight of the soil over the wall footing.

Retaining wall footings should have a minimum width of 12 inches and a minimum embedment of 12 inches below the lowest adjacent grade. An allowable bearing capacity of 2,000 psf may be used for retaining wall footing design, based on the minimum footing width and depth. This bearing value may be increased by 300 psf per foot increase in width or depth to a maximum allowable bearing pressure of 3,500 psf.

3.6 Pavement Design

A representative soil sample tested during this investigation had an R-value of 61. Based on the design procedures outlined in the current Caltrans Highway Design Manual, preliminary flexible pavement section recommendations are presented in the following table for the Traffic Indices indicated. Final pavement design should be based on the Traffic Index determined by the project civil engineer and R-value testing provided near the completion of street grading. These pavement sections meet the City of Moreno Valley's current minimum pavement requirements.

AC PAVEMENT SECTION THICKNESS		
Traffic Index	Asphaltic Concrete (AC) Thickness (feet)	Class 2 Aggregate Base (AB) Thickness (feet)
6 or less	0.30	.040
7	0.35	0.40

If the pavement is to be constructed prior to construction of the structures, we recommend that the full depth of the pavement section be placed in order to support heavy construction traffic.

All pavement construction should be performed in accordance with the Standard Specifications for Public Works Construction. Field inspection and periodic testing, as needed during placement of the base course materials, should be undertaken to ensure that the requirements of the standard specifications are fulfilled. Prior to placement of aggregate base, the subgrade soil should be processed to a minimum depth of 6 inches, moisture-conditioned, as necessary, and recompacted to a minimum of 90 percent relative compaction. Aggregate base should be moisture conditioned, as necessary, and compacted to a minimum of 95 percent relative compaction.

3.7 Temporary Excavations

All temporary excavations, including utility trenches, retaining wall excavations, etc. should be performed in accordance with project plans, specifications and all OSHA requirements.

No surcharge loads should be permitted within a horizontal distance equal to the height of cut or 5 feet, whichever is greater from the top of the slope, unless the cut is shored appropriately. Excavations that extend below an imaginary plane inclined at 45 degrees below the edge of any adjacent existing structure should be properly shored to maintain support of the structure.

Typical cantilever shoring should be designed based on the active fluid pressure presented in the retaining wall section. If excavations are braced at the top and at specific design intervals, the active pressure may then be approximated by a rectangular soil pressure distribution with the pressure per foot of width equal to 22H, where H is equal to the depth of the excavation being shored.

During construction, the soil conditions should be regularly evaluated to verify that conditions are as anticipated. The contractor should be responsible for providing the "competent person" required by OSHA standards to evaluate soil conditions. Close coordination between the competent person and the geotechnical engineer should be maintained to facilitate construction while providing safe excavations.

3.8 Trench Backfill

Utility-type trenches onsite can be backfilled with the onsite material, provided it is free of debris, significant organic material and oversized material. Prior to backfilling the trench, pipes should be bedded and shaded in a granular material that has a sand equivalent of 30 or greater. The sand should extend 12 inches above the top of the pipe. The bedding/shading sand should be densified in-place by jetting. The native backfill should be placed in loose layers, moisture conditioned, as necessary, and mechanically compacted using a minimum standard of 90 percent relative compaction.

3.9 Surface Drainage

Surface drainage should be designed to be directed away from foundations and toward approved drainage devices. Irrigation of landscaping should be controlled to maintain, as much as possible, a consistent moisture content sufficient to provide healthy plant growth without overwatering.

3.10 Cement Type and Corrosion Protection

Based on the results of laboratory testing, concrete structures in contact with the onsite soil will have negligible exposure to water-soluble sulfates in the soil. Common Type II cement may be used for concrete construction onsite and the concrete should be designed in accordance with Table 19-A-4 of the Uniform Building Code.

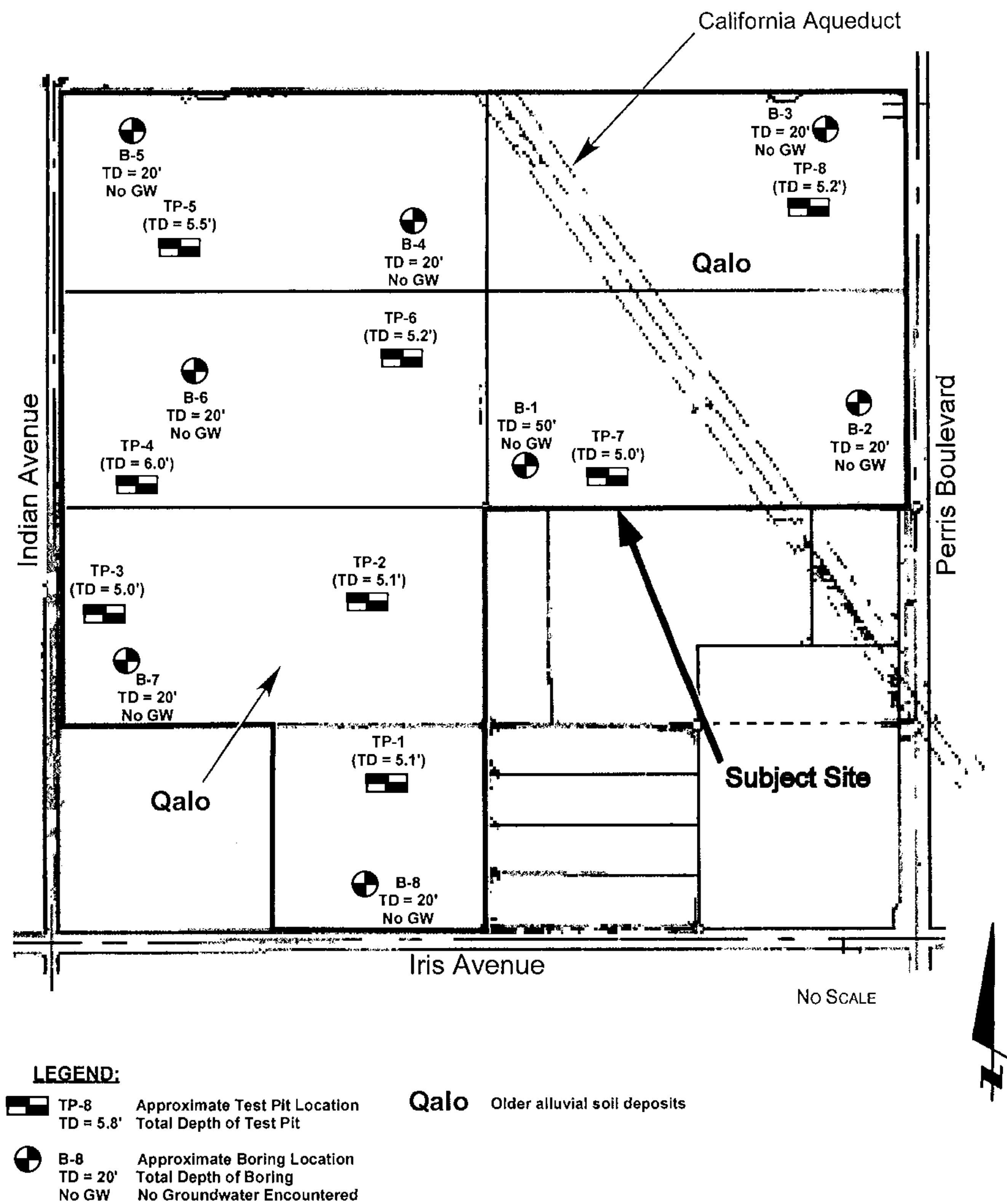
Based on our laboratory testing, the onsite soil is considered mildly corrosive to ferrous metals. The corrosion information presented in this report should be provided to your underground utility subcontractors.

3.11 Additional Geotechnical Investigation and Services

The preliminary geotechnical recommendations presented in this report are based on subsurfacc conditions as interpreted from limited subsurface explorations and limited laboratory testing. Our preliminary geotechnical recommendations provided in this report are based on information available at the time the report was prepared and may change as plans are developed. Additional geotechnical investigation and analysis may be required based on final development plans. Leighton and Associates should review the site and grading plans when available and comment further on the geotechnical aspects of the project. Geotechnical observation and testing should be conducted during excavation and all phases of grading operations. The conclusions and preliminary recommendations presented herein should be reviewed and verified by Leighton and Associates during construction and revised accordingly if geotechnical conditions encountered vary from our preliminary findings and interpretations. Geotechnical observation and testing should be provided:

- After completion of site clearing.
- During overexcavation of compressible soil.
- During compaction of all fill materials.

- After excavation of all footings and prior to placement of concrete.
- During utility trench backfilling and compaction.
- During pavement subgrade and base preparation.
- When any unusual conditions are encountered.



PROPOSED 104-ACRE RESIDENTIAL DEVELOPMENT NORTHWEST OF PERRIS BOULEVARD AND IRIS AVENUE, City of Moreno Valley, California	**GEOTECHNICAL MAP**	PROJECT NO. **021164-001** DATE **June, 2004** Figure 2

APPENDIX A

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Aerial Photographs Reviewed

Date	Flight	Frame	Agency
10/16/1959	R 10165 9	33 and 34	RCFCD
5/24/1974	RCFC 74	234	RCFCD
2/7/1984	RCFC 83	1341	RCFCD

GEOTECHNICAL BORING LOG B-1

Date: 3-31-04
Project: Young Homes Moreno Valley
Project No.: 021164-001
Drilling Co.: Redman Drilling
Type of Rig: Hollow Stem Auger
Hole Diameter: 8 inches
Drive Weight: 140 pounds Automatic Hammer
Drop: 30"
Elevation Top of Hole: '
Location: See Boring Location Map

Logged By: RSB
Sampled By: RSB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION
	0								**ALLUVIUM (Qal)**
				R-1	5	116.2	10.8	ML	2': TOP: Sandy SILT, yellow brown, slightly moist, soft, fine to medium sand, trace gravel up to 1/16" diameter BOTTOM: Sandy SILT, dark brown, very moist, soft, fine to coarse sand, trace gravel up to 1/16" diameter
	5			R-2	7			SM	5': Silty SAND, dark brown, very moist, loose, fine to coarse sand, trace gravel up to 1/8" diameter
	10			R-3	15	105.7	1.8	SW	10': Gravelly SAND, well graded, light yellow brown, moist to very moist, loose, fine to coarse sand, trace gravel up to 1/4" diameter
	15			R-4	22	124.2	11.2	ML	15': Sandy SILT/Clayey SILT, dark brown, very moist, stiff, fine to medium sand, trace gravel up to 1/8" diameter
	20			S-1	13			CL	20': Sandy CLAY/Silty CLAY, dark brown, very moist, medium stiff to stiff, fine to medium sand
	25			S-2	11			CL	25': Silty CLAY, dark brown, very moist, medium stiff, trace fine sand
	30								

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
SH SHELBY TUBE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-1

Date: 3-31-04 | Sheet 2 of 2
Project: Young Homes Moreno Valley | Project No.: 021164-001
Drilling Co.: Redman Drilling | Type of Rig: Hollow Stem Auger
Hole Diameter: 8 inches | Drive Weight: 140 pounds Automatic Hammer | Drop: 30"
Elevation Top of Hole: ' | Location: See Boring Location Map

Logged By: RSB
Sampled By: RSB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION
	30			S-3	13			SM ML	30': TOP: Silty SAND, yellow brown, very moist, loose, fine sand BOTTOM: Sandy SILT, yellow brown, very moist, medium stiff to stiff, fine to medium sand, trace gravel up to 1/8" diameter
	35			S-4	12			ML CL	35': TOP: Sandy SILT, yellow brown, very moist, medium stiff, fine to medium sand, trace gravel up to 1/16" diameter BOTTOM: Sandy CLAy/Silty CLAY, dark brown, very moist, medium stiff, fine to medium sand, trace gravel up to 1/16" diameter
	40			S-5	14			ML	40': Sandy SILT, yellow brown, very moist, stiff, fine to medium sand, trace gravel up to 1/16" diameter
	45			S-6	27			SM ML	45': TOP: Silty SAND, yellow brown, moist, medium dense, fine to coarse sand, some gravel up to 1/4" diameter BOTTOM: Sandy SILT, yellow brown, moist, very stiff, fine to medium sand, trace gravel up to 1/8" diameter
	50			S-2	19			ML	50': TOP: Sandy SILT, yellow brown, very moist, stiff, fine to medium sand, trace gravel up to 1/8" diameter BOTTOM: SILT, dark yellow brown, very moist, stiff, some fine
	55								Total Depth 50 feet No Groundwater encountered No Bedrock encountered Boring Backfilled with Native Soil
	60								

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
SH SHELBY TUBE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-2

Date 3-31-04 **Sheet** 1 **of** 1
Project Young Homes Moreno Valley **Project No.** 021164-001
Drilling Co. Redman Drilling **Type of Rig** Hollow Stem Auger
Hole Diameter 8 inches **Drive Weight** 140 pounds Automatic Hammer **Drop** 30"
Elevation Top of Hole ' **Location** See Boring Location Map

Logged By RSB
Sampled By RSB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION
	0								**ALLUVIUM (Qal)**
				R-1	8	117.6	5.4	SM ML	2': TOP: Silty SAND, light yellow brown, slightly moist, loose, fine to medium sand, trace gravel up to 1/4" diameter, rootlets BOTTOM: Sandy SILT, dark brown, very moist, medium stiff, fine to coarse sand, trace gravel up to 1/4" diameter
	5			R-2	11			ML SM	5': TOP: Sandy SILT, dark brown, very moist, medium stiff, fine to medium sand, trace gravel up to 1/4" diameter BOTTOM: Silty SAND, dark yellow brown, very moist, loose, fine to coarse sand, trace gravel up to 1/4" diameter
				R-3	14	105.3	1.4	SW	7': Gravelly SAND, well graded, light yellow brown, moist to very moist, loose, fine to coarse sand, gravel up to 1" diameter
	10			R-4	21	124.7	8.4	SW SM	10': TOP: Gravelly SAND, well graded, light yellow brown, moist to very moist, medium dense, fine to coarse sand, gravel up to 1/2" diameter BOTTOM: Silty SAND, dark brown, very moist, medium dense, fine to coarse sand, trace gravel up to 1/4" diameter
	15			R-5	35	127.5	10.3	ML CL	15': TOP: Sandy SILT, dark brown, very moist, very stiff, fine to medium sand, trace gravel up to 1/8" diameter BOTTOM: Silty CLAY/Sandy CLAY, dark brown, very moist, very stiff, some fine sand, trace gravel up to 1/8" diameter
	20			R-6	25			SM	20': Silty SAND, yellow brown, very moist, medium dense, fine to coarse sand, gravel up to 1/4" diameter
									Total Depth 20 feet No Groundwater encountered No Bedrock encountered Boring Backfilled with Native Soil
	25								
	30								

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
SH SHELBY TUBE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-3

Date 3-31-04 | Sheet 1 of 1
Project Young Homes Moreno Valley | Project No. 021164-001
Drilling Co. Redman Drilling | Type of Rig Hollow Stem Auger
Hole Diameter 8 inches | Drive Weight 140 pounds Automatic Hammer | Drop 30"
Elevation Top of Hole ' | Location See Boring Location Map

Logged By RSB
Sampled By RSB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION
	0								**ALLUVIUM (Qal)**
				R-1	18	107.9	4.2	ML	2': Sandy SILT, dark yellow brown, slightly moist, stiff, fine to medium sand, trace gravel up to 1/8" diameter, porosity 3%, rootlets
	5			R-2	12			SM	5': Silty SAND, yellow brown, slightly moist to moist, loose, fine to medium sand, trace gravel up to 1/4" diameter
	10			R-3	17			CL	10': Sandy CLAY/Silty CLAY, dark brown, very moist, stiff, some fine sand, trace gravel up to 1/8" diameter
	15			S-1	17			ML	15': Sandy SILT, dark brown, moist to very moist, stiff, fine to medium sand
	20			S-2	8			SM	20': Silty SAND, yellow brown, very moist, loose, fine to coarse sand, some gravel up to 1/4" diameter
									Total Depth 20 feet No Groundwater encountered No Bedrock encountered Boring Backfilled with Native Soil
	25								
	30								

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
SH SHELBY TUBE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-4

Date 3-31-04 **Sheet** 1 **of** 1

Project Young Homes Moreno Valley **Project No.** 021164-001

Drilling Co. Redman Drilling **Type of Rig** Hollow Stem Auger

Hole Diameter 8 inches **Drive Weight** 140 pounds Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Boring Location Map

Logged By RSB

Sampled By RSB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION
	0								ALLUVIUM (Qal)
				R-1	15	116.6	2.7	SW	2': Gravelly SAND, well graded, yellow brown, slightly moist to moist, loose, fine to coarse sand, gravel up to 1/4" diameter
	5			R-2	10	103.5	1.1	SW	5': Gravelly SAND, well graded, yellow brown, slightly moist to moist, loose, fine to coarse sand, gravel up to 1/2" diameter
				R-3	16	103.5	1.6	SW	7': Gravelly SAND, well graded, yellow brown, slightly moist, loose, fine to coarse sand, gravel up to 1/2" diameter
	10			R-4	15	102.0	1.9	SW	10': Gravelly SAND, well graded, yellow brown, slightly moist, loose, fine to coarse sand, gravel up to 1/2" diameter
	15			R-5	33			SM	15': Silty SAND, dark brown, very moist, medium dense, fine to coarse sand, trace gravel up to 1/4" diameter
	20			R-6	36			ML CL	20': TOP: Sandy SILT/Clayey SILT, dark brown, very moist to wet, very stiff, fine to medium sand, trace gravel up to 1/4" diameter BOTTOM: Sandy CLAY/Silty CLAY, dark red brown, very moist, very stiff, fine to medium sand, trace gravel up to 1/4" diameter
									Total Depth 20 feet No Groundwater encountered No Bedrock encountered Boring Backfilled with Native Soil
	25								
	30								

SAMPLE TYPES:
- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE
- G GRAB SAMPLE
- SH SHELBY TUBE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-5

Date	3-31-04	**Sheet**	1 **of** 1
Project	Young Homes Moreno Valley	**Project No.**	021164-001
Drilling Co.	Redman Drilling	**Type of Rig**	Hollow Stem Auger
Hole Diameter	8 inches	**Drive Weight**	140 pounds Automatic Hammer — **Drop** 30"
Elevation Top of Hole	'	**Location**	See Boring Location Map

Logged By RSB
Sampled By RSB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION
	0								**ALLUVIUM (Qal)**
				R-1	8	109.5	6.8	ML	2': Sandy SILT, dark brown, very moist, medium stiff, fine to coarse sand, trace gravel up to 1/8" diameter
	5			R-2	10			SM	5': Silty SAND, yellow brown, highly moist, loose, fine to medium sand, trace gravel up to 1/4" diameter
	10			R-3	22			SW	10': SAND, well graded, light brown, very moist, medium dense, fine to coarse sand, gravel up to 1/8" diameter, some fines
	15			S-1	13			SM	15': Silty SAND, dark brown, very moist to wet, loose, fine to medium sand, trace gravel up to 1/8" diameter
	20			S-2	50/3"			CL	20': Sandy CLAY/Silty CLAY, dark brown, very moist, hard, fine to medium sand, some black stain
									Total Depth 20 feet No Groundwater encountered No Bedrock encountered Boring Backfilled with Native Soil
	25								
	30								

SAMPLE TYPES:
- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE
- G GRAB SAMPLE
- SH SHELBY TUBE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-6

Date 3-31-04 **Sheet** 1 **of** 1

Project Young Homes Moreno Valley **Project No.** 021164-001

Drilling Co. Redman Drilling **Type of Rig** Hollow Stem Auger

Hole Diameter 8 inches **Drive Weight** 140 pounds Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Boring Location Map

Logged By RSB

Sampled By RSB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION
	0								**ALLUVIUM (Qal)**
				R-1	12	112.0	4.3	ML	2': Sandy SILT, yellow brown, slightly moist to moist, medium stiff, fine to medium sand, trace gravel up to 1/8" diameter
	5			R-2	22	114.7	1.7	SM	5': Silty SAND, yellow brown, slightly moist to dry, medium dense, fine to coarse sand, with gravel up to 1/4" diameter
				R-3	13			SW	7': Gravelly SAND, well graded, yellow brown, slightly moist to dry, loose, fine to coarse sand, gravel up to 1/4" diameter
	10			R-4	31	117.7	5.3	ML	10': Sandy SILT, dark brown, moist to very moist, very stiff, fine sand
	15			R-5	20			ML SM	15': TOP: Sandy SILT, dark brown, moist to very moist, stiff, fine to medium sand, trace gravel up to 1/8" diameter BOTTOM: Silty SAND, dark brown, very moist, medium dense, fine to medium sand, trace gravel up to 1/8" diameter
	20			R-6	23			SW CL	20': TOP: Gravelly SAND, well graded, dark yellow brown, very moist, medium dense, fine to coarse sand, gravel up to 1/2" diameter BOTTOM: Silty CLAY, olive brown, very moist, stiff, trace fine sand
									Total Depth 20 feet No Groundwater encountered No Bedrock encountered Boring Backfilled with Native Soil
	25								
	30								

SAMPLE TYPES:

S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
SH SHELBY TUBE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-7

Date 3-31-04 **Sheet** 1 **of** 1

Project Young Homes Moreno Valley **Project No.** 021164-001

Drilling Co. Redman Drilling **Type of Rig** Hollow Stem Auger

Hole Diameter 8 inches **Drive Weight** 140 pounds Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Boring Location Map

Logged By RSB

Sampled By RSB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION
	0								**ALLUVIUM (Qal)**
				R-1	13	120.7	3.4	SM	2': Silty SAND, dark brown, moist, loose, fine to coarse sand, with gravel up to 1/8" diameter
	5			R-2	11	109.9	1.6	SW	5': Gravelly SAND, well graded, yellow brown, very moist, loose, fine to coarse sand, gravel up to 1/4" diameter, some fines
	10			R-3	19			SW	10': Gravelly SAND, well graded, light yellow brown, slightly moist to moist, medium dense, fine to coarse sand, gravel up to 1/2" diameter
	15			S-1	13			CL	15': CLAY, dark brown, very moist, medium stiff to stiff, some silt, trace fine sand
	20			S-2	17			CL	20': Silty CLAY, dark brown, very moist, stiff, some fine sand
									Total Depth 20 feet No Groundwater encountered No Bedrock encountered Boring Backfilled with Native Soil
	25								
	30								

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
SH SHELBY TUBE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-8

Date 3-31-04 **Sheet** 1 of 1
Project Young Homes Moreno Valley **Project No.** 021164-001
Drilling Co. Redman Drilling **Type of Rig** Hollow Stem Auger
Hole Diameter 8 inches **Drive Weight** 140 pounds Automatic Hammer **Drop** 30"
Elevation Top of Hole ' **Location** See Boring Location Map

Logged By RSB
Sampled By RSB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION
	0								**ALLUVIUM (Qal)**
				R-1	13	115.7	2.6	SM	2': Silty SAND, yellow brown, slightly moist, loose, fine sand, trace gravel up to 1/8" diameter
	5			R-2	13	114.4	1.6	SW	5': Gravelly SAND, well graded, yellow brown, slightly moist, loose, fine to coarse sand, gravel up to 1/4" diameter, trace fines
				R-3	11			SP	7': SAND, poorly graded, yellow brown, slightly moist to moist, loose, fine to medium sand, trace gravel up to 1/8" diameter, trace fines
	10			R-4	18			SM	10': Silty SAND, dark yellow brown, very moist, medium dense, fine sand, trace gravel up to 1/8" diameter
	15			R-5	20			SW CL	15': TOP: Gravelly SAND, yellow brown, very moist, medium dense, fine to coarse sand, gravel up to 1/8" diameter BOTTOM: Silty CLAY, dark brown, very moist to wet, stiff
	20			R-6	23			CL	20': CLAY, dark brown, very moist to wet, stiff, some fine sand, trace gravel up to 1/16" diameter
									Total Depth 20 feet No Groundwater encountered No Bedrock encountered Boring Backfilled with Native Soil
	25								
	30								

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
SH SHELBY TUBE

LEIGHTON AND ASSOCIATES, INC.

