

## **Appendix “B”**

*Site Specific Preliminary Water Quality Management Plan Tract 38605*

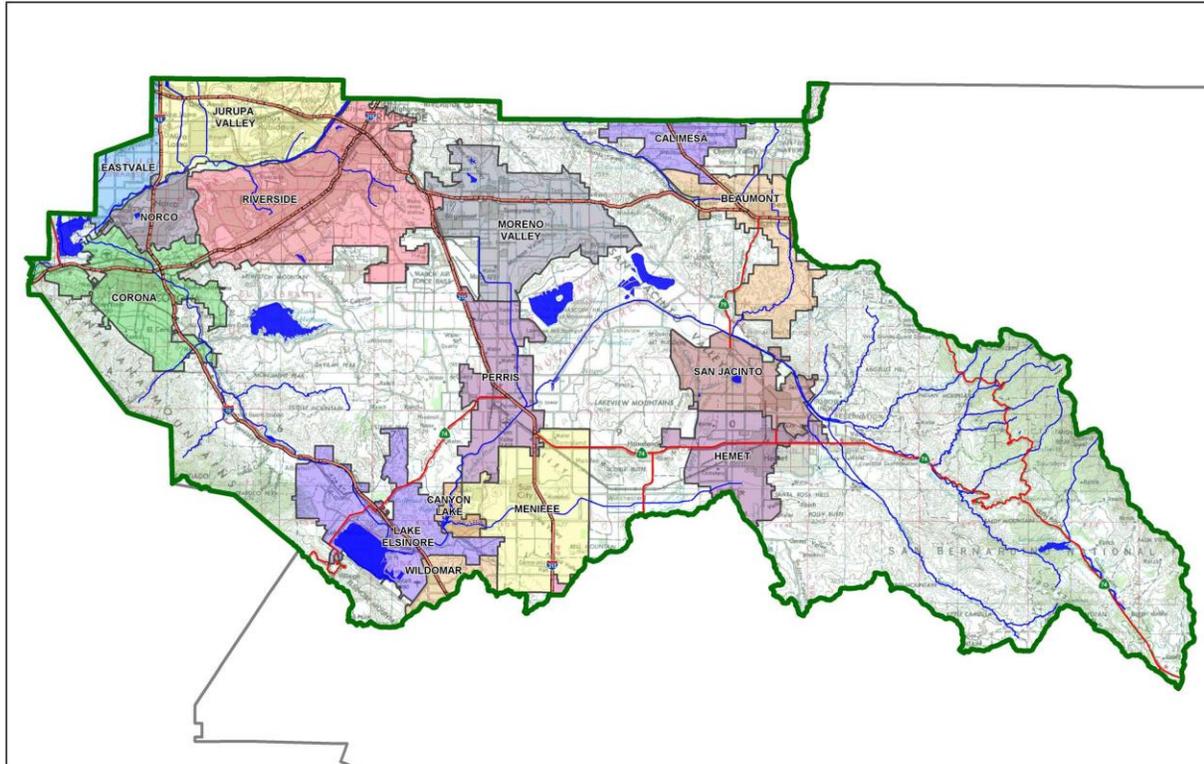
# Project Specific Water Quality Management Plan

Project located within the *Santa Ana Watershed* Region of Riverside County

**Project Title:** Tract 38605

**Development No:** CC011498

**Design Review/Case No:** TTM 38605



- Preliminary
- Final

**Original Date Prepared:** December 2022

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

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## OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) for the TTM 38605 Project has been prepared for **RAINCROSS DEVELOPMENT LLC**, and prepared by Adkan Engineers, Mitch Adkison, Managing Member.

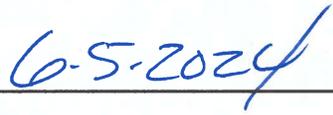
This WQMP is intended to comply with the requirements of the unincorporated area of the County of Riverside which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

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 the County of Riverside Water Quality Ordinance.