Geotechnical Test Pit Logs

Young Homes / Moreno Valley
Project No. 021164-001

Logged by: MM
Sampled by: MM

Test Pit TP-1

Date: April 2004 Location: See Geotechnical Map

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results Sample number	Test Results Depth ft	Test Results Density (dry)pfc	Test Results Moisture %
0	1.1	SM	Silty SAND, light gray brown, dry, dense, fine to medium grain sand, rootlets (tilled)	Afu				
1.1	2.6	SM	Silty SAND, dark brown, slightly moist, medium dense, fine to coarse grain sand, porous to 1% up to 1/8" in diameter, some rootlets	Qal	Bag-1	2.5'		10.1
2.6	5.1	SW	Sand with gravel, light brown, dry to slightly moist, loose, fine to coarse grain sand, gravel up to 1/4", no apparent porosity	Qal		5.1		2.2

Total Depth (ft): 5.1
No ground water encountered.
Test pit backfilled, wheel rolled at surface.

Test Pit TP-2

Date: April 2004 Location: See Geotechnical Map

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results Sample number	Test Results Depth ft	Test Results Density (dry)pfc	Test Results Moisture %
0	1.6	SM	Silty SAND, light gray, dry, dense, fine to medium sand, rootlets (tilled)	Afu				
1.6	3.3	SM	Silty SAND, dark olive brown, slightly moist, medium dense, fine to medium grain with some coarse grain sand, porous to < 1% up to 1/8" in diameter, some rootlets	Qal	Bag-1	2		4.5
3.3	4	SP	SAND, dark brown, slightly moist, very dense, medium to coarse grain sand	Qal				
4	5.1	SW	SAND with gravel and some silt, light brown, dry to slightly moist, loose, fine to coarse grain sand, gravel up to 1/4", porous to < 0.5% up to 1/16" in diameter	Qal		5.1		4.1

Total Depth (ft): 5.1
No ground water enceuntered.
Test pit backfilled, wheel rolled at surface.

Test Pit TP-3

Date: April 2004 Location: See Geotechnical Map

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results Sample number	Test Results Depth ft	Test Results Density (dry)pfc	Test Results Moisture %
0	1.3		Fill - weathered alluvium (tilled)	Afu				
1.3	3	SW	SAND with some gravel and thin layers of silt, light to dark brown, slightly moist, dense to medium dense, fine to coarse grain sand with fine gravel, porous to < 1% up to 1/8" in diameter	Qal	Bag-1	2.3		3.6
3	5	SP	SAND, light to dark brown, slightly moist, medium dense to loose, medium to coarse grain sand with some fine gravel, no apparent porosity	Qal		5		3.4

Total Depth (ft): 5.0
No ground water encountered.
Test pit backfilled, wheel rolled at surface.

Geotechnical Test Pit Logs

Young Homes / Moreno Valley
Project No. 021164-001

Logged by: MM
Sampled by: MM

Test Pit TP-4

Date: April 2004 Location: See Geotechnical Map

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth ft	Density (dry)pfc	Moisture %
0	1.6		Fill - weathered alluvium (tilled)	Afu				
1.6	6	SM	Silty SAND, light brown, slightly moist, medium dense, fine to coarse grain sand, porous to < 0.5% up to 1/16" in diameter	Qal	Bag-1	2.5		4.1
				Qal		6		5.8

Total Depth (ft): 6.0
No ground water encountered.
Test pit backfilled, wheel rolled at surface.

Test Pit TP-5

Date: April 2004 Location: See Geotechnical Map

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth ft	Density (dry)pfc	Moisture %
0	1.4		Fill - weathered alluvium (tilled)	Afu				
1.4	3.2	SM	Silty SAND, light brown, dry to slightly moist, dense to medium dense, fine to coarse grain sand, thin layers of dark silt, porous to < 0.5% up to 1/16" in diameter, rootlets	Qal	Bag-1	2.5		2.6
3.2	5.5	SW	SAND with gravel, light brown, slightly moist, medium dense to loose, fine to coarse grain sand, fine gravel, no apparent porosity	Qal		5.5		3.3

Total Depth (ft): 5.5
No ground water encountered.
Test pit backfilled, wheel rolled at surface.

Test Pit TP-6

Date: April 2004 Location: See Geotechnical Map

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth ft	Density (dry)pfc	Moisture %
0	1.8		Fill - weathered alluvium (tilled)	Afu				
1.8	4.1	SM	Silty SAND, dark brown, slightly moist, medium dense, fine to coarse grain sand, porous to < 1% up to 1/8" in diameter, some rootlets	Qal	Bag-1	2.5		6.1
4.1	5.2	SW	SAND with gravel, light brown, dry to slightly moist, loose, fine to coarse grain sand, no apparent porosity	Qal		5.2		3.6

Total Depth (ft): 5.2
No ground water encountered.
Test pit backfilled, wheel rolled at surface.

Geotechnical Test Pit Logs

Young Homes / Moreno Valley
Prolect No. 021164-001

Logged by: MM
Sampled by: MM

Test Pit TP-7

Date: April 2004 Location: See Geotechnical Map

Depth		Soil symbol (USCS)	Description	Geologic Unit	Test Results			
Top (ft)	Bottom (ft)				Sample number	Depth ft	Density (dry)pfc	Moisture %
0	1.5		Fill - weathered alluvium (tilled)	Afu				
1.5	3.3	SM	Silty SAND, dark brown, dry to slightly moist, medium dense, fine to coarse grain sand, porous to <0.5% up to 1/16" in diameter	Qal	Bag-1	3		2.9
3.3	5	SW	Gravelly SAND, light brown, dry to slightly moist, loose, fine to coarse grain sand and fine gravel, no apparent porosity	Qal		5		3.3

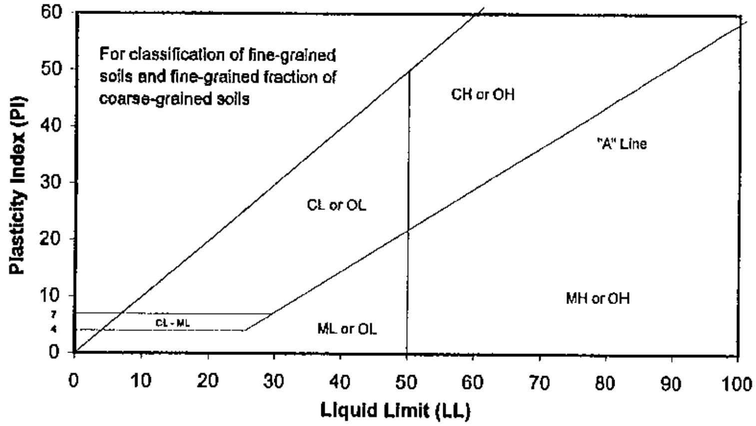
Total Depth (ft): 5.0
No ground water encountered.
Test pit backfilled, wheel rolled at surface.

Test Pit TP-8

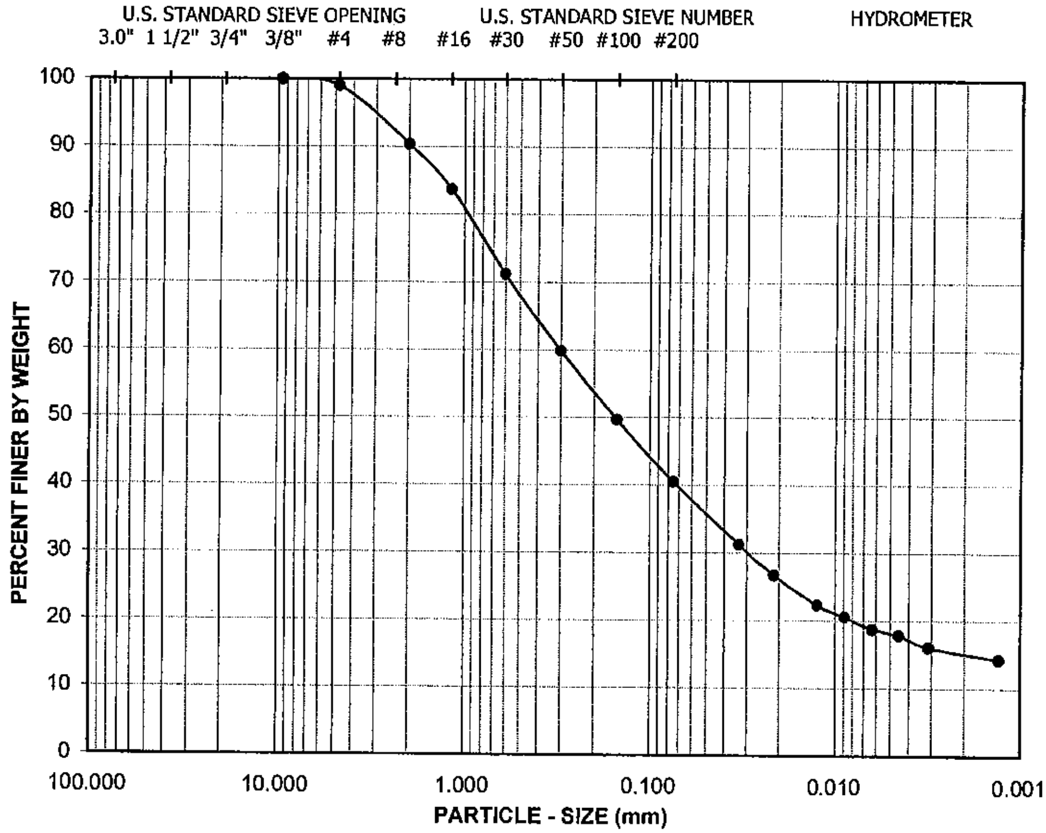
Date: April 2004 Location: See Geotechnical Map

Depth		Soil symbol (USCS)	Description	Geologic Unit	Test Results			
Top (ft)	Bottom (ft)				Sample number	Depth ft	Density (dry)pfc	Moisture %
0	1.5		Fill - weathered alluvium (tilled)	Afu				
1.5	4.5	SM	Silty SAND with some gravel, light to dark brown, dry to slightly moist, medium dense, fine to coarse grain sand and fine gravel, porous to < 1% up to 1/16" in diameter, some rootlets	Qal	Bag-1	2.3		3.9
4.5	5.2	SW	SAND with some gravel, light brown, dry to slightly moist, medium dense to loose, fine to coarse grain sand and fine gravel, no apparent porosity	Qal		5.2		3.5

Total Depth (ft): 5.2
No ground water encountered.
Test pit backfilled, wheel rolled at surface.



GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

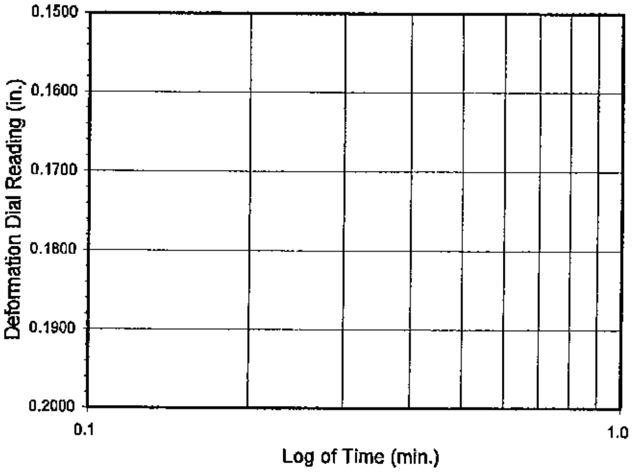


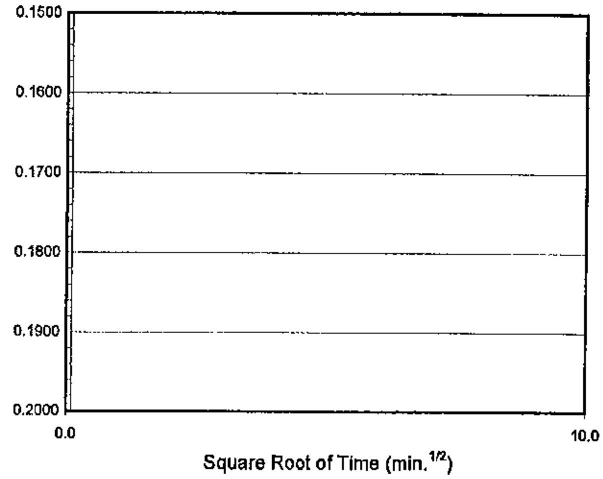
Boring No.:	Sample No.:	Depth (ft.) :	Soil Type	GR:SA:FI	LL,PL,PI
TP-1	Bag-1	2.5	SC-SM	1:58:41	NA,,

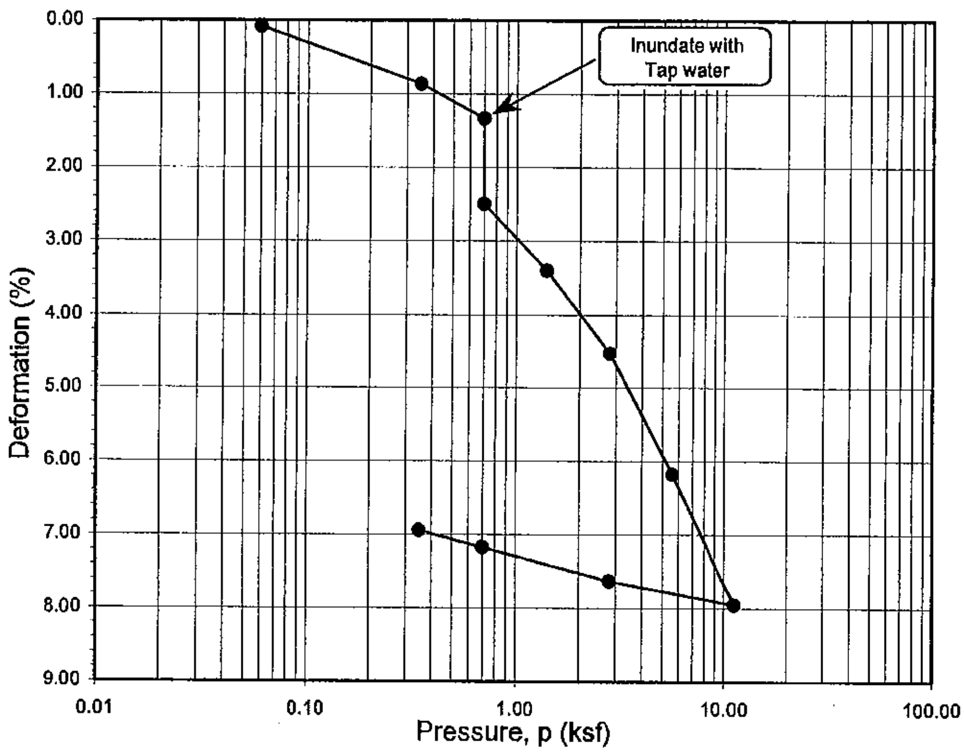
Soil Description: Brown silty, clayey sand (SC-SM)

Teratest Labs, Inc. A LEIGHTON GROUP COMPANY	**ATTERBERG LIMITS, PARTICLE - SIZE CURVE** **ASTM D 4318, D 422**	Project No.: 021164-001 Young Homes / MV 05-04

No Time Readings







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
B-3	**R-2**	**5**	**2.4**	**14.3**	**112.7**	**120.6**	**0.495**	**0.391**	**13**	**97**

Soil Identification: Brown silty sand (SM)

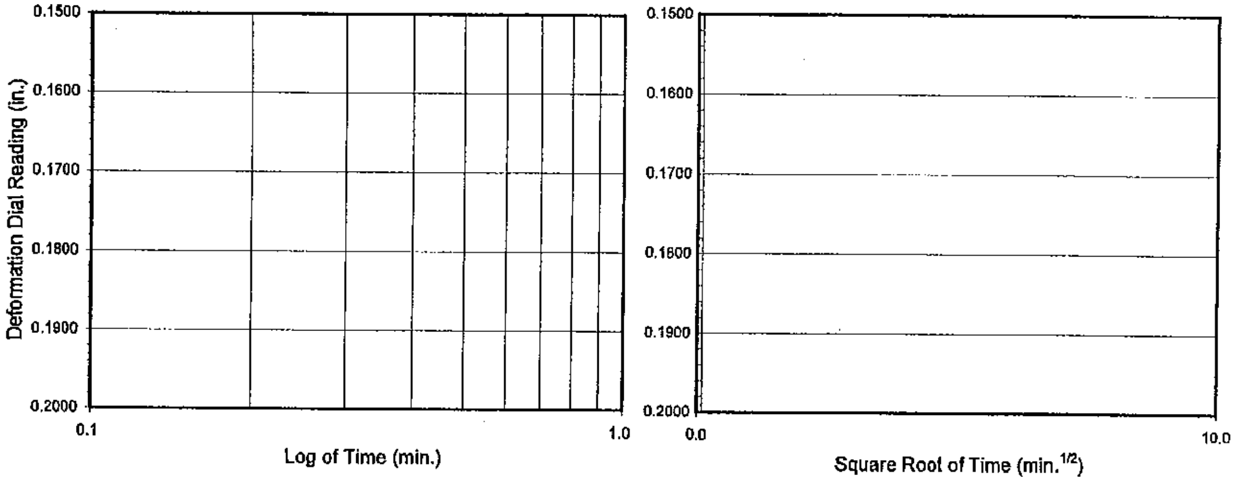
Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

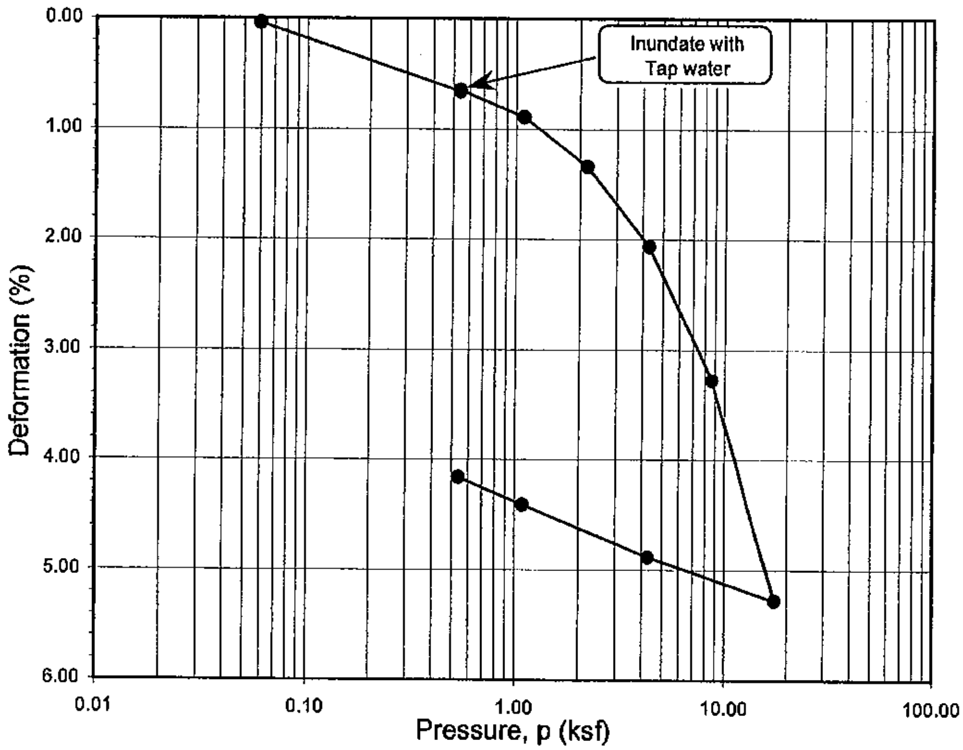
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
(ASTM D 2435)