"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

Mitch Adkison  
\_\_\_\_\_  
Owner

  
\_\_\_\_\_  
Date

Managing Member  
\_\_\_\_\_  
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

Mitch Adkison  
\_\_\_\_\_  
Preparer's Printed Name

  
\_\_\_\_\_  
Date

Senior Project Manager  
\_\_\_\_\_  
Preparer's Title/Position

Preparer's Licensure:



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## Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	Residential
Planning Area:	Lake Matthews/Woodcrest Area Plan
Community Name:	TRACT 38605
Development Name:	TRACT 38605
PROJECT LOCATION	
<b>Latitude &amp; Longitude (DMS):</b> 33° 51' 54.17" N - 117° 25' 30.08" W	
<b>Project Watershed and Sub-Watershed:</b> Temescal Creek Reach 1 to Santa Ana River Reach 3 – Via Arlington Channel	
<b>APN(s):</b> 270-070-005, 270-070-006, 270-070-007, 270-160-005	
<b>Map Book and Page No.:</b> TB Page: 745 – Grid: B6, C6	
*Note: Project drains to Temescal Creek Reach 1B to Temescal Creek Reach 1A.	
PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	RC-LDR, RC-VLDR
Proposed or Potential SIC Code(s)	1521 SFR
Area of Impervious Project Footprint (SF)	1,932,841 SF
Total Area of <u>proposed</u> Impervious Surfaces within the Project Limits (SF)/or Replacement	1,932,841 SF
Does the project consist of offsite road improvements?	<input checked="" type="checkbox"/> Y <input type="checkbox"/> N
Does the project propose to construct unpaved roads?	<input type="checkbox"/> Y <input checked="" type="checkbox"/> N
Is the project part of a larger common plan of development (phased project)?	<input checked="" type="checkbox"/> Y <input type="checkbox"/> N
EXISTING SITE CHARACTERISTICS	
Total area of <u>existing</u> Impervious Surfaces within the project limits (SF)	0
Is the project located within any MSHCP Criteria Cell?	<input checked="" type="checkbox"/> Y <input type="checkbox"/> N
If so, identify the Cell number:	Cells H & I
Are there any natural hydrologic features on the project site?	<input checked="" type="checkbox"/> Y <input type="checkbox"/> N
Is a Geotechnical Report attached?	<input checked="" type="checkbox"/> Y <input type="checkbox"/> N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)	20% B, 70% C & 10% D
What is the Water Quality Design Storm Depth for the project?	0.55

### 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
On-site Storm Drain System (HU #801.26)	N/A	N/A	Start
Temescal Creek – Reach 1 (HU #801.25) Via Arlington Channel	N/A	N/A	2.92 mi
Santa Ana River – Reach 3 (HU #801.21/801.25)	Copper, Lead, Indicator Bacteria	Warm Fresh Water Habitat, Water Contact Recreation	RARE
Prado Basin (HU #801.21)	Ph	Warm Fresh Water Habitat	RARE
<b>Additional Downstream Reaches to Pacific Ocean (outside of “proximate” project influence)</b> *Note: Project drains to Temescal Creek Reach 1B to Temescal Creek Reach 1A.			

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

**Table A.2 Other Applicable Permits**

Agency	Permit Required	
State Department of Fish and Wildlife, 1602 Streambed Alteration Agreement	<input checked="" type="checkbox"/> Y	<input type="checkbox"/> N
State Water Resources Control Board, Clean Water Act (CWA) Section 401 Water Quality Cert.	<input checked="" type="checkbox"/> Y	<input type="checkbox"/> N
US Army Corps of Engineers, CWA Section 404 Permit	<input type="checkbox"/> Y	<input checked="" type="checkbox"/> N
US Fish and Wildlife, Endangered Species Act Section 7 Biological Opinion	<input type="checkbox"/> Y	<input checked="" type="checkbox"/> N
Statewide Construction General Permit Coverage	<input checked="" type="checkbox"/> Y	<input type="checkbox"/> N
Statewide Industrial General Permit Coverage	<input type="checkbox"/> Y	<input checked="" type="checkbox"/> N
Western Riverside MSHCP Consistency Approval (e.g., JPR, DBESP)	<input checked="" type="checkbox"/> Y	<input type="checkbox"/> N
Other (please list in the space below as required)	<input type="checkbox"/> Y	<input checked="" type="checkbox"/> 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)

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 sites historic existing drainage patterns will be preserved. All proposed runoff from the site will drain into the two major drainage areas flowing to the Northeast corner of the site.*

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

*Yes, the surrounding existing vegetation as seen on the WQMP site map has been identified and protected as open space areas. It is an inherent design concept seen throughout the Master Planned Community in an effort to preserve open space and sensitive plant habitats.*

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

*Yes, a large amount of natural open space areas have primarily been preserved. As such, the "natural infiltration" characteristics and capacity of these areas is considered "preserved." As demonstrated in the geotechnical study, the two major drainage areas have a high permeability both areas are being preserved.*