Project No.: 021164-001

Young Homes / MV

No Time Readings





Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
B-1	**R-2**	**5**	**8.9**	**12.6**	**118.2**	**122.5**	**0.426**	**0.366**	**57**	**90**

Soil Identification: Brown clayey sand (SC)

Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
(ASTM D 2435)

Project No.: 021164-001

Young Homes / MV

Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

One-Dimensional Swell or Settlement Potential of Cohesive Soils
(ASTM D 4546)

Project Name: Young Homes / MV
Project No.: 021164-001
Boring No.: B-8
Sample No.: R-4
Sample Description: Brown silty sand (SM)

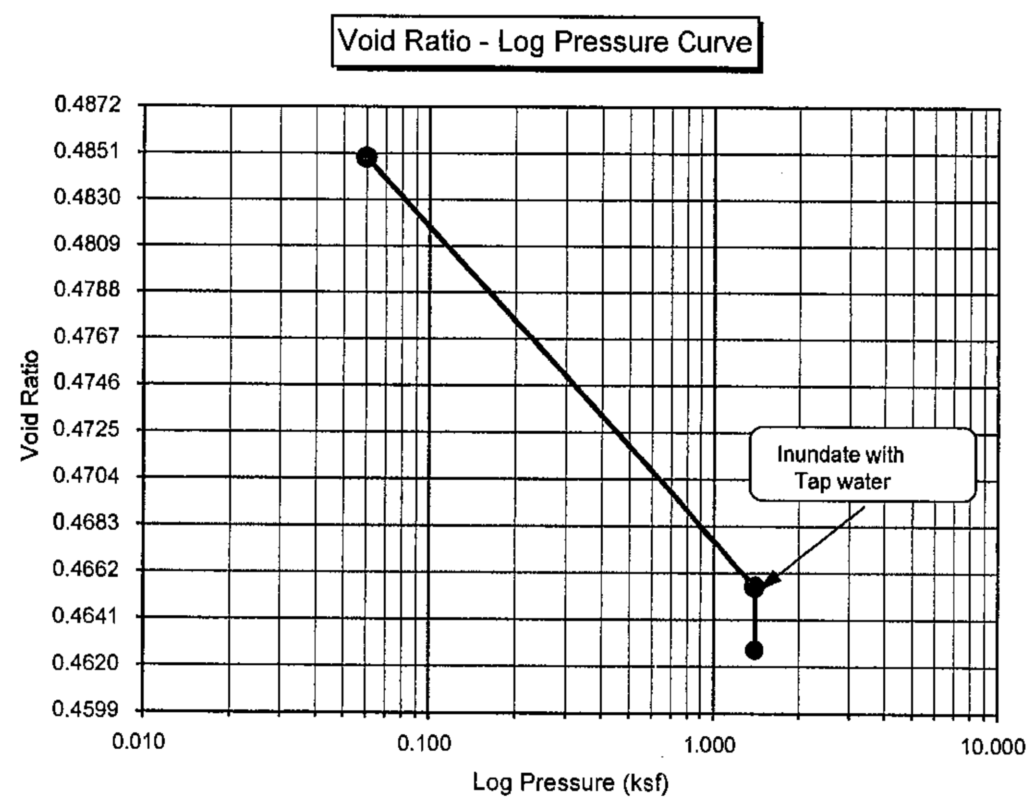
Tested By: FT
Checked By: LF
Sample Type: Drive
Depth (ft.) 10.0

Initial Dry Density (pcf):	113.4
Initial Moisture (%):	5.80
Initial Length (in.):	1.0000
Initial Dial Reading:	0.2563
Diameter(in):	2.416

Final Dry Density (pcf):	113.7
Final Moisture (%) :	17.8
Initial Void ratio:	0.4859
Specific Gravity(assumed):	2.70
Initial Saturation (%)	32.2

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.060	0.2570	0.9993	0.00	-0.07	0.4849	-0.07
1.400	0.2700	0.9863	0.00	-1.37	0.4656	-1.37
H2O	0.2719	0.9844	0.00	-1.56	0.4628	-1.56

Percent Swell (+) / Settlement (-) After Inundation = -0.19



Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

One-Dimensional Swell or Settlement Potential of Cohesive Soils
(ASTM D 4546)

Project Name:	Young Homes / MV	Tested By:	FT
Project No.:	021164-001	Checked By:	LF
Boring No.:	B-6	Sample Type:	Drive
Sample No.:	R-5	Depth (ft.)	15.0
Sample Description:	Brown silty sand (SM)		

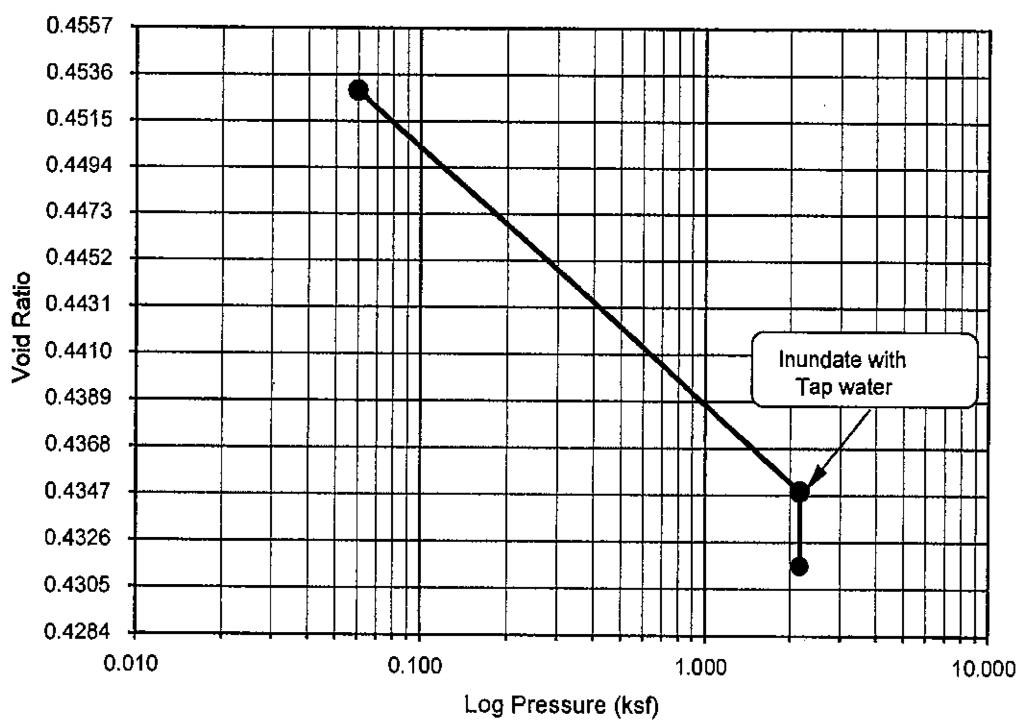
Initial Dry Density (pcf):	116.0
Initial Moisture (%):	6.69
Initial Length (in.):	1.0000
Initial Dial Reading:	0.1000
Diameter(in):	2.416

Final Dry Density (pcf):	117.4
Final Moisture (%) :	16.3
Initial Void ratio:	0.4533
Specific Gravity(assumed):	2.70
Initial Saturation (%)	39.8

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.060	0.1003	0.9997	0.00	-0.03	0.4529	-0.03
2.170	0.1127	0.9873	0.00	-1.27	0.4349	-1.27
H2O	0.1150	0.9850	0.00	-1.50	0.4315	-1.50

Percent Swell (+) / Settlement (-) After Inundation = -0.23

Void Ratio - Log Pressure Curve



Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

One-Dimensional Swell or Settlement Potential of Cohesive Soils
(ASTM D 4546)

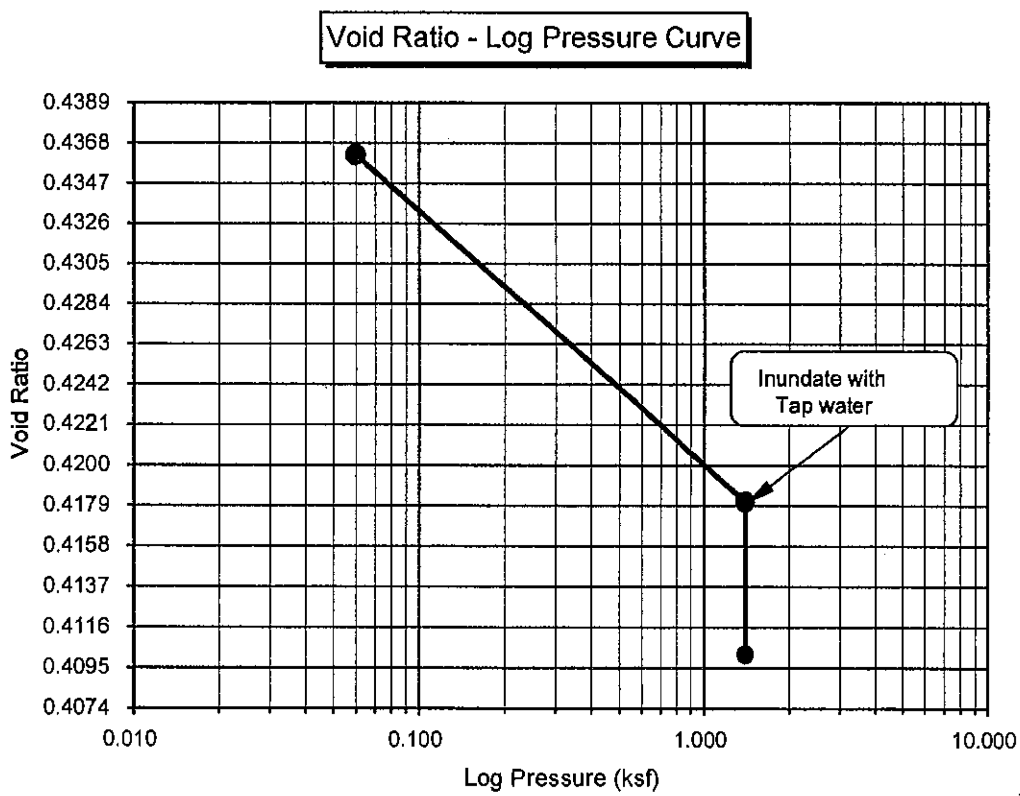
Project Name:	Young Homes / MV	Tested By:	FT
Project No.:	021164-001	Checked By:	LF
Boring No.:	B-5	Sample Type:	Drive
Sample No.:	R-3	Depth (ft.)	10.0
Sample Description:	Brown silty sand (SM)		

Initial Dry Density (pcf):	117.4
Initial Moisture (%):	1.92
Initial Length (in.):	1.0000
Initial Dial Reading:	0.1000
Diameter(in):	2.416

Final Dry Density (pcf):	118.6
Final Moisture (%) :	14.6
Initial Void ratio:	0.4363
Specific Gravity(assumed):	2.70
Initial Saturation (%)	11.9

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.060	0.1001	0.9999	0.00	-0.01	0.4362	-0.01
1.400	0.1127	0.9873	0.00	-1.27	0.4181	-1.27
H2O	0.1182	0.9818	0.00	-1.82	0.4102	-1.82

Percent Swell (+) / Settlement (-) After Inundation = -0.56



Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

One-Dimensional Swell or Settlement Potential of Cohesive Soils
(ASTM D 4546)

Project Name: Young Homes / MV
Project No.: 021164-001
Boring No.: B-5
Sample No.: R-2
Sample Description: Brown silty sand (SM)

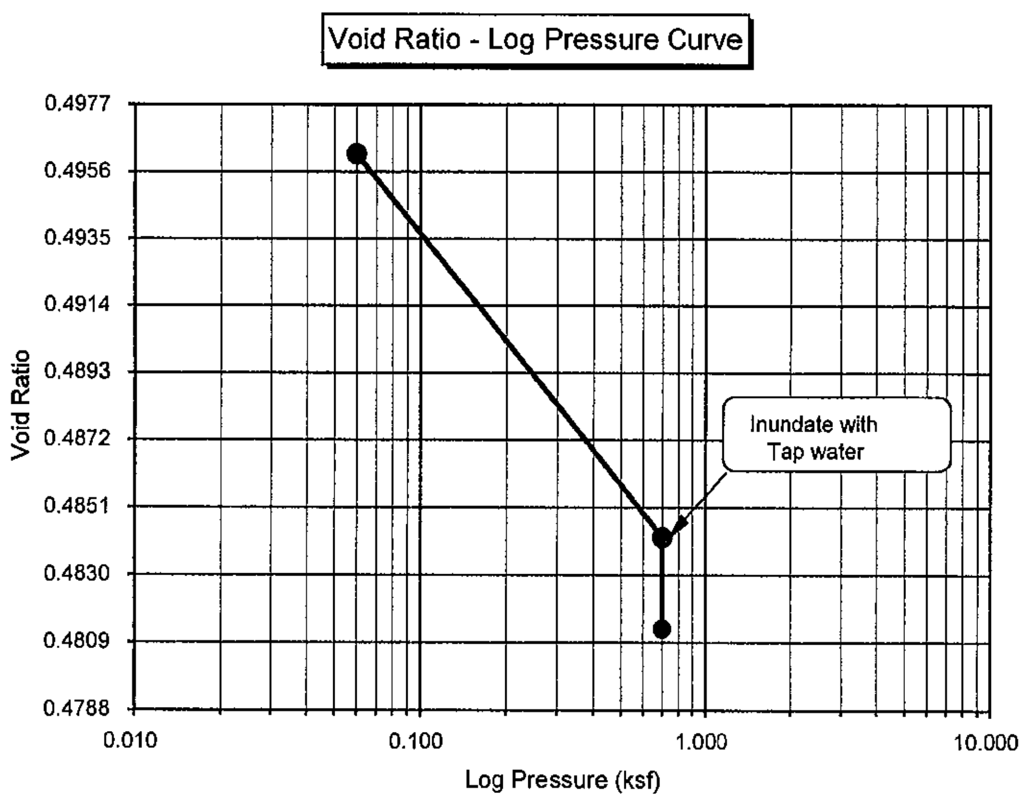
Tested By: FT
Checked By: LF
Sample Type: Drive
Depth (ft.) 5.0

Initial Dry Density (pcf):	112.6
Initial Moisture (%):	4.73
Initial Length (in.):	1.0000
Initial Dial Reading:	0.2300
Diameter(in):	2.416

Final Dry Density (pcf):	112.5
Final Moisture (%) :	17.2
Initial Void ratio:	0.4967
Specific Gravity(assumed):	2.70
Initial Saturation (%)	25.7

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.060	0.2304	0.9996	0.00	-0.04	0.4961	-0.04
0.700	0.2384	0.9916	0.00	-0.84	0.4842	-0.84
H2O	0.2403	0.9897	0.00	-1.03	0.4813	-1.03

Percent Swell (+) / Settlement (-) After Inundation = -0.19



Teratest Labs, Inc.
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One-Dimensional Swell or Settlement Potential of Cohesive Soils
(ASTM D 4546)

Project Name: Young Homes / MV
Project No.: 021164-001
Boring No.: B-4
Sample No.: R-5
Sample Description: Brown clayey sand (SC)

Tested By: FT
Checked By: LF
Sample Type: Drive
Depth (ft.) 15.0

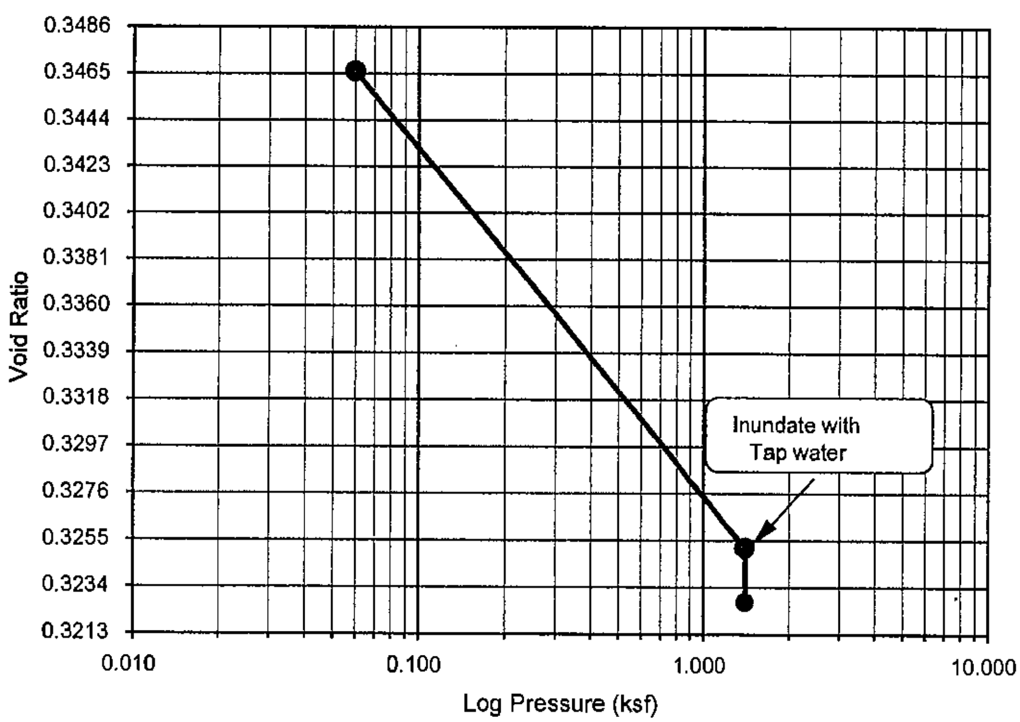
Initial Dry Density (pcf):	125.0
Initial Moisture (%):	7.31
Initial Length (in.):	1.0000
Initial Dial Reading:	0.1590
Diameter(in):	2.416

Final Dry Density (pcf):	126.3
Final Moisture (%) :	10.8
Initial Void ratio:	0.3481
Specific Gravity(assumed):	2.70
Initial Saturation (%)	56.7

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.060	0.1601	0.9989	0.00	-0.11	0.3466	-0.11
1.400	0.1760	0.9830	0.00	-1.70	0.3252	-1.70
H2O	0.1778	0.9812	0.00	-1.88	0.3227	-1.88

Percent Swell (+) / Settlement (-) After Inundation = -0.18

Void Ratio - Log Pressure Curve



Teratest Labs, Inc.
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One-Dimensional Swell or Settlement Potential of Cohesive Soils
(ASTM D 4546)

Project Name: Young Homes / MV
Project No.: 021164-001
Boring No.: B-3
Sample No.: R-3
Sample Description: Brown sandy lean clay s(CL)

Tested By: FT, ESS
Checked By: LF
Sample Type: Drive
Depth (ft.) 10.0

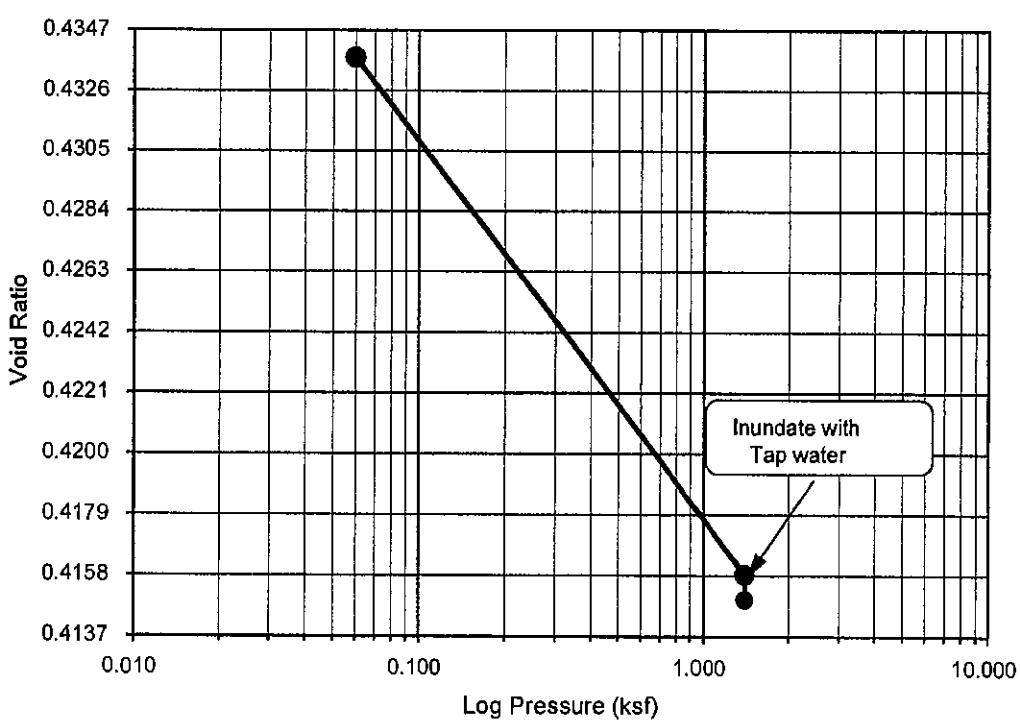
Initial Dry Density (pcf):	117.6
Initial Moisture (%):	11.23
Initial Length (in.):	1.0000
Initial Dial Reading:	0.1441
Diameter(in):	2.416

Final Dry Density (pcf):	118.8
Final Moisture (%) :	15.7
Initial Void ratio:	0.4338
Specific Gravity(assumed):	2.70
Initial Saturation (%)	69.9

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.060	0.1441	1.0000	0.00	0.00	0.4338	0.00
1.400	0.1566	0.9875	0.00	-1.25	0.4158	-1.25
H2O	0.1572	0.9869	0.00	-1.31	0.4150	-1.31