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

*Yes, within the development envelope, street widths were minimized to the acceptable County standards and many of the sidewalks are reduced in width based on a planted parkway between the sidewalk and curbface (sidewalks without landscaped parkways and adjacent to curbs are wider for public safety purposes). Additionally, landscaped parkways between the sidewalks and curb allows for runoff across the sidewalks to be slowed and partially infiltrated when introduced to vegetated landscaped parkways.*

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

*Yes, homes drain to side yard swales, sidewalks have green belt parkways between them and the street, and over 92 percent of the site drains to biotreatment BMP's prior to discharge from the site. Including various pervious areas throughout the site allows for the overarching water quality concept to "slow" the flows, "spread" them out and "soak" them in.*

# 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) <sup>1</sup>	Area (Sq. Ft.)	DMA Type
D 1.1	Streets	400,033	D
D 1.2	Roof	236,979	D
D 1.2	Ornamental Landscape	355,467	D
D 1.3	Landscape	120,764	D
D 2.1	Streets	403,868	D
D 2.2	Roof	555,793	D
D 2.2	Landscape	833,689	D
D 2.3	Ornamental Landscape	100,210	D
D 3.1	Streets	101,880	D
D 3.2	Roof	67,690	D
D 3.2	Landscape	101,536	D
D 3.3	Ornamental Landscape	68,151	D

<sup>1</sup>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)
D 1.4	57,511	Natural Soil C	
D 2.4	368,003	Natural Soil C	
D 3.4	14,013	Natural Soil C	

**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)	Storm Depth (inches)	DMA Name / ID	[C] from Table C.4 = [C]	Required Retention Depth (inches)
		[A]	[B]			[D]

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

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

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

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

DMA Name or ID	BMP Name or ID
D 1.1	Extended Detention Basin 1
D 1.2	Extended Detention Basin 1
D 1.2	Extended Detention Basin 1
D 1.3	Extended Detention Basin 1
D 2.1	Extended Detention Basin 2
D 2.2	Extended Detention Basin 2
D 2.2	Extended Detention Basin 2
D 2.3	Extended Detention Basin 2
D 3.1	Extended Detention Basin 3
D 3.2	Extended Detention Basin 3
D 3.2	Extended Detention Basin 3
D 3.3	Extended Detention Basin 3

*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 Committee 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? If Yes, list affected DMAs:		X
...have any DMAs located within 100 feet of a water supply well? If Yes, list affected DMAs:		X
...have any areas identified by the geotechnical report as posing a public safety risk where infiltration of stormwater could have a negative impact? If Yes, list affected DMAs:		X
...have measured in-situ infiltration rates of less than 1.6 inches / hour? If Yes, list affected DMAs: ALL DMA'S	X	
...have significant cut and/or fill conditions that would preclude in-situ testing of infiltration rates at the final infiltration surface? If Yes, list affected DMAs:		X
...geotechnical report identify other site-specific factors that would preclude effective and safe infiltration? Describe here:		X

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 Committee).
- 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).

Reclaimed water will be used in the park sites and landscaped areas which lessen the demand for harvest rainwater, therefore harvest and use will not be used on this project.

## 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 Committee to discuss this option. Proceed to Section E to document your alternative compliance measures.

## D.4 Feasibility Assessment Summaries

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

Table D.2 LID Prioritization Summary Matrix

DMA Name/ID	LID BMP Hierarchy				No LID (Alternative Compliance)
	1. Infiltration	2. Harvest and use	3. Bioretention	4. Biotreatment	
D 1.1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
D 1.2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
D 1.2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
D 1.3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
D 2.1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
D 2.2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
D 2.2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
D 2.3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
D 3.1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
D 3.2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
D 3.2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
D 3.3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

It should be noted that biotreatment is being utilized in lieu of bioretention because of the overall acreage of the project. Bioretention would typically be utilized in area where infiltration is not feasible, however bioretention DMA's are limited to 10 acres for their effectivity. Additionally, the HCOC's required for the project require mitigation of the 100 year storm events (1, 3, 6, and 24 hour) as required by Riverside County Flood Control to eliminate any potential impacts to the downstream Harrison Dam. Utilizing a bioretention system as a detention facility for a project with a large tributary drainage acreage requires ponding in excess of 6" and results in increased maintenance and concerns of damage to the bioretention facilities given the large storm volumes and flow rates expected. Extended Detention Basins (EDBS), utilizing biotreatment are being proposed for this project as the most effective BMP available for treatment given the inability to infiltrate, having DMA's in excess of 10 acres, being able to utilizing the BMP to mitigate the HCOC's, and to reduce the overall number of BMP's in turn reducing overall maintenance and repair costs burdened by CFD for the perpetuity of the project.