Percent Swell (+) / Settlement (-) After Inundation = -0.06

Void Ratio - Log Pressure Curve



Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

One-Dimensional Swell or Settlement Potential of Cohesive Soils
(ASTM D 4546)

Project Name:	Young Homes / MV	Tested By:	FT, ESS
Project No.:	021164-001	Checked By:	LF
Boring No.:	B-2	Sample Type:	Drive
Sample No.:	R-6	Depth (ft.)	20.0
Sample Description:	Brown silty sand (SM)		

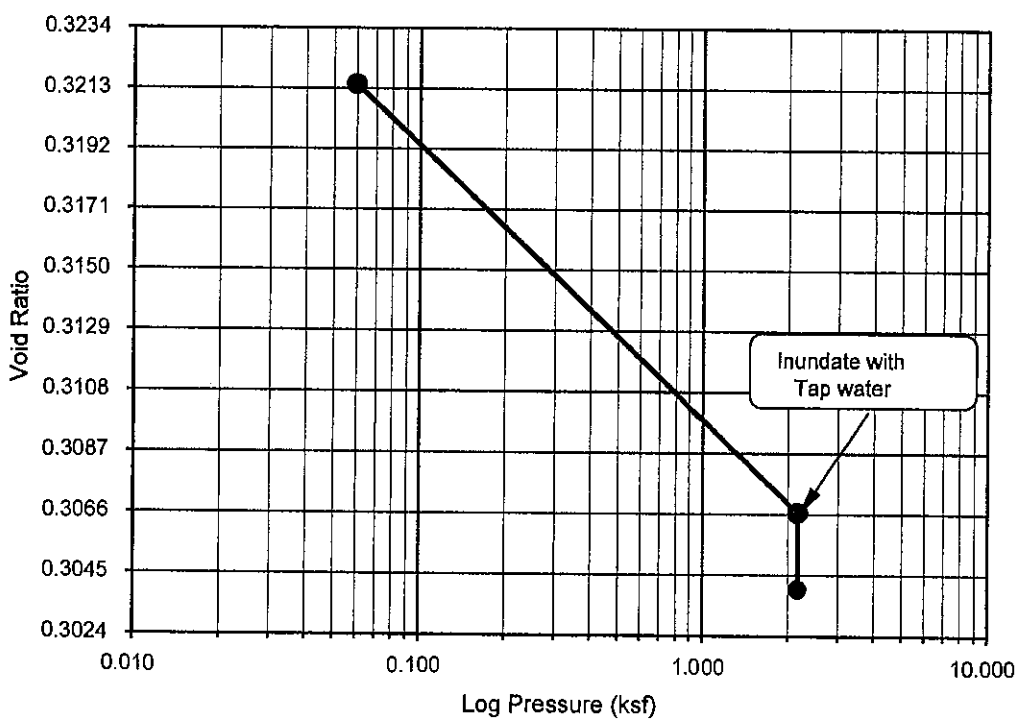
Initial Dry Density (pcf):	127.5
Initial Moisture (%):	5.38
Initial Length (in.):	1.0000
Initial Dial Reading:	0.1000
Diameter(in):	2.416

Final Dry Density (pcf):	127.9
Final Moisture (%) :	11.3
Initial Void ratio:	0.3216
Specific Gravity(assumed):	2.70
Initial Saturation (%)	45.1

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.060	0.1001	0.9999	0.00	-0.01	0.3215	-0.01
2.170	0.1113	0.9887	0.00	-1.13	0.3067	-1.13
H2O	0.1133	0.9867	0.00	-1.33	0.3040	-1.33

Percent Swell (+) / Settlement (-) After Inundation = -0.20

Void Ratio - Log Pressure Curve



Teratest Labs, Inc.
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One-Dimensional Swell or Settlement Potential of Cohesive Soils
(ASTM D 4546)

Project Name:	Young Homes / MV	Tested By:	FT, ESS
Project No.:	021164-001	Checked By:	LF
Boring No.:	B-2	Sample Type:	Drive
Sample No.:	R-2	Depth (ft.)	5.0
Sample Description:	Brown silty sand (SM)		

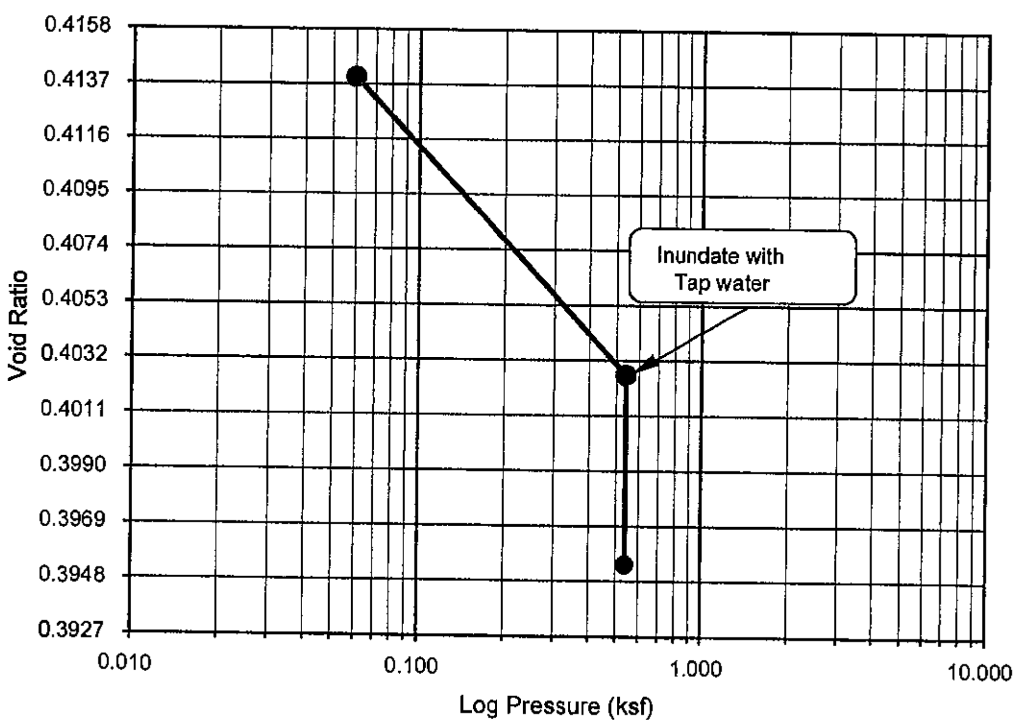
Initial Dry Density (pcf):	119.2
Initial Moisture (%):	3.19
Initial Length (in.):	1.0000
Initial Dial Reading:	0.1093
Diameter(in):	2.416

Final Dry Density (pcf):	119.0
Final Moisture (%) :	13.5
Initial Void ratio:	0.4147
Specific Gravity(assumed):	2.70
Initial Saturation (%)	20.8

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.060	0.1098	0.9995	0.00	-0.05	0.4140	-0.05
0.540	0.1178	0.9915	0.00	-0.85	0.4027	-0.85
H2O	0.1229	0.9864	0.00	-1.36	0.3954	-1.36

Percent Swell (+) / Settlement (-) After Inundation = -0.51

Void Ratio - Log Pressure Curve



MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

Project Name:	Young Homes / MV	Tested By :	GB
Project No.:	021164-001	Input By :	LF
Boring No.:	TP-3	Depth (ft.)	2-3
Sample No. :	Bag-1		
Soil Identification:	Olive brown poorly graded sand (SP)		

Preparation Method: ☐ Moist ☒ Dry ☒ Mechanical Ram ☐ Manual Ram

Mold Volume (ft^3) 0.03323 *Ram Weight = 10 lb.; Drop = 18 in.*

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3753.6	3855.7	3946.2	3901.9		
Weight of Mold (g)	1771.0	1771.0	1771.0	1771.0		
Net Weight of Soil (g)	1982.6	2084.7	2175.2	2130.9		
Wet Weight of Soil + Cont. (g)	411.70	355.40	374.30	399.80		
Dry Weight of Soil + Cont. (g)	404.20	341.80	353.40	369.80		
Weight of Container (g)	51.80	51.20	52.10	49.30		
Moisture Content (%)	2.13	4.68	6.94	9.36		
Wet Density (pcf)	131.5	138.3	144.3	141.4		
Dry Density (pcf)	128.8	132.1	134.9	129.3		

Maximum Dry Density (pcf) 135.0 **Optimum Moisture Content (%)** 7.0

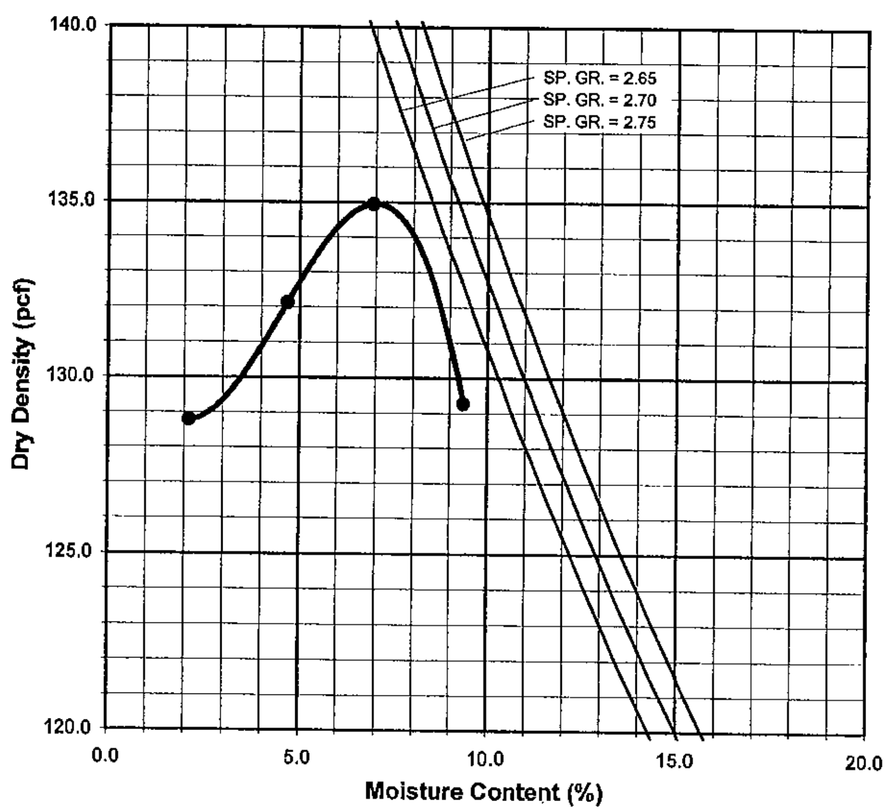
PROCEDURE USED

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

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

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

Particle-Size Distribution:
GR:SA:FI
Atterberg Limits:
LL,PL,PI



MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

Project Name:	Young Homes / MV	Tested By :	GB
Project No.:	021164-001	Input By :	LF
Boring No.:	TP-6	Depth (ft.)	2-5
Sample No. :	Bag-1		
Soil Identification:	Dark reddish brown silty clay (CL-ML)		

Preparation Method: [ ] Moist [X] Dry [X] Mechanical Ram [ ] Manual Ram

Mold Volume (ft³) 0.03323 *Ram Weight = 10 lb.; Drop = 18 in.*

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3683.6	3842.9	3913.2	3810.1		
Weight of Mold (g)	1771.0	1771.0	1771.0	1771.0		
Net Weight of Soil (g)	1912.6	2071.9	2142.2	2039.1		
Wet Weight of Soil + Cont. (g)	369.90	347.80	312.20	329.70		
Dry Weight of Soil + Cont. (g)	354.20	326.10	287.80	298.20		
Weight of Container (g)	52.00	51.00	52.50	54.00		
Moisture Content (%)	5.20	7.89	10.37	12.90		
Wet Density (pcf)	126.9	137.5	142.1	135.3		
Dry Density (pcf)	120.6	127.4	128.8	119.8		

Maximum Dry Density (pcf) 129.0 **Optimum Moisture Content (%)** 9.5

PROCEDURE USED

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

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

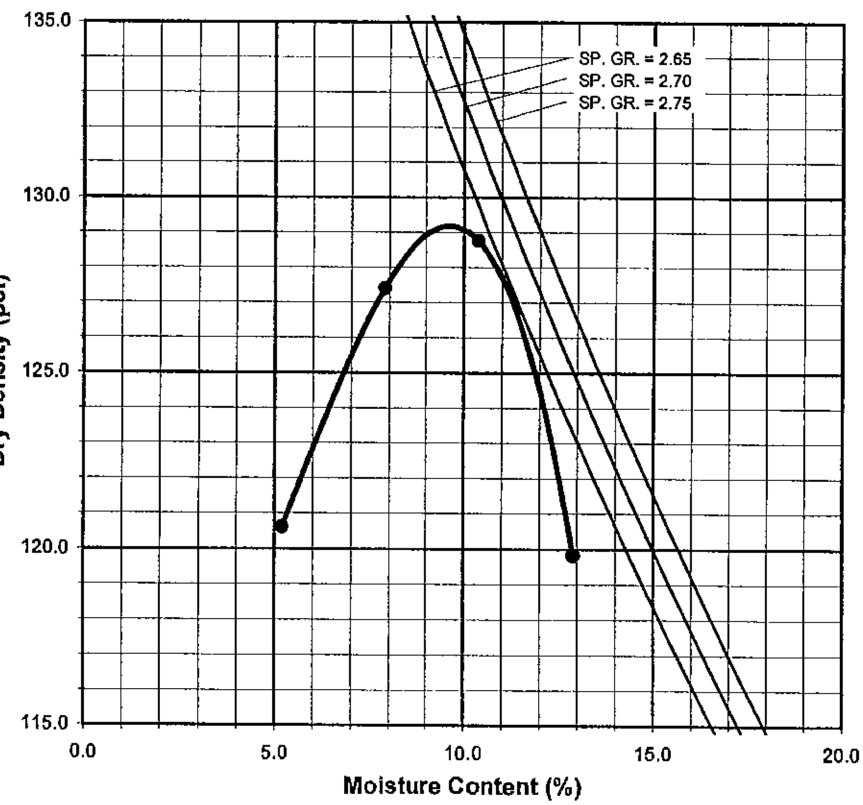
[ ] **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI



MX TP-6 Bag-1

EXPANSION INDEX of SOILS
ASTM D 4829

Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

Project Name:	Young Homes / MV	Tested By:	GB
Project No. :	021164-001	Checked By:	LF
Boring No.:	TP-1	Depth (ft.)	2-5
Sample No. :	Bag-1		
Soil Identification:	Dark yellowish brown clayey sand (SC)		

Dry Wt. of Soil + Cont.	(g)	1000.00
Wt. of Container No.	(g)	0.00
Dry Wt. of Soil	(g)	1000.00
Weight Soil Retained on #4 Sieve		0.00
Percent Passing # 4		100.00

MOLDED SPECIMEN		Before Test	After Test
Specimen Diameter	(in.)	4.01	4.01
Specimen Height	(in.)	1.0000	1.0043
Wt. Comp. Soil + Mold	(g)	636.10	443.00
Wt. of Mold	(g)	210.80	0.00
Specific Gravity (Assumed)		2.70	2.70
Container No.		O	O
Wet Wt. of Soil + Cont.	(g)	848.50	653.80
Dry Wt. of Soil + Cont.	(g)	787.90	605.70
Wt. of Container	(g)	0.00	210.80
Moisture Content	(%)	7.69	12.18
Wet Density	(pcf)	128.3	133.1
Dry Density	(pcf)	119.1	118.6
Void Ratio		0.415	0.421
Total Porosity		0.293	0.296
Pore Volume	(cc)	60.7	61.6
Degree of Saturation (%) [S_{meas}]		**50.0**	78.1

SPECIMEN INUNDATION in distilled water for the period of 24 h or expansion rate < 0.0002 in./h

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
04/21/04	16:02	1.0	0	0.0710
04/21/04	16:12	1.0	10	0.0703
Add Distilled Water to the Specimen				
04/21/04	17:07	1.0	55	0.0742
04/22/04	6:45	1.0	873	0.0753
04/22/04	10:10	1.0	1078	0.0753

Expansion Index (EI_{meas}) = ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	5.0
Expansion Index $(EI)_{50}$ = $EI_{meas} - (50 - S_{meas})x((65+EI_{meas}) / (220-S_{meas}))$	**5**

Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

EXPANSION INDEX of SOILS

ASTM D 4829

Project Name:	Young Homes / MV	Tested By:	GB
Project No. :	021164-001	Checked By:	LF
Boring No.:	TP-5	Depth (ft.)	2-5
Sample No. :	Bag-1		
Soil Identification:	Dark yellowish brown poorly graded sand (SP)		

Dry Wt. of Soil + Cont.	(g)	1000.00
Wt. of Container No.	(g)	0.00
Dry Wt. of Soil	(g)	1000.00
Weight Soil Retained on #4 Sieve		0.00
Percent Passing # 4		100.00

MOLDED SPECIMEN		Before Test	After Test
Specimen Diameter	(in.)	4.01	4.01
Specimen Height	(in.)	1.0000	1.0004
Wt. Comp. Soil + Mold	(g)	629.40	449.10
Wt. of Mold	(g)	190.80	0.00
Specific Gravity (Assumed)		2.70	2.70
Container No.		O	O
Wet Wt. of Soil + Cont.	(g)	854.10	639.90
Dry Wt. of Soil + Cont.	(g)	794.50	598.80
Wt. of Container	(g)	0.00	190.80
Moisture Content	(%)	7.50	10.07
Wet Density	(pcf)	132.3	135.4
Dry Density	(pcf)	123.1	123.0
Void Ratio		0.370	0.370
Total Porosity		0.270	0.270
Pore Volume	(cc)	55.9	56.0
Degree of Saturation (%) [S_{meas}]		**54.8**	73.4

SPECIMEN INUNDATION in distilled water for the period of 24 h or expansion rate < 0.0002 in./h

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
04/21/04	16:29	1.0	0	0.0508
04/21/04	16:39	1.0	10	0.0507
Add Distilled Water to the Specimen				
04/21/04	17:06	1.0	27	0.0509
04/22/04	6:47	1.0	848	0.0512
04/22/04	10:02	1.0	1043	0.0512

Expansion Index (EI_{meas})	= ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	0.5
Expansion Index (EI) $_{50}$	= EI_{meas} - (50 - S_{meas})x((65+EI_{meas}) / (220-S_{meas}))	**2**

EXPANSION INDEX of SOILS

ASTM D 4829

Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

Project Name:	Young Homes / MV	Tested By:	GB
Project No. :	021164-001	Checked By:	LF
Boring No.:	TP-8	Depth (ft.)	2-3
Sample No. :	Bag-1		
Soil Identification:	Dark yellowish brown silty sand (SM)		

Dry Wt. of Soil + Cont.	(g)	1000.00
Wt. of Container No.	(g)	0.00
Dry Wt. of Soil	(g)	1000.00
Weight Soil Retained on #4 Sieve		0.00
Percent Passing # 4		100.00

MOLDED SPECIMEN		Before Test	After Test
Specimen Diameter	(in.)	4.01	4.01
Specimen Height	(in.)	1.0000	1.0000
Wt. Comp. Soil + Mold	(g)	620.80	440.00
Wt. of Mold	(g)	201.80	0.00
Specific Gravity (Assumed)		2.70	2.70
Container No.		O	O
Wet Wt. of Soil + Cont.	(g)	862.40	641.80
Dry Wt. of Soil + Cont.	(g)	804.50	592.70
Wt. of Container	(g)	0.00	201.80
Moisture Content	(%)	7.20	12.56
Wet Density	(pcf)	126.4	132.7
Dry Density	(pcf)	117.9	117.9
Void Ratio		0.430	0.430
Total Porosity		0.301	0.301
Pore Volume	(cc)	62.2	62.2
Degree of Saturation (%) [S_{meas}]		**45.2**	78.9

SPECIMEN INUNDATION in distilled water for the period of 24 h or expansion rate < 0.0002 in./h

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
04/21/04	16:55	1.0	0	0.1090
04/21/04	17:05	1.0	10	0.1087
Add Distilled Water to the Specimen				
04/21/04	17:10	1.0	5	0.1087
04/22/04	6:44	1.0	819	0.1090
04/22/04	10:15	1.0	1030	0.1090

Expansion Index (EI_{meas})	= ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	0.3
Expansion Index (EI)$_{50}$	= EI_{meas} - (50 - S_{meas})x((65+EI_{meas}) / (220-S_{meas}))	**0**

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

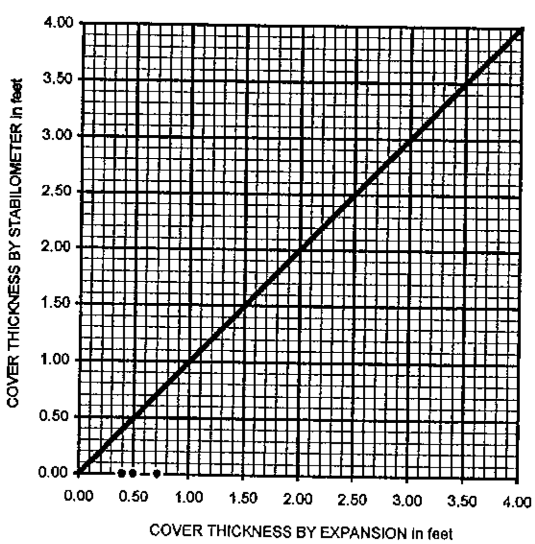
R-VALUE TEST RESULTS

PROJECT NAME:	Young Homes / MV	PROJECT NUMBER:	021164-001
SAMPLE NUMBER:	Bag 1	SAMPLE LOCATION:	TP-8 2-3'
SAMPLE DESCRIPTION:	Si. Sa.	TECHNICIAN:	SCF

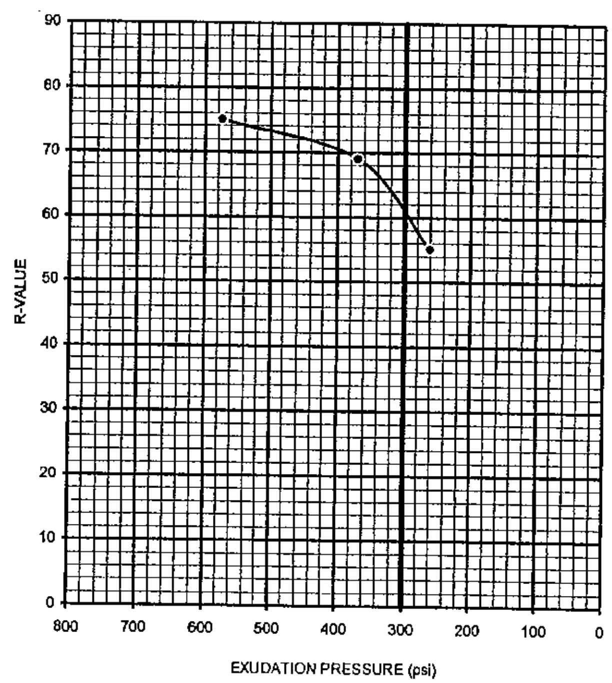
TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION %	9.5	9.9	10.3
HEIGHT OF SAMPLE, Inches	2.44	2.57	2.53
DRY DENSITY, pcf	126.6	125.6	127.4
COMPACTOR AIR PRESSURE, psf	200	150	100
EXUDATION PRESSURE, psf	574	369	261
EXPANSION, Inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	25	30	43
TURNS DISPLACEMENT	4.58	4.98	5.56
R-VALUE UNCORRECTED	75	69	55
R-VALUE CORRECTED	75	69	55

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.40	0.50	0.72
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION:	100
R-VALUE BY EXUDATION:	61
EQUILIBRIUM R-VALUE:	61

Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

TESTS for SULFATE CONTENT CHLORIDE CONTENT and pH of SOILS

Project Name: Young Homes / MV | Tested By : VJ

Project No. : 021164-001 | Data Input By: LF

Boring No.	TP-1	TP-8		
Sample No.	Bag-1	Bag-1		
Sample Depth (ft)	2-5	2-3		
Soil Identification:	SC	SM		
Wet Weight of Soil + Container (g)	222.36	193.02		
Dry Weight of Soil + Container (g)	215.40	187.60		
Weight of Container (g)	74.75	38.66		
Moisture Content (%)	4.95	3.64		
Weight of Soaked Soil (g)	100.24	100.39		

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	14	15		
Crucible No.	19	20		
Furnace Temperature (°C)	830	830		
Time In / Time Out	7:45 / 8:30	7:45 / 8:30		
Duration of Combustion (min)	45	45		
Wt. of Crucible + Residue (g)	20.9062	21.2107		
Wt. of Crucible (g)	20.9043	21.2096		
Wt. of Residue (g) (A)	0.0019	0.0011		
PPM of Sulfate (A) x 41150	78.18	45.27		
PPM of Sulfate, Dry Weight Basis	**82**	**47**		

CHLORIDE CONTENT, DOT California Test 422

ml of Chloride Soln. For Titration (B)	30	30		
ml of AgNO3 Soln. Used in Titration (C)	0.6	0.6		
PPM of Chloride (C -0.2) * 100 * 30 / B	40	40		
PPM of Chloride, Dry Wt. Basis	**42**	**42**		

pH TEST, DOT California Test 532/643

pH Value	**7.02**	**7.07**		
Temperature °C	20.7	20.6		

Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

Project Name: Young Homes / MV

Project No. : 021164-001

Boring No.: TP-1

Sample No. : Bag-1

Soil Identification: SC

Tested By : VJ

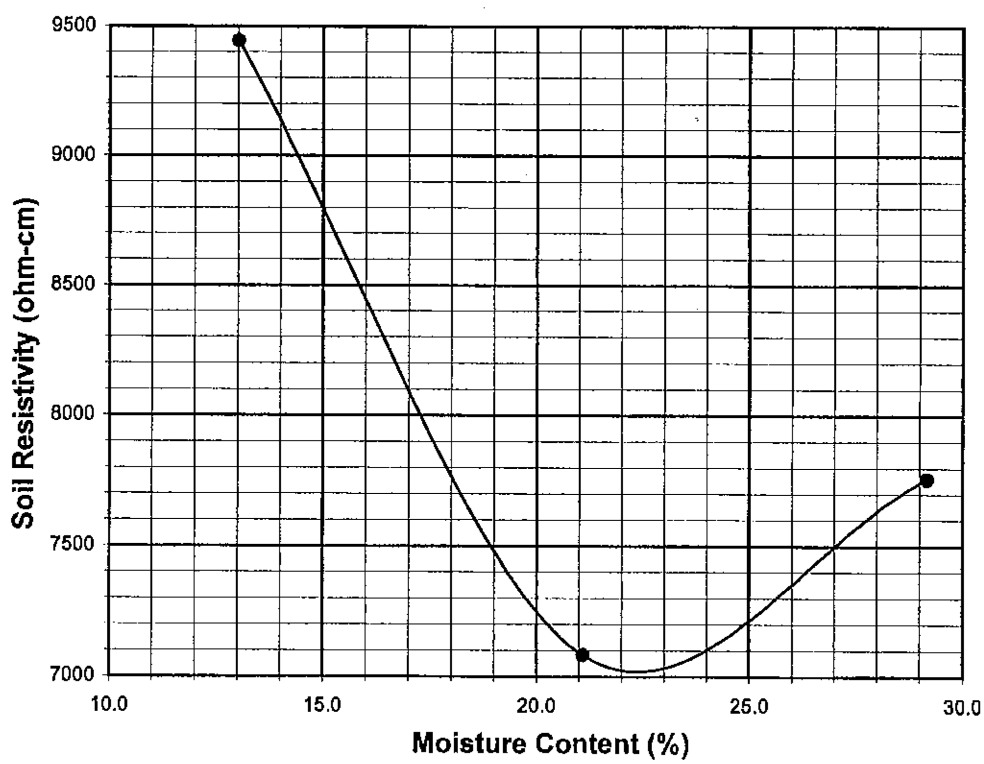
Data Input By: LF

Depth (ft.) : 2-5

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	100	13.02	1400	9444
2	200	21.09	1050	7083
3	300	29.17	1150	7758
4				
5				

Moisture Content (%) (MCi)	4.95
Wet Wt. of Soil + Cont. (g)	222.36
Dry Wt. of Soil + Cont. (g)	215.40
Wt. of Container (g)	74.75
Container No.	
Initial Soil Wt. (g) (Wt)	1300.00
Box Constant	6.746
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
7020	**22.3**	**82**	**42**	**7.02**	**20.7**



SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

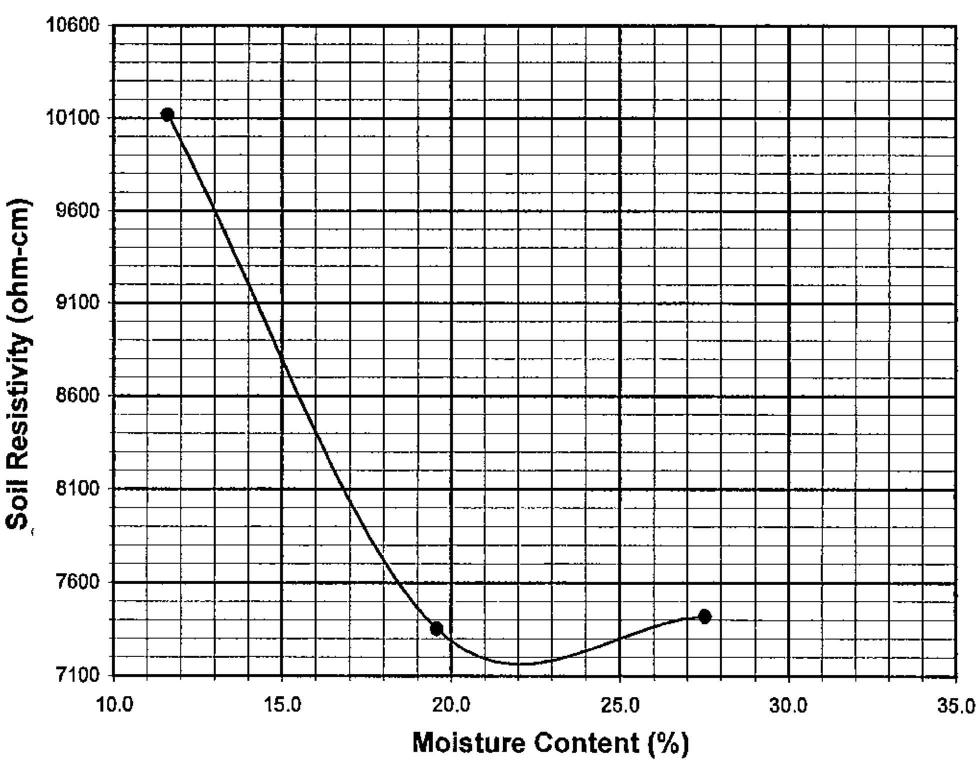
Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

Project Name:	Young Homes / MV	Tested By :	VJ
Project No. :	021164-001	Data Input By:	LF
Boring No.:	TP-8	Depth (ft.) :	2-3
Sample No. :	Bag-1		
Soil Identification:	SM		

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	100	11.61	1500	10119
2	200	19.58	1090	7353
3	300	27.56	1100	7421
4				
5				

Moisture Content (%) (MCi)	3.64
Wet Wt. of Soil + Cont. (g)	193.02
Dry Wt. of Soil + Cont. (g)	187.60
Wt. of Container (g)	38.66
Container No.	
Initial Soil Wt. (g) (Wt)	1300.00
Box Constant	6.746
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
7170	**22.0**	**47**	**42**	**7.07**	**20.6**



APPENDIX E

LEIGHTON AND ASSOCIATES, INC.

GENERAL EARTHWORK AND GRADING SPECIFICATIONS FOR ROUGH GRADING

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1.0 General

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

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

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

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground after it has been cleared for receiving fill but before fill is placed, bottoms of all "remedial removal" areas, all key bottoms, and benches made on sloping ground to receive fill.

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

1.3 The Earthwork Contractor: The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The

Contractor shall be solely responsible for performing the grading in accordance with the plans and specifications.

The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified.

2.0 Preparation of Areas to be Filled

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

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 5 percent of organic matter. Nesting of the organic materials shall not be allowed.

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

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

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

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

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

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

3.0 Fill Material

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

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

3.3 Import: If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

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

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

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

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

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

4.6 Frequency of Compaction Testing: Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

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

5.0 Subdrain Installation

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

6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

7.1 Safety: The Contractor shall follow all OHSA and Cal/OSHA requirements for safety of trench excavations.

7.2 Bedding and Backfill: All bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 90 percent of maximum from 1 foot above the top of the conduit to the surface.

The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

7.3 Lift Thickness: Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

7.4 Observation and Testing: The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

May 9, 2014 Project No. 14541-11A

Mr. Jason Keller
MISSION PACIFIC LAND COMPANY
3649 Mission Inn Avenue
1st Floor Rotunda
Riverside, CA 92501

Subject: **Interpretive Report for Infiltration System Design, Proposed Residential Development, Located at the Northeast Corner of Indian Avenue and Santiago Street City of Moreno Valley, Riverside County, California**

Earth-Strata, Inc. is pleased to present this interpretive report for the proposed development, located at the northeast corner of Indian Avenue and Santiago Street in the City of Moreno Valley, Riverside County, California. The purpose of our study was to determine the infiltration rates and physical characteristics of the subsurface earth materials within the proposed development. We have provided guidelines for the design of onsite detention basins, where applicable. This study is intended to provide onsite infiltration rates for the earth materials at the approximate depth near the proposed porous pavement areas.

PROPERTY DESCRIPTION

The subject property is located at northwest corner of Indian Avenue and Santiago Street in the City of Moreno Valley, Riverside County, California (see Figure 1). The subject property consists of a developed parcel of land with relatively flat terrain. The subject property is underlain by undocumented fill and alluivium (Qal).

PROPOSED CONSTRUCTION

Based on information provided by you, the proposed development will consist of single family residences which include interior driveways, utilities and hardscape.

SUBSURFACE EXPLORATION AND INFILTRATION TESTING

SUBSURFACE EXPLORATION

Subsurface exploration of the subject site consisted of 2 exploratory excavations to a depth of 6 feet, conducted on May 7, 2014. The exploratory holes were excavated to evaluate insitu permeability rates for the soil below the porous pavement. The approximate location of the exploratory excavations are shown on the attached Infiltration Location Map, Plate 1.

EARTH MATERIALS

A general description of the earth materials observed on site is provided below.

- Quaternary Alluvium (map symbol Qal): Quaternary alluvium was encountered to a maximum depth explored. These alluvial deposits consist predominately of interlayered brown to gray brown, fine to coarse grained silty sand. These deposits were generally noted to be in a slightly moist to moist, loose to medium dense state.

GROUNDWATER

Groundwater was not observed within the exploratory excavations.

INFILTRATION TESTING

The continuous presoak test method was utilized to perform a total of two (2) infiltration tests on May 7, 2014 to evaluate near surface infiltratiion rates in order to estimate the amount of storm water runoff that can percolate into the onsite bio swale retention basins. The infiltration tests were performed in general accordance with the requirements of insitu infiltration testing.

The infiltration tests were performed within 8 inch holes, 6 feet deep. The locations of the infiltration test holes are indicated on the attached Infiltration Location Map, Plate 1. The infiltration test holes were located by property boundary measurement on the site plan and by using geographic features. For the continuous presoak testing method, the pipe was filled with water and allowed to stand.

After the presoak, testing was performed by adjusting the water level. The drop in water level was measured from a fixed initial reference point for more reliable readings, with measurements having an accuracy of 1/8-inch. After each measurement, the water level was brought up to the original test level. Infiltration test data recorded in the field is summarized in the following table and is included within Appendix A.

INFILTRATION TEST SUMMARY

TEST NUMBER	INFILTRATION HOLE DEPTH (ft.)	INFILTRATION RATE (cm/sec)	DESCRIPTION
P-1	6	5	Silty SAND
P-2	6	3	Silty SAND

The infiltration test rates ranged from 3 to 5 minutes per inch (mpi).

CONCLUSIONS AND RECOMMENDATIONS

Based on the data presented in this report and the recommendations set forth herein, it is the opinion of Earth-Strata that the retention basin can be designed for a infiltration rate of 5 mpi.

The following equation was used in order to convert the infiltration rate to infiltration rate.

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

The design infiltration rate of 5 mpi is equalvent to 0.45 inch/hour.

GRADING PLAN REVIEW AND CONSTRUCTION SERVICES

This report has been prepared for the exclusive use of **Mr. Jason Keller** and their authorized representative. It likely does not contain sufficient information for other parties or other uses. Earth-Strata should be engaged to review the final design plans and specifications prior to construction. This is to verify that the recommendations contained in this report have been properly incorporated into the project plans and specifications. Should Earth-Strata not be accorded the opportunity to review the project plans and specifications, we are not responsibility for misinterpretation of our recommendations.

Earth-Strata should be retained to provide observations during construction to validate this report. In order to allow for design changes in the event that the subsurface conditions differ from those anticipated prior to construction.

Earth-Strata should review any changes in the project and modify and approve in writing the conclusions and recommendations of this report. This report and the drawings contained within are intended for design input purposes only and are not intended to act as construction drawings or specifications. In the event that conditions encountered during grading or construction operations appear to be different than those indicated in this report, this office should be notified immediately, as revisions may be required.

REPORT LIMITATIONS

Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable soils engineers and geologists, practicing at the time and location this report was prepared. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

Earth materials vary in type, strength, and other geotechnical properties between points of observation and exploration. Groundwater and moisture conditions can also vary due to natural processes or the works of man on this or adjacent properties. As a result, we do not and cannot have complete knowledge of the subsurface conditions beneath the subject property. No practical study can completely eliminate uncertainty with regard to the anticipated geotechnical conditions in connection with a subject property. The conclusions and recommendations within this report are based upon the findings at the points of observation and are subject to confirmation by Earth-Strata during construction. This report is considered valid for a period of one year from the time the report was issued.

This report was prepared with the understanding that it is the responsibility of the owner or their representative, to ensure that the conclusions and recommendations contained herein are brought to the attention of the other project consultants and are incorporated into the plans and specifications. The owners' contractor should properly implement the conclusions and recommendations during grading and construction, and notify the owner if they consider any of the recommendations presented herein to be unsafe or unsuitable.

Respectfully submitted,

EARTH-STRATA, INC.

Stephen M. Poole, PE 40219
President
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
STEPHEN MICHAEL POOLE
No. 40219
Exp.
CIVIL
STATE OF CALIFORNIA

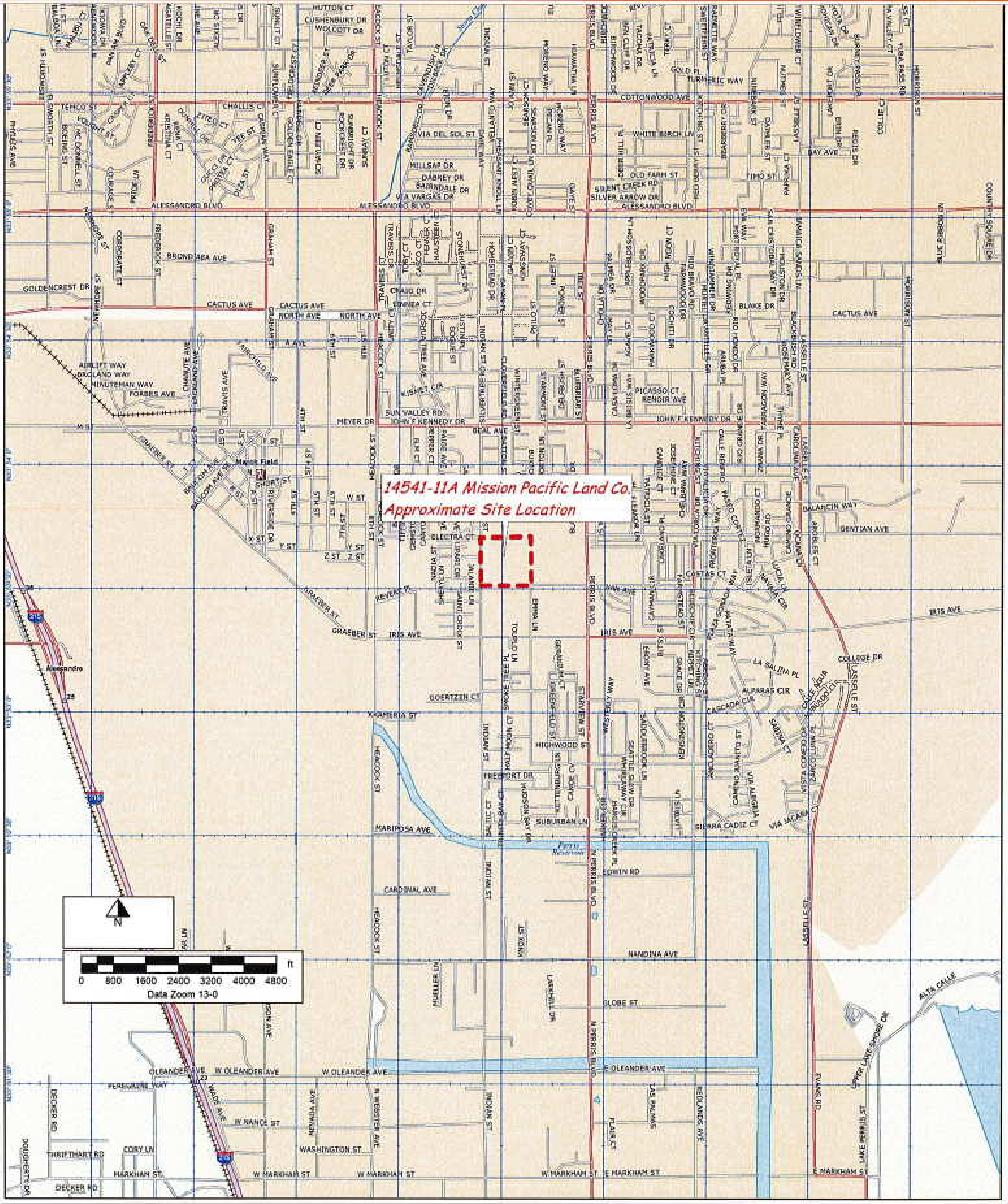
SMP/ca

Distribution: (2) Addressee

Attachments: Figure 1 – Vicinity Map *(Rear of Text)*
Appendix A – Exploratory Logs *(Rear of Text)*
Appendix B – Infiltration Test Sheets *(Rear of Text)*
Plate 1 – Infiltration Location Map *(Rear of Text)*

FIGURE 1

VICINITY MAP



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Earth - Strata, Inc.
Geotechnical, Environmental and Materials Testing Consultants
BETTER PEOPLE • BETTER SERVICE • BETTER RESULTS

MISSION PACIFIC LAND COMPANY		14541-11A
VICINITY MAP	SEE BAR SCALE	
	MAY 2014	FIGURE 1

APPENDIX A

EXPLORATORY LOGS

Geotechnical Boring Log B-1

Date: May 6, 2014	**Project Name: Moreno Valley** **Page: 1 of 1**
Project Number: 14541-11A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: CME 45B**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0					SM	**Quarternary Alluvium (Qal):**
						Silty **SAND**, Brown to Gray Brown, fine to coarse grained, slightly moist
						to moist, loose to medium dense
5						
10						
15						
20						
25						
30						

42217 Rio Nedo Rd., Suite A-104, Temecula CA 92590

Earth - Strata, Inc.

APPENDIX B

INFILTRATION TEST SHEETS

Job No.: 14541-11A | Tested By: TJ

Job Name: Moreno Valley, Indian Avenue

Test Hole Number: P-1 | Test Hole Diameter (inches): 8

Soil Classification: Silty SAND | Date Excavated: 5/6/2014

Test Hole Depth (ft): 6 | Date Tested: 5/7/2014

Time Interval of Presoak: 0

Date / Time

Start: 5/7/14 11:42

Stop: 5/7/14 13:43

Amount of Water Used / Comments: 0

Time	Time Interval (min.)	Initial Water Level (inches)	Final Water Level (inches)	Water Level Drop (inches)	Percolation Rate (Min./Inch)	Total Depth of Percolation Hole
11:42 12:12	30	28.5	36.5	8.00	4	72.00
12:12 12:42	30	36.5	43	6.50	5	72.00
12:42 12:52	10	43	45	2.00	5	72.00
12:52 13:02	10	45	46	1.00	10	72.00
13:02 13:12	10	46	47	1.00	10	72.00
13:12 13:22	10	47	48	1.00	10	72.00
13:23 13:33	10	28	33	5.00	2	72.00
13:33 13:43	10	33	35	2.00	5	72.00

"It" is the tested infiltration rate.

Time interval, Δt Initial Depth to Water, D_0

Final Depth to Water, D_f Total Depth of Test Hole, D_T

2Test Hole Radius, r

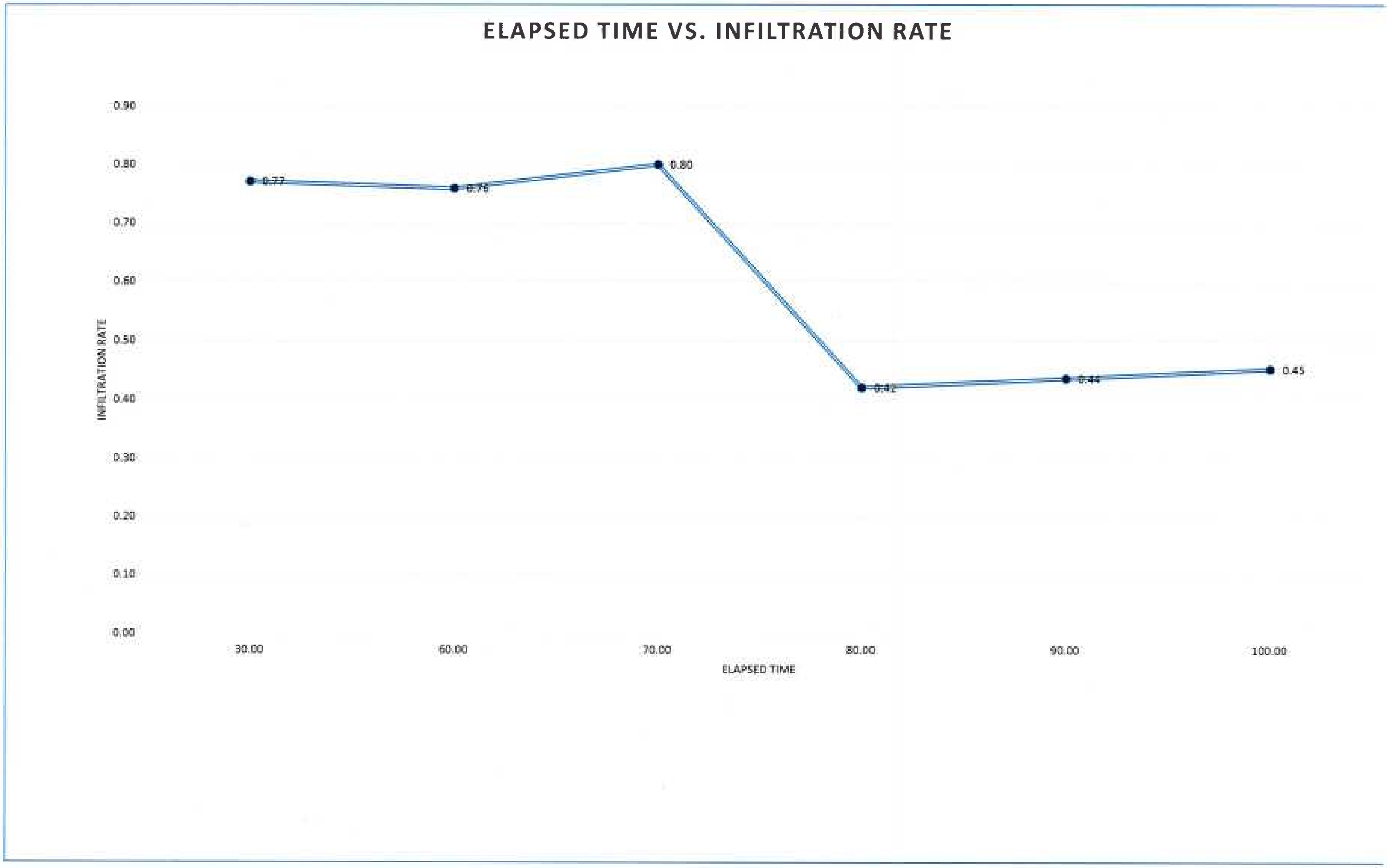
The conversion equation is used:

"Havg" is the average head height over the time interval.

$$It = \frac{\Delta H\ 60\ r}{\Delta t(r+2Havg)}$$

Time Interval Δt	Initial Water Ho	Final Water Hf	Total Depth of Test Hole Dt	Raduis of Perc Hole r	ΔH	H Avg	ΔH 60 r)/(Δt (r+2Havg)) It	ELAPSED TIME Δt
30.00	43.50	35.50	72.00	4.00	8.00	39.50	0.77	30.00
30.00	35.50	29.00	72.00	4.00	6.50	32.25	0.76	60.00
10.00	29.00	27.00	72.00	4.00	2.00	28.00	0.80	70.00
10.00	27.00	26.00	72.00	4.00	1.00	26.50	0.42	80.00
10.00	26.00	25.00	72.00	4.00	1.00	25.50	0.44	90.00
10.00	25.00	24.00	72.00	4.00	1.00	24.50	0.45	100.00
10.00	44.00	39.00	72.00	4.00	5.00	41.50	1.38	110.00
10.00	39.00	37.00	72.00	4.00	2.00	38.00	0.60	120.00

Job No.: 14541-11A
Job Name: Moreno Valley, Indian Avenue
Test Hole Number: P-1



Job No.: 14541-11A

Job Name: Moreno Valley, Indian Avenue

Test Hole Number: P-2

Soil Classification: Silty SAND

Test Hole Depth (ft): 6

Tested By: TJ

Test Hole Diameter (inches): 8

Date Excavated: 5/6/2014

Date Tested: 5/7/2014

Time Interval of Presoak: 0

Amount of Water Used / Comments: 0

Date / Time

Start: 5/7/14 11:40

Stop: 5/7/14 13:42

"It" is the tested infiltration rate.

Time interval, Δt Initial Depth to Water, D_0

Final Depth to Water, D_f Total Depth of Test Hole, D_T

2Test Hole Radius, r

The conversion equation is used:

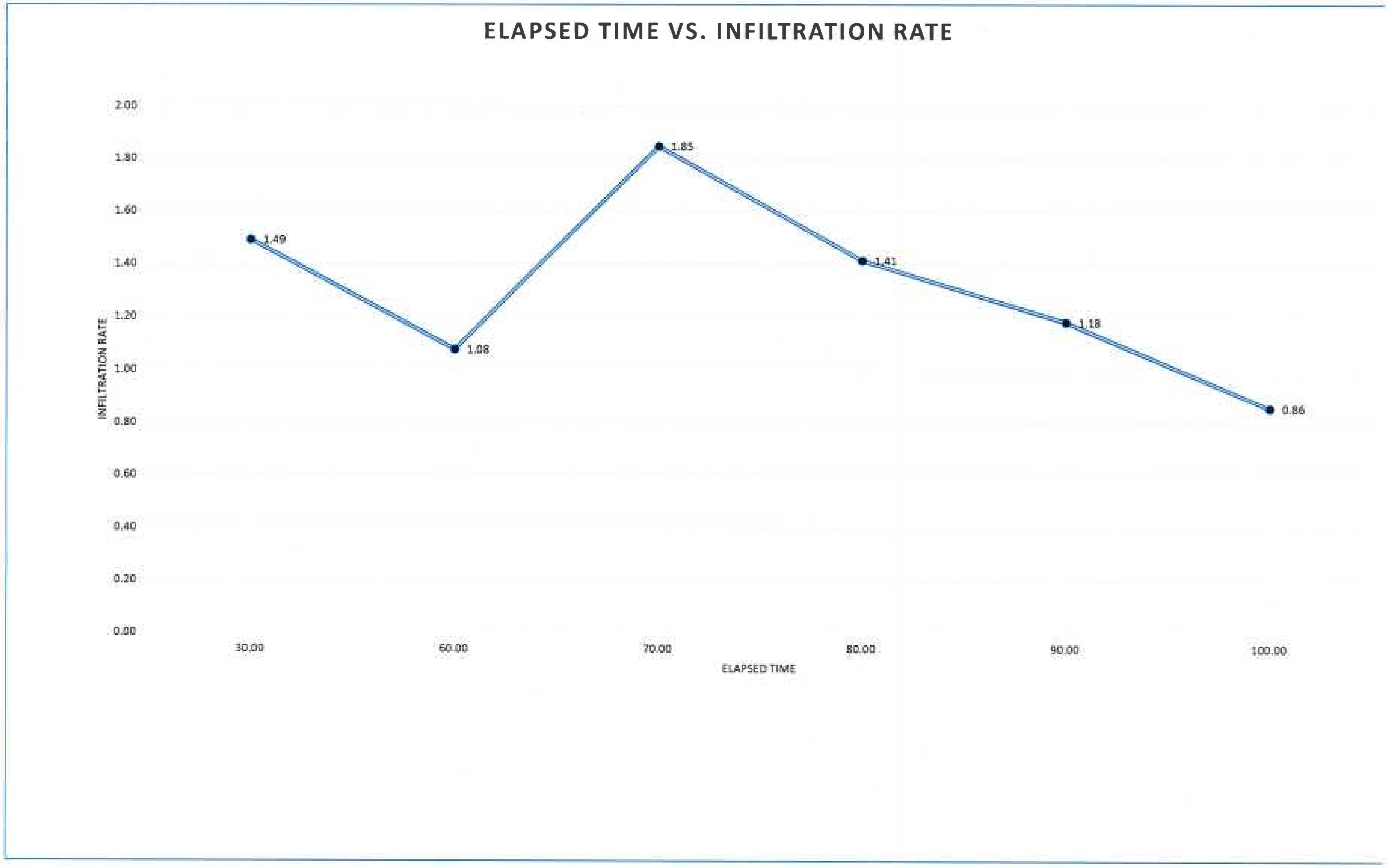
"Havg" is the average head height over the time interval.

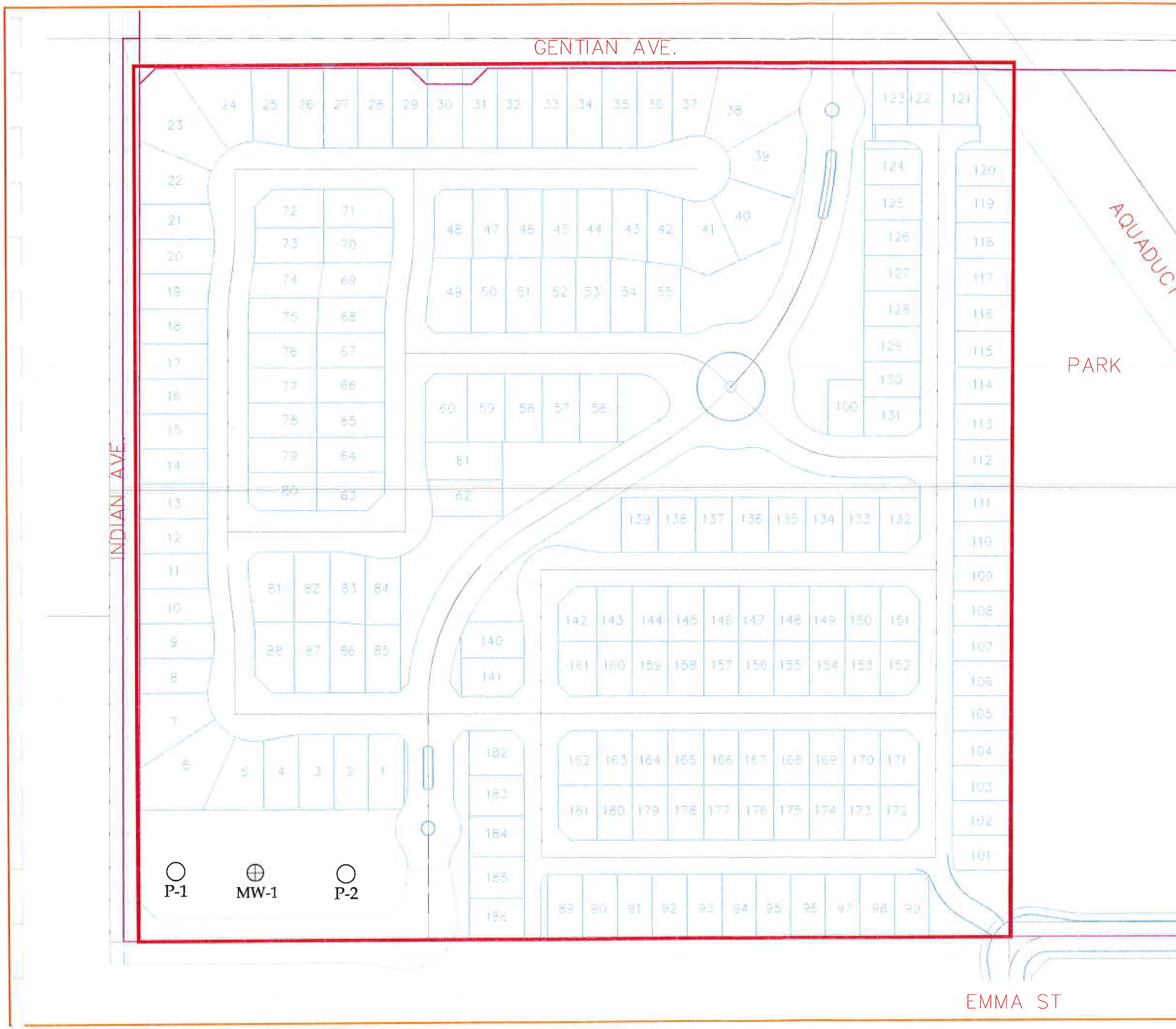
$$It = \frac{\Delta H\ 60\ r}{\Delta t(r+2Havg)}$$

Time	Time Interval (min.)	Initial Water Level (inches)	Final Water Level (inches)	Water Level Drop (inches)	Percolation Rate (Min./Inch)	Total Depth of Percolation Hole
11:40 12:10	30	31	44.5	13.50	3	72.00
12:10 12:40	30	44.5	51.5	7.00	5	72.00
12:41 12:51	10	32	38	6.00	2	72.00
12:51 13:01	10	38	42	4.00	3	72.00
13:01 13:11	10	42	45	3.00	4	72.00
13:11 13:21	10	45	47	2.00	5	72.00
13:22 13:32	10	36	39	3.00	4	72.00
13:32 13:42	10	39	42	3.00	4	72.00

Time Interval Δt	Initial Water H_0	Final Water H_f	Total Depth of Test Hole D_T	Radius of Perc Hole r	ΔH	H Avg	ΔH 60 r/(Δt (r+2Havg)) It	ELAPSED TIME Δt
30.00	41.00	27.50	72.00	4.00	13.50	34.25	1.49	30.00
30.00	27.50	20.50	72.00	4.00	7.00	24.00	1.08	60.00
10.00	40.00	34.00	72.00	4.00	6.00	37.00	1.85	70.00
10.00	34.00	30.00	72.00	4.00	4.00	32.00	1.41	80.00
10.00	30.00	27.00	72.00	4.00	3.00	28.50	1.18	90.00
10.00	27.00	25.00	72.00	4.00	2.00	26.00	0.86	100.00
10.00	36.00	33.00	72.00	4.00	3.00	34.50	0.99	110.00
10.00	33.00	30.00	72.00	4.00	3.00	31.50	1.07	120.00

Job No.: 14541-11A
Job Name: Moreno Valley, Indian Avenue
Test Hole Number: P-2





LEGEND

Locations are Approximate

Symbols

- Limits of Report

P-2 - Percolation Test Location

MW-1 - Percolation Monitoring Well Location

NORTH

PERCOLATION MAP

LOCATED EAST OF INDIAN AVE., SOUTH OF GENETIAN AVE.
CITY OF MORENO VALLEY
RIVERSIDE COUNTY, CALIFONIA

PROJECT	MISSION VALLEY LAND COMPANY		
CLIENT	MR. JASON KELLER		
PROJECT NO.	14541-11A		
DATE	MAY 2014		
SCALE	1:40		
DWG XREFS			
REVISION			
DRAWN BY	CS	PLATE	1 OF 1

Earth - Strata, Inc.
Geotechnical, Environmental and Materials Testing Consultants
BETTER PEOPLE • BETTER SERVICE • BETTER RESULTS

Appendix 4: Historical Site Conditions

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

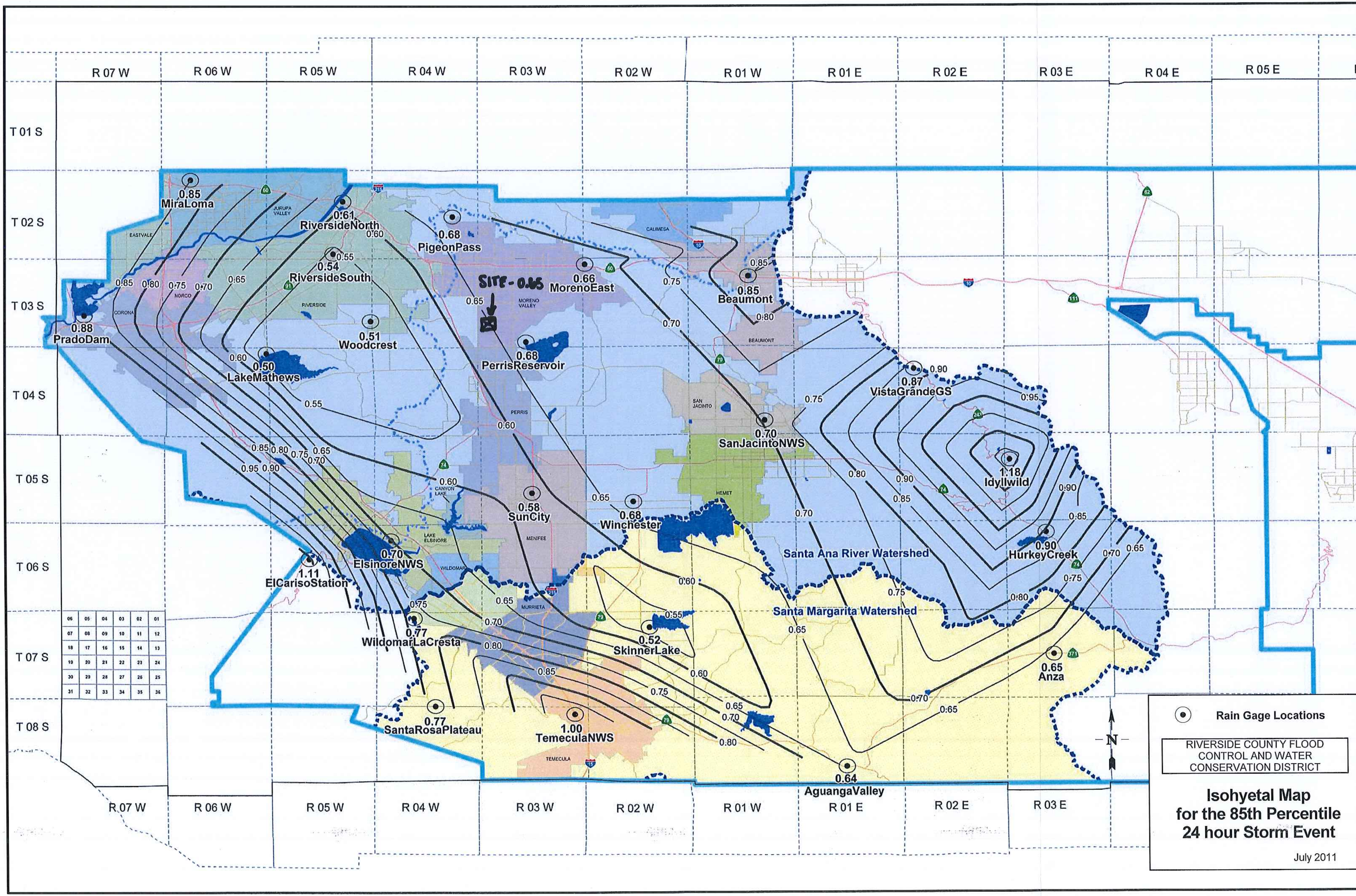
Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

(NOT APPLICABLE)

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation



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
0.68 PigeonPass
0.54 RiversideSouth
0.66 MorenoEast
0.85 Beaumont
SITE - 0.65
0.88 PradoDam
0.51 Woodcrest
0.68 PerrisReservoir
0.50 LakeMathews
0.87 VistaGrandeGS
0.70 SanJacintoNWS
1.18 Idyllwild
0.58 SunCity
0.68 Winchester
0.90 HurkeyCreek
0.70 ElsinoreNWS
1.11 ElCarisoStation
Santa Ana River Watershed
Santa Margarita Watershed
0.77 WildomarLaCresta
0.52 SkinnerLake
0.65 Anza
0.77 SantaRosaPlateau
1.00 TemeculaNWS
0.64 AguangaValley
N
Rain Gage Locations
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
Isohyetal Map for the 85th Percentile 24 hour Storm Event
July 2011

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: REC
Date: 6/8/2015
Designed by: TMG
Case No:
Company Project Number/Name: 16464B Legacy Park

BMP Identification

BMP NAME / ID: Area 100 West

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-100	*320442*	*Concrete or Asphalt*	*1*	*0.89*	*285834.3*			
D-100	*727285*	*Roofs*	*1*	*0.89*	*648738.2*			
D-100	*571926*	*Ornamental Landscaping*	*0.1*	*0.11*	*63173.8*			
	1619653	***Total***			**997746.3**	**0.65**	***54044.6***	***54,045***

Notes:

The design capture volume is stored in the sub-surface media and gravel layers, with excess water not exceeding a maximum of 6" ponded depth (see attached calculation sheet titled "Ponded Depth Calc"). The actual basin volume exceeds the proposed Vbmp for hydrology detetention requirements.

Bioretention Facility - Design Procedure	BMP ID	Legend:	Required Entries
	D-100		Calculated Cells

Company Name:	REC	Date:	6/18/2015
Designed by:	ROG	County/City Case No.:	

Design Volume

Enter the area tributary to this feature A_T= 36.2 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook V_{BMP}= 54,045 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 = 130.0 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 = 1.79 ft

Minimum Surface Area, A_m

$$A_M\,(ft^2) = \frac{V_{BMP}\,(ft^3)}{d_E\,(ft)}$$

A_M = 30,115 ft^2

Proposed Surface Area A= 31,934 ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility z = 4 :1

Diameter of Underdrain 6 inches

Longitudinal Slope of Site (3% maximum) 0 %

6" Check Dam Spacing 0 feet

Describe Vegetation: Natural Grasses

Notes:

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

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

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

Company Name: REC
Date: 6/8/2015
Designed by: TMG
Case No:
Company Project Number/Name: 16464B Legacy Park

BMP Identification

BMP NAME / ID: Area 200 East

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-200	*118702*	*Concrete or Asphalt*	*1*	*0.89*	*105882.2*			
D-200	*230892*	*Roofs*	*1*	*0.89*	*205955.7*			
D-200	*193462*	*Ornamental Landscaping*	*0.1*	*0.11*	*21369.4*			
	543056	***Total***			333207.3	**0.65**	***18048.7***	***18,049***

Notes:

The design capture volume is stored in the sub-surface media and gravel layers, with excess water not exceeding a maximum of 6" ponded depth (see attached calculation sheet titled "Ponded Depth Calc"). The actual basin volume exceeds the proposed Vbmp for hydrology detetention requirements.

Bioretention Facility - Design Procedure	BMP ID	Legend:	Required Entries
	D-200		Calculated Cells

Company Name: REC — Date: 6/18/2015

Designed by: ROG — County/City Case No.:

Design Volume

Enter the area tributary to this feature — A_T= 12.5 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook — V_{BMP}= 18,049 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 = 2.0 ft

Top Width of Bioretention Facility, excluding curb — w_T = 74.0 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 = 1.49 ft

Minimum Surface Area, A_m

$$A_M\,(ft^2) = \frac{V_{BMP}\,(ft^3)}{d_E\,(ft)}$$

A_M = 12,110 ft^2

Proposed Surface Area — A= 27,885 ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility — z = 4 :1

Diameter of Underdrain — 6 inches

Longitudinal Slope of Site (3% maximum) — 0 %

6" Check Dam Spacing — 0 feet

Describe Vegetation: Natural Grasses

Notes:

WEST BASIN #100

DESIGN CAPTURE VOLUME (VBMP) ≈ 54,045 ft^3 = 1.2 AC-FT

SUB-SURFACE STORAGE:

BOTTOM OF BASIN SURFACE AREA = 31,934 ft^2
36" SOIL MEDIA LAYER @ 30% POROSITY
12" GRAVEL LAYER @ 40% POROSITY

VOLUME IN (12") GRAVEL LAYER = (1 ft × 31,934 ft^2) × 0.4 = 12,774 ft^3

VOLUME IN (36") SOIL MEDIA = (3 ft × 31,934 ft^2) × 0.3 = 28,741 ft^3

SUM OF SUB-SURFACE STORAGE VOLUME = 41,515 ft^3

REMAINING VOLUME = 54,045 ft^3 − 41,515 ft^3 = 12,530 ft^3

BASIN VOLUME @ 6" ABOVE BASIN BOTTOM = 15,882 ft^3

∴ PONDED DEPTH < 6"

EAST BASIN #200

DESIGN CAPTURE VOLUME = 18,049 ft^3 = 0.4 AC-FT

SUB-SURFACE STORAGE:

BOTTOM OF BASIN SURFACE AREA = 27,885 ft^2
24" SOIL MEDIA @ 30% POROSITY
12" GRAVEL LAYER @ 40% POROSITY

VOLUME IN (12") GRAVEL LAYER = (1 ft × 27,885 ft^2) × 0.4 = 11,154 ft^3

VOLUME IN (24") SOIL MEDIA = (2 ft × 27,885 ft^2) × 0.3 = 16,731 ft^3

SUM OF SUB-SURFACE STORAGE VOLUME = 27,885 ft^3

∴ PONDED DEPTH < 6"

TOPS. 35500

APPENDIX E
BMP POLLUTANT REMOVAL EFFECTIVENESS

BMP Pollutant Removal Effectiveness (1)

Pollutant of Concern	Harvest and Use (8)	Infiltration BMPs (3)	Bioretention	Extended Detention Basins (2)	Sand Filter Basin (7)
Sediment	H	H	H	M	H
Nutrient	H	H	(5)	M (4)	L (6)
Trash	H	H	H	H	H
Metal	H	H	H	M	M
Bacteria	H	H	H	M	M
Oil & Grease	H	H	H	M	H
Organic Compounds	H	H	H	M	H
Pesticides	H	H	H	U	U

Abbreviations:

L: Low removal efficiency M: Medium removal efficiency H: High removal efficiency U: Unknown

Notes:

(1) Periodic performance assessment and updating of this table may be performed based on updated information from studies from the District, CASQA, Caltrans or others. These effectiveness ratings are based on the specific BMP designs incorporated into this manual.

(2) Effectiveness based upon total 72-hour drawdown time.

(3) Includes infiltration basins, infiltration trenches, and permeable pavements.

(4) Medium for soil types A & B only. Low for soil types C & D.

(5) Removal rating is dependent on the soil media depth. L=Min. 18" deep, M= Min. 24" deep, H=Max. 30"-36" deep.

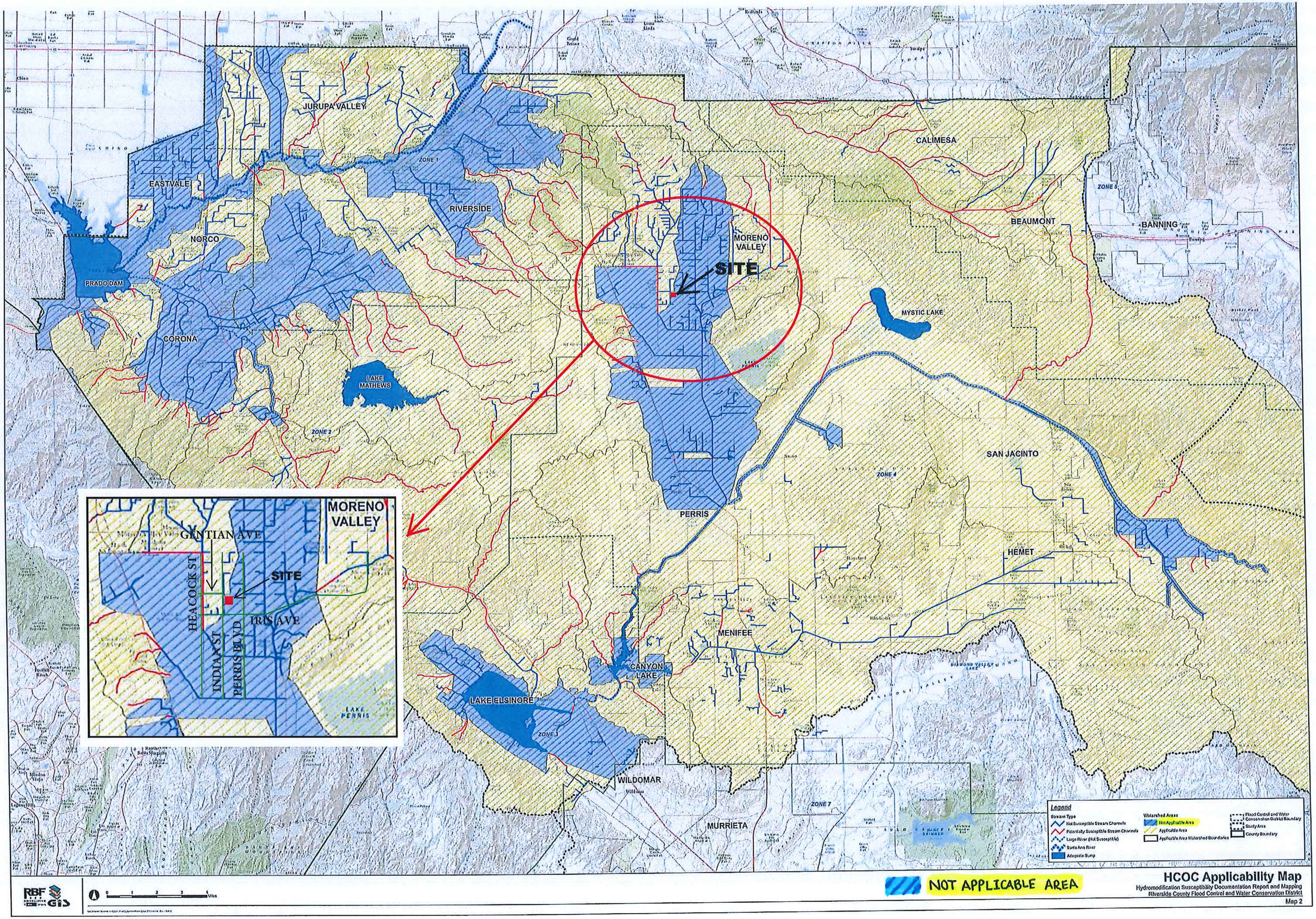
(6) Medium where sand filter layer is increased to 36".

(7) Considered to be a Treatment Control BMP. See the WQMP to determine if this BMP can be used.

(8) Cisterns, when associated with an adequate and reliable (year-round) demand for non-potable use of captured storm water (see the applicable WQMP for any specific requirements), have a High effectiveness at removing all pollutants from stormwater runoff. If there is inadequate demand to reliably drain the cistern through a non-potable use throughout the year, pollutant removal effectiveness will be Low.

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern



JURUPA VALLEY
EASTVALE
NORCO
PRADO DAM
CORONA
RIVERSIDE
LAKE MATHEWS
ZONE 1
ZONE 2
ZONE 3
ZONE 4
ZONE 5
ZONE 7
CALIMESA
BEAUMONT
BANNING
MORENO VALLEY
SITE
MYSTIC LAKE
SAN JACINTO
PERRIS
HEMET
MENIFEE
CANYON LAKE
LAKE ELSINORE
WILDOMAR
MURRIETA
MORENO VALLEY
GENTIAN AVE
HEACOCK ST
INDIAN ST
PERRIS BLVD
IRIS AVE
SITE
LAKE PERRIS
Legend
Stream Type
Not Susceptible Stream Channels
Potentially Susceptible Stream Channels
Large River (Not Susceptible)
Santa Ana River
Adequate Sump
Watershed Areas
Not Applicable Area
Applicable Area
Applicable Area Watershed Boundaries
Flood Control and Water Conservation District Boundary
Study Area
County Boundary
NOT APPLICABLE AREA
HCOC Applicability Map
Hydromodification Susceptibility Documentation Report and Mapping
Riverside County Flood Control and Water Conservation District
Map 2

Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Shown on WQMP Drawings	3 Permanent Controls—Listed in WQMP Table and Narrative	4 Operational BMPs—Included in WQMP Table and Narrative
☒ A. On-site storm drain inlets	☒ 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," 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 blockages and overflow.
☐ C. Interior parking garages		☐ State that parking garage floor drains will be plumbed to the sanitary sewer.	☐ Inspect and maintain blockages and overflow.

1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Shown on WQMP Drawings	3 Permanent Controls—Listed in WQMP Table and Narrative	4 Operational BMPs—Included 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/Downloads/ LandscapeGardenBrochure.pdf ☒ Provide IPM information to new owners, lessees and operators.

1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Shown on WQMP Drawings	3 Permanent Controls—Listed in WQMP Table and Narrative	4 Operational BMPs—Included in WQMP Table and Narrative
☐ E. Pools, spas, ponds, decorative fountains, and other water features.	☐ Show location of water feature and 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

1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Shown on WQMP Drawings	3 Permanent Controls—Listed in WQMP Table and Narrative	4 Operational BMPs—Included 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/

1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Shown on WQMP Drawings	3 Permanent Controls—Listed in WQMP Table and Narrative	4 Operational BMPs—Included 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 therequirements 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/ha z mat /	☐ 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

1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Shown on WQMP Drawings	3 Permanent Controls—Listed in WQMP Table and Narrative	4 Operational BMPs—Included 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 shutoff 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): ☐ Wash water 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.

1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Shown on WQMP Drawings	3 Permanent Controls—Listed in WQMP Table and Narrative	4 Operational BMPs—Included 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/

1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Shown on WQMP Drawings	3 Permanent Controls—Listed in WQMP Table and Narrative	4 Operational BMPs—Included in WQMP Table and Narrative
☐ L. Fuel Dispensing Areas	☐ Fueling areas6 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 area1.] 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.

1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Shown on WQMP Drawings	3 Permanent Controls—Listed in WQMP Table and Narrative	4 Operational BMPs—Included 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

1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Shown on WQMP Drawings	3 Permanent Controls—Listed in WQMP Table and Narrative	4 Operational BMPs—Included in WQMP Table and Narrative
☐ N. Fire Sprinkler Test Water		☐ Provide a mean 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.	

1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Shown on WQMP Drawings	3 Permanent Controls—Listed in WQMP Table and Narrative	4 Operational BMPs—Included 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

Operation and Maintenance Responsibility for Treatment Control BMPs

BMP	Operation and Maintenance Activities	BMP Start Date	Frequency	Indications for Maintenance	Parties Responsible For Maintenance and Funding
Landscaping and Irrigation	Inspect landscaping and irrigation systems and repair/replace if needed.	At the completion of project	The landscaping and irrigation systems shall be monitored monthly.	The landscaping areas should be maintained if areas are eroding away. Irrigation systems should be checked for irregular flows to the landscaped areas when ponding or dry soil occurs.	MPLC Legacy 75 Partners, LLP 4100 Newport Place, Suite 400 Newport, California 92660
Bioretention Basin	Maintain vegetation as needed and remove debris and litter from the basin. Inspect hydraulic and structural facilities, check erosion, and verify infiltration.	At the completion of project	The basin shall be monitored before annual storm seasons and following rainfall events. Mulch replacement prior to start of wet season. An in-depth inspection should occur annually, within 72 hours after a significant rainfall. Perform biannual health evaluation of trees/shrubs.	Vegetation should be maintained if it has eroded. If any debris or litter is seen it should be removed. Odor, insects, and overgrowth indicate the need for repair. The inlet should be examined for blockage, embankment, and damage to the structural integrity. The basin should be aerated if significant ponding of more than 72 hours occurs.	Home Owner's Association
Activity Restrictions	Any activity that may affect surrounding areas or the downstream receiving waters (such as car washes or leaving trash bin lids open) is strictly prohibited.	At the completion of project	Trash areas shall be checked before and after a major storm event, as well as on a monthly basis to reduce debris.	Not applicable	MPLC Legacy 75 Partners, LLP 4100 Newport Place, Suite 400 Newport, California 92660
Education Program	Educational materials are included in this WQMP Attachment D. The property owner shall distribute additional copies of handouts to the homeowners.	When new homeowners move in	The educational material provided shall be included in homeowner information packets and reviewed quarterly.	Not applicable	MPLC Legacy 75 Partners, LLP 4100 Newport Place, Suite 400 Newport, California 92660

BMP	Operation and Maintenance Activities	BMP Start Date	Frequency	Indications for Maintenance	Parties Responsible For Maintenance and Funding
Street Sweeping	A street sweeper shall clean the privately maintained streets and parking areas to reduce debris.	At the completion of project	A street sweeper shall clean the privately maintained streets and parking areas monthly and before any known storm event.	Not applicable	MPLC Legacy 75 Partners, LLP 4100 Newport Place, Suite 400 Newport, California 92660

Appendix 10: Educational Materials

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

3.5 Bioretention Facility

Type of BMP	LID – Bioretention
Treatment Mechanisms	Infiltration, Evapotranspiration, Evaporation, Biofiltration
Maximum Drainage Area	This BMP is intended to be integrated into a project's landscaped area in a distributed manner. Typically, contributing drainage areas to Bioretention Facilities range from less than 1 acre to a maximum of around 10 acres.
Other Names	Rain Garden, Bioretention Cell, Bioretention Basin, Biofiltration Basin, Landscaped Filter Basin, Porous Landscape Detention

Description

Bioretention Facilities are shallow, vegetated basins underlain by an engineered soil media. Healthy plant and biological activity in the root zone maintain and renew the macro-pore space in the soil and maximize plant uptake of pollutants and runoff. This keeps the Best Management Practice (BMP) from becoming clogged and allows more of the soil column to function as both a sponge (retaining water) and a highly effective and self-maintaining biofilter. In most cases, the bottom of a Bioretention Facility is unlined, which also provides an opportunity for infiltration to the extent the underlying onsite soil can accommodate. When the infiltration rate of the underlying soil is exceeded, fully biotreated flows are discharged via underdrains. Bioretention Facilities therefore will inherently achieve the maximum feasible level of infiltration and evapotranspiration and achieve the minimum feasible (but highly biotreated) discharge to the storm drain system.

Siting Considerations

These facilities work best when they are designed in a relatively level area. Unlike other BMPs, Bioretention Facilities can be used in smaller landscaped spaces on the site, such as:

- ✓ Parking islands
- ✓ Medians
- ✓ Site entrances

Landscaped areas on the site (such as may otherwise be required through minimum landscaping ordinances), can often be designed as Bioretention Facilities. This can be accomplished by:

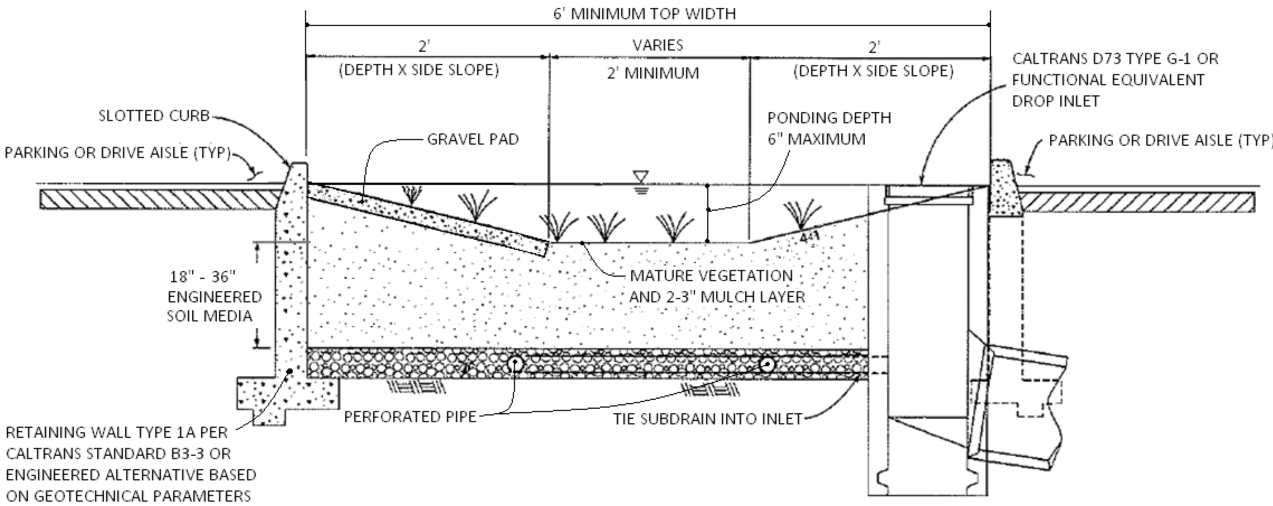
- *Depressing* landscaped areas below adjacent impervious surfaces, rather than elevating those areas
- Grading the site to direct runoff from those impervious surfaces *into* the Bioretention Facility, rather than away from the landscaping
- Sizing and designing the depressed landscaped area as a Bioretention Facility as described in this Fact Sheet

Bioretention Facilities should however not be used downstream of areas where large amounts of sediment can clog the system. Placing a Bioretention Facility at the toe of a steep slope should also be avoided due to the potential for clogging the engineered soil media with erosion from the slope, as well as the potential for damaging the vegetation.

Design and Sizing Criteria

The recommended cross section necessary for a Bioretention Facility includes:

- Vegetated area
- 18' minimum depth of engineered soil media
- 12' minimum gravel layer depth with 6' perforated pipes (added flow control features such as orifice plates may be required to mitigate for HCOC conditions)



While the 18-inch minimum engineered soil media depth can be used in some cases, it is recommended to use 24 inches or a preferred 36 inches to provide an adequate root zone for the chosen plant palate. Such a design also provides for improved removal effectiveness for nutrients. The recommended ponding depth inside of a Bioretention Facility is 6 inches; measured from the flat bottom surface to the top of the water surface as shown in Figure 1.

Because this BMP is filled with an engineered soil media, pore space in the soil and gravel layer is assumed to provide storage volume. However, several considerations must be noted:

- Surcharge storage above the soil surface (6 inches) is important to assure that design flows do not bypass the BMP when runoff exceeds the soil's absorption rate.
- In cases where the Bioretention Facility contains engineered soil media deeper than 36 inches, the pore space within the engineered soil media can only be counted to the 36-inch depth.
- A maximum of 30 percent pore space can be used for the soil media whereas a maximum of 40 percent pore space can be use for the gravel layer.

Figure 1: Standard Layout for a Bioretention Facility

Engineered Soil Media Requirements
The engineered soil media shall be comprised of 85 percent mineral component and 15 percent organic component, by volume, drum mixed prior to placement. The mineral component shall be a Class A sandy loam topsoil that meets the range specified in Table 1 below. The organic component shall be nitrogen stabilized compost[1], such that nitrogen does not leach from the media.

Table 1: Mineral Component Range Requirements

Percent Range	Component
70-80	Sand
15-20	Silt
5-10	Clay

The trip ticket, or certificate of compliance, shall be made available to the inspector to prove the engineered mix meets this specification.

Vegetation Requirements
Vegetative cover is important to minimize erosion and ensure that treatment occurs in the Bioretention Facility. The area should be designed for at least 70 percent mature coverage throughout the Bioretention Facility. To prevent the BMP from being used as walkways, Bioretention Facilities shall be planted with a combination of small trees, densely planted shrubs, and natural grasses. Grasses shall be native or ornamental; preferably ones that do not need to be mowed. The application of fertilizers and pesticides should be minimal. To maintain oxygen levels for the vegetation and promote biodegradation, it is important that vegetation not be completely submerged for any extended period of time. Therefore, a maximum of 6 inches of ponded water shall be used in the design to ensure that plants within the Bioretention Facility remain healthy.

A 2 to 3-inch layer of standard shredded aged hardwood mulch shall be placed as the top layer inside the Bioretention Facility. The 6-inch ponding depth shown in Figure 1 above shall be measured from the top surface of the 2 to 3-inch mulch layer.

Curb Cuts
To allow water to flow into the Bioretention Facility, 1-foot-wide (minimum) curb cuts should be placed approximately every 10 feet around the perimeter of the Bioretention Facility. Figure 2 shows a curb cut in a Bioretention Facility. Curb cut flow lines must be at or above the V_{BMP} water surface level.

[1] For more information on compost, visit the US Composting Council website at: http://compostingcouncil.org/

Figure 2: Curb Cut located in a Bioretention Facility

To reduce erosion, a gravel pad shall be placed at each inlet point to the Bioretention Facility. The gravel should be 1- to 1.5-inch diameter in size. The gravel should overlap the curb cut opening a minimum of 6 inches. The gravel pad inside the Bioretention Facility should be flush with the finished surface at the curb cut and extend to the bottom of the slope.

In addition, place an apron of stone or concrete, a foot square or larger, inside each inlet to prevent vegetation from growing up and blocking the inlet. See Figure 3.

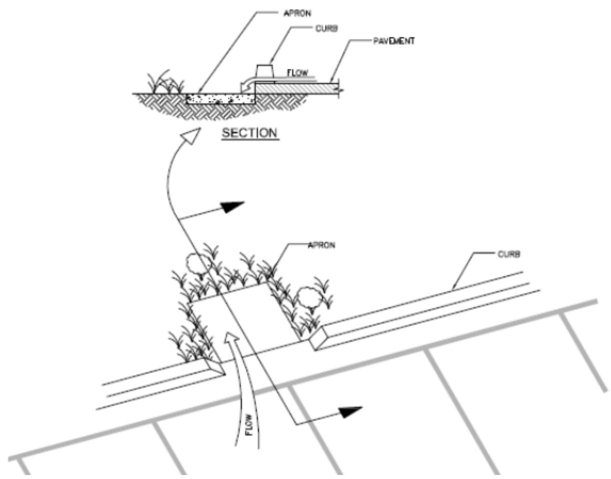


Figure 3: Apron located in a Bioretention Facility

Terracing the Landscaped Filter Basin

It is recommended that Bioretention Facilities be level. In the event the facility site slopes and lacks proper design, water would fill the lowest point of the BMP and then discharge from the basin without being treated. To ensure that the water will be held within the Bioretention Facility on sloped sites, the BMP must be terraced with nonporous check dams to provide the required storage and treatment capacity.

The terraced version of this BMP shall be used on non-flat sites with no more than a 3 percent slope. The surcharge depth cannot exceed 0.5 feet, and side slopes shall not exceed 4:1. Table 2 below shows the spacing of the check dams, and slopes shall be rounded up (i.e., 2.5 percent slope shall use 10' spacing for check dams).

Table 2: Check Dam Spacing

6" Check Dam Spacing	
Slope	**Spacing**
1%	*25'*
2%	*15'*
3%	*10'*

Roof Runoff

Roof downspouts may be directed towards Bioretention Facilities. However, the downspouts must discharge onto a concrete splash block to protect the Bioretention Facility from erosion.

Retaining Walls

It is recommended that Retaining Wall Type 1A, per Caltrans Standard B3-3 or equivalent, be constructed around the entire perimeter of the Bioretention Facility. This practice will protect the sides of the Bioretention Facility from collapsing during construction and maintenance or from high service loads adjacent to the BMP. Where such service loads would not exist adjacent to the BMP, an engineered alternative may be used if signed by a licensed civil engineer.

Side Slope Requirements

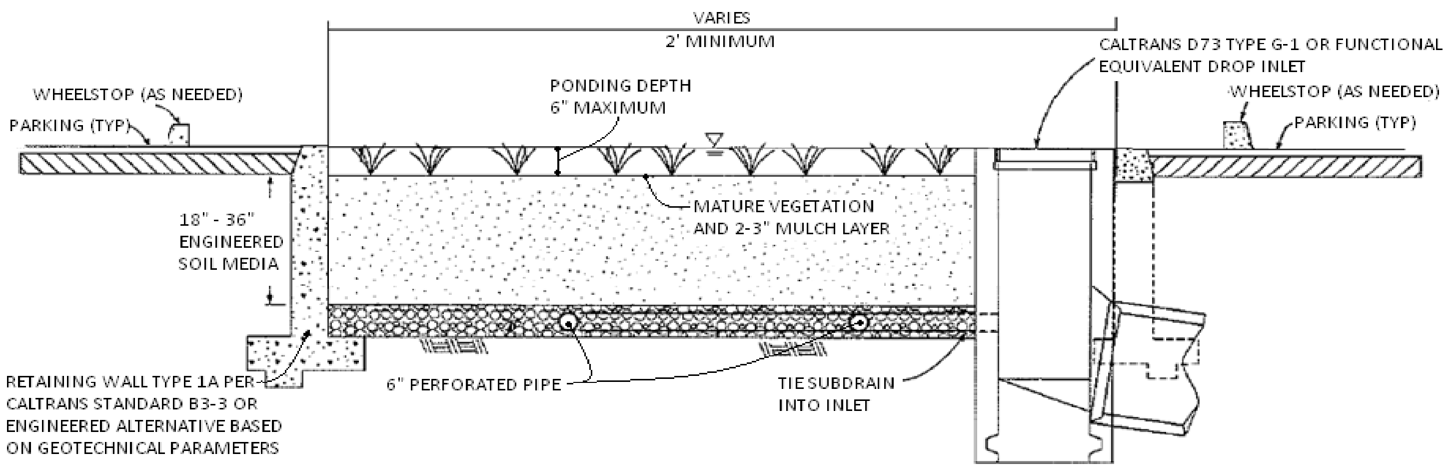
Bioretention Facilities Requiring Side Slopes

The design should assure that the Bioretention Facility does not present a tripping hazard. Bioretention Facilities proposed near pedestrian areas, such as areas parallel to parking spaces or along a walkway, must have a gentle slope to the bottom of the facility. Side slopes inside of a Bioretention Facility shall be 4:1. A typical cross section for the Bioretention Facility is shown in Figure 1.

Bioretention Facilities Not Requiring Side Slopes

Where cars park perpendicular to the Bioretention Facility, side slopes are not required. A 6-inch maximum drop may be used, and the Bioretention Facility must be planted with trees and shrubs to prevent pedestrian access. In this case, a curb is not placed around the Bioretention Facility,

but wheel stops shall be used to prevent vehicles from entering the Bioretention Facility, as shown in Figure 4.



Planter Boxes

Bioretention Facilities can also be placed above ground as planter boxes. Planter boxes must have a minimum width of 2 feet, a maximum surcharge depth of 6 inches, and no side slopes are necessary. Planter boxes must be constructed so as to ensure that the top surface of the engineered soil media will remain level. This option may be constructed of concrete, brick, stone or other stable materials that will not warp or bend. Chemically treated wood or galvanized steel, which has the ability to contaminate stormwater, should not be used. Planter boxes must be lined with an impermeable liner on all sides, including the bottom. Due to the impermeable liner, the inside bottom of the planter box shall be designed and constructed with a cross fall, directing treated flows within the subdrain layer toward the point where subdrain exits the planter box, and subdrains shall be oriented with drain holes oriented down. These provisions will help avoid excessive stagnant water within the gravel underdrain layer. Similar to the in-ground Bioretention Facility versions, this BMP benefits from healthy plants and biological activity in the root zone. Planter boxes should be planted with appropriately selected vegetation.

Figure 5: Planter Box

Source: LA Team Effort

Overflow

An overflow route is needed in the Bioretention Facility design to bypass stored runoff from storm events larger than V_{BMP} or in the event of facility or subdrain clogging. Overflow systems must connect to an acceptable discharge point, such as a downstream conveyance system as shown in Figure 1 and Figure 4. The inlet to the overflow structure shall be elevated inside the Bioretention Facility to be flush with the ponding surface for the design capture volume (V_{BMP}) as shown in Figure 4. This will allow the design capture volume to be fully treated by the Bioretention Facility, and for larger events to safely be conveyed to downstream systems. The overflow inlet shall **not** be located in the entrance of a Bioretention Facility, as shown in Figure 6.

Underdrain Gravel and Pipes
An underdrain gravel layer and pipes shall be provided in accordance with Appendix B – Underdrains.

Figure 6: Incorrect Placement of an Overflow Inlet.

Inspection and Maintenance Schedule

The Bioretention Facility area shall be inspected for erosion, dead vegetation, soggy soils, or standing water. The use of fertilizers and pesticides on the plants inside the Bioretention Facility should be minimized.

Schedule	Activity
Ongoing	• Keep adjacent landscape areas maintained. Remove clippings from landscape maintenance activities. • Remove trash and debris • Replace damaged grass and/or plants • Replace surface mulch layer as needed to maintain a 2-3 inch soil cover.
After storm events	• Inspect areas for ponding
Annually	• Inspect/clean inlets and outlets

Bioretention Facility Design Procedure

1) Enter the area tributary, A_T, to the Bioretention Facility.

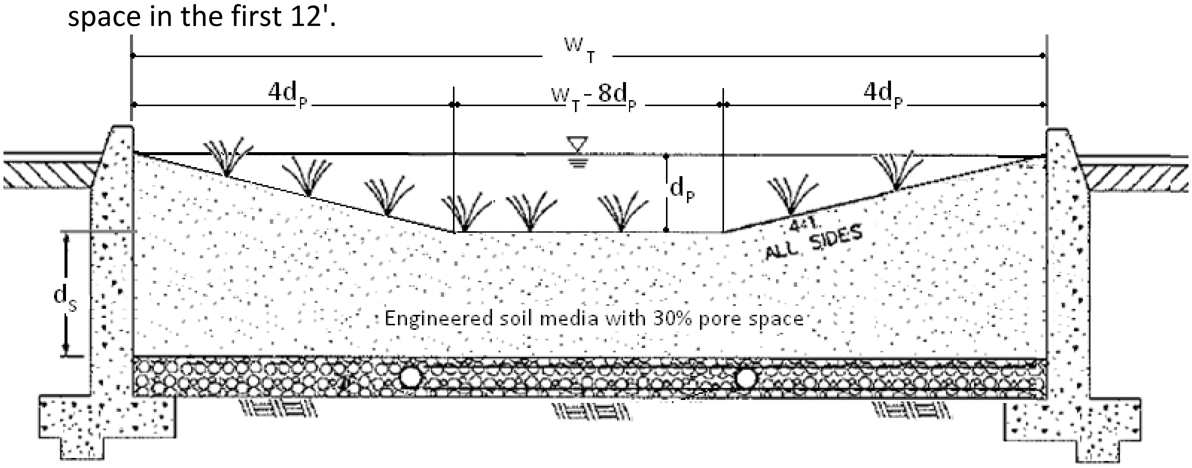
2) Enter the Design Volume, $V_{BMP,}$ determined from Section 2.1 of this Handbook.

3) Select the type of design used. There are two types of Bioretention Facility designs: the standard design used for most project sites that include side slopes, and the modified design used when the BMP is located perpendicular to the parking spaces or with planter boxes that do not use side slopes.

4) Enter the depth of the engineered soil media, d_S. The minimum depth for the engineered soil media can be 18' in limited cases, but it is recommended to use 24' or a preferred 36' to provide an adequate root zone for the chosen plant palette. Engineered soil media deeper than 36' will only get credit for the pore space in the first 36'.

5) Enter the top width of the Bioretention Facility.

6) Calculate the total effective depth, d_E, within the Bioretention Facility. The maximum allowable pore space of the soil media is 30% while the maximum allowable pore space for the gravel layer is 40%. Gravel layer deeper than 12' will only get credit for the pore space in the first 12'.



a. For the design with side slopes the following equation shall be used to determine the total effective depth. Where, d_P is the depth of ponding within the basin.

$$d_E(\mathrm{ft}) = \frac{0.3 \times \left[\left(w_T(\mathrm{ft}) \times d_S(\mathrm{ft})\right) + 4\left(d_P(\mathrm{ft})\right)^2\right] + 0.4 \times 1(\mathrm{ft}) + d_P(\mathrm{ft})\left[4d_P(\mathrm{ft}) + \left(w_T(\mathrm{ft}) - 8d_P(\mathrm{ft})\right)\right]}{w_T(\mathrm{ft})}$$

This above equation can be simplified if the maximum ponding depth of 0.5’ is used. The equation below is used on the worksheet to find the minimum area required for the Bioretention Facility:

$$d_E(\mathrm{ft}) = (0.3 \times d_S(\mathrm{ft}) + 0.4 \text{ x } 1(\mathrm{ft})) - \left(\frac{0.7\ (\mathrm{ft}^2)}{w_T(\mathrm{ft})}\right) + 0.5(\mathrm{ft})$$

b. For the design without side slopes the following equation shall be used to determine the total effective depth:

$$d_E(ft) = d_P(ft) + [(0.3) \times d_S(ft) + \ (0.4) \ \times 1(ft)]$$

The equation below, using the maximum ponding depth of 0.5', is used on the worksheet to find the minimum area required for the Bioretention Facility:

$$d_E(ft) = 0.5 \ (ft) + [(0.3) \times d_S(ft) + \ (0.4) \ \times 1(ft)]$$

7) Calculate the minimum surface area, A_M, required for the Bioretention Facility. This does not include the curb surrounding the Bioretention Facility or side slopes.

$$A_M(ft^2) = \frac{V_{BMP}(ft^3)}{d_E \ (ft)}$$

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

9) Verify that side slopes are no steeper than 4:1 in the standard design, and are not required in the modified design.

10) Provide the diameter, minimum 6 inches, of the perforated underdrain used in the Bioretention Facility. See Appendix B for specific information regarding perforated pipes.

11) Provide the slope of the site around the Bioretention Facility, if used. The maximum slope is 3 percent for a standard design.

12) Provide the check dam spacing, if the site around the Bioretention Facility is sloped.

13) Describe the vegetation used within the Bioretention Facility.

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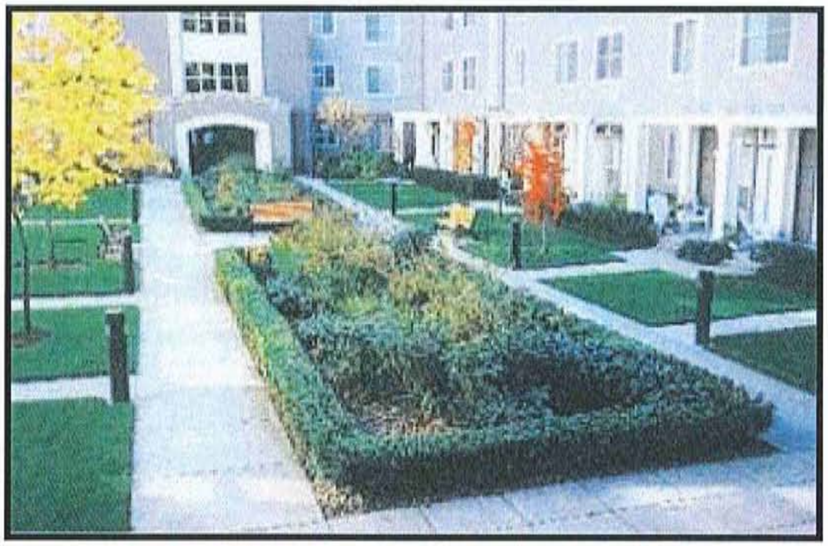

Design Considerations

- 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.

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

Targeted Constituents

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

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

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.

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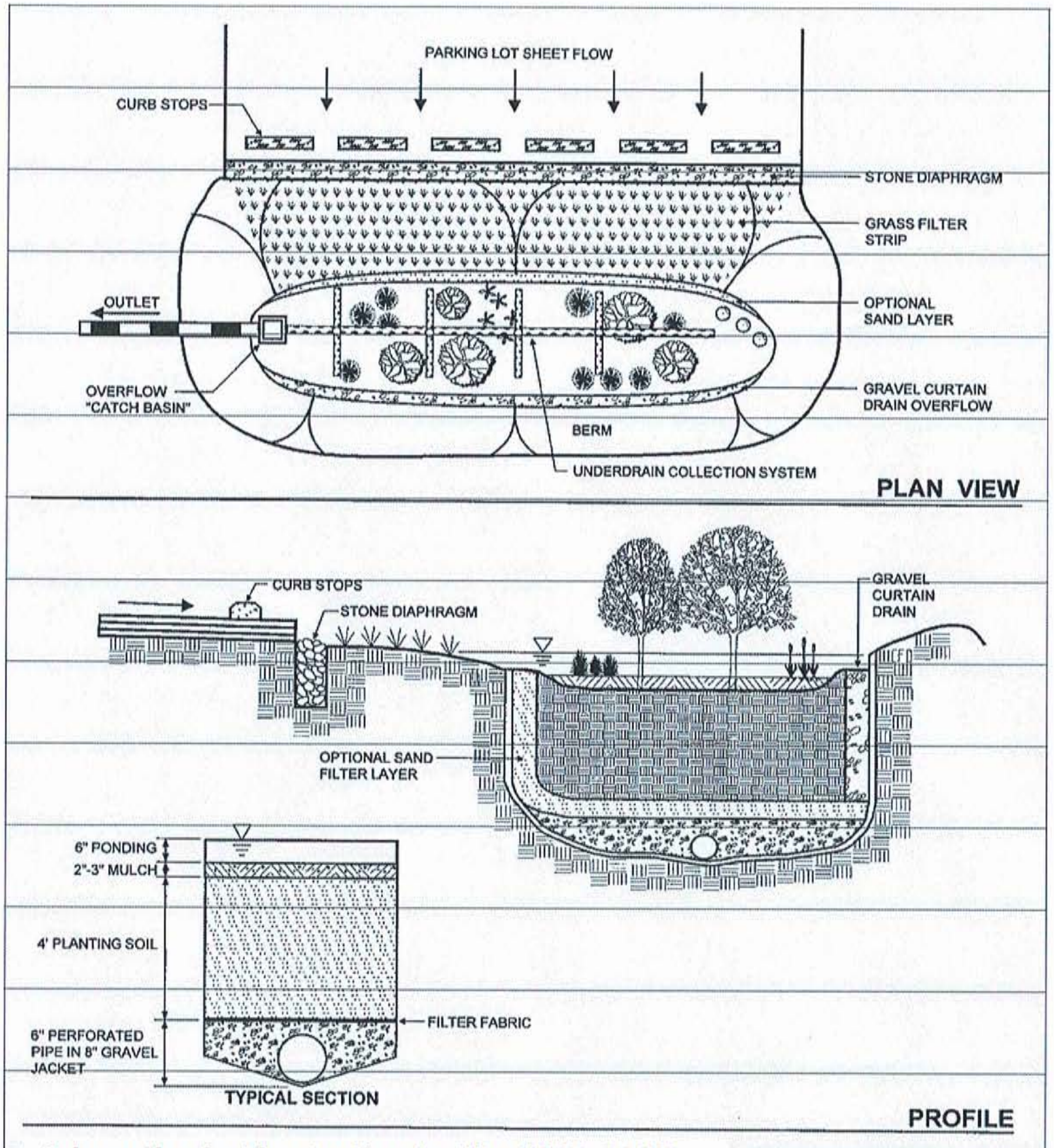
Kim, H., Seagren, E.A., and Davis, A.P., "Engineered Bioretention for Removal of Nitrate from Stormwater Runoff," *WEFTEC 2000 Conference Proceedings on CDROM Research Symposium, Nitrogen Removal*, Session 19, Anaheim CA, October 2000.

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)

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 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

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.