## 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 Committee. Utilize the worksheets found in the LID BMP Design Handbook or consult with your Committee 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	<b>Extended Detention Basin 1</b>		
<b>D 1.1</b>	400,033.00	Concrete/Asphalt	1	0.89	356,829.40	Design Storm Depth (in)	Design Capture Volume, $V_{BMP}$ (cubic feet)	Proposed Volume on Plans (cubic feet)
<b>D 1.2</b>	236,979.00	Roofs	1	0.89	211,385.30			
<b>D 1.2</b>	355,467.00	Ornamental Landscaping	0.1	0.11	39,264.20			
<b>D 1.3</b>	120,764.00	Ornamental Landscaping	0.1	0.11	13,339.30			
<b>D 1.4</b>	57,511.00	Natural Soil C	0.3	0.23	12,949.50			
	<b>1,170,754</b>	<b>Total</b>			<b>633,767.70</b>	<b>0.55</b>	<b>29,047.70</b>	<b>106,966</b>

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, $I_f$	DMA Runoff Factor	DMA Areas x Runoff Factor	<b>Extended Detention Basin 2</b>		
<b>D 2.1</b>	403,868.00	Concrete/Asphalt	1	0.89	360,250.30	Design Storm Depth (in)	Design Capture Volume, $V_{BMP}$ (cubic feet)	Proposed Volume on Plans (cubic feet)
<b>D 2.2</b>	555,793.00	Roofs	1	0.89	495,767.40			
<b>D 2.2</b>	833,689.00	Ornamental Landscaping	0.1	0.11	92,087.60			
<b>D 2.3</b>	100,210.00	Ornamental Landscaping	0.1	0.11	11,069.00			
<b>D 2.4</b>	368,003.00	Natural Soil C	0.3	0.23	82,861.80			
	<b>2,261,563</b>	<b>Total</b>			<b>1,042,036.10</b>	<b>0.55</b>	<b>47,760.00</b>	<b>118,029</b>

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I <sub>f</sub>	DMA Runoff Factor	DMA Areas x Runoff Factor	<b>Extended Detention Basin 3</b>		
	[A]		[B]	[C]	[A] x [C]			
<b>D 3.1</b>	101,880.00	Concrete/Asphalt	1	0.89	90,877.00	Design Storm Depth (in)	Design Capture Volume, V <sub>BMP</sub> (cubic feet)	Proposed Volume on Plans (cubic feet)
<b>D 3.2</b>	67,690.00	Roofs	1	0.89	60,379.50			
<b>D 3.2</b>	101,536.00	Ornamental Landscaping	0.1	0.11	11,215.50			
<b>D 3.3</b>	68,151.00	Ornamental Landscaping	0.1	0.11	7,527.3			
<b>D 3.4</b>	14,013.00	Natural Soil C	0.3	0.23	3,155.3			
	<b>353,270.00</b>	<b>Total</b>			<b>173,155.10</b>	<b>0.55</b>	<b>7,936.3</b>	<b>29,764.00</b>

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

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

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

## Section E: Alternative Compliance (LID Waiver Program)

LID BMPs are expected to be feasible on virtually all projects. Where LID BMPs have been demonstrated to be infeasible as documented in Section D, other Treatment Control BMPs must be used (subject to LID waiver approval by the Committee). 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
<input checked="" type="checkbox"/> Detached Residential Development	P	N	P	P	N	P	P	P
<input type="checkbox"/> Attached Residential Development	P	N	P	P	N	P	P	P <sup>(2)</sup>
<input type="checkbox"/> Commercial/Industrial Development	P <sup>(3)</sup>	P	P <sup>(1)</sup>	P <sup>(1)</sup>	P <sup>(5)</sup>	P <sup>(1)</sup>	P	P
<input type="checkbox"/> Automotive Repair Shops	N	P	N	N	P <sup>(4, 5)</sup>	N	P	P
<input type="checkbox"/> Restaurants (>5,000 ft <sup>2</sup> )	P	N	N	N	N	N	P	P
<input type="checkbox"/> Hillside Development (>5,000 ft <sup>2</sup> )	P	N	P	P	N	P	P	P
<input checked="" type="checkbox"/> Parking Lots (>5,000 ft <sup>2</sup> )	P <sup>(6)</sup>	P	P <sup>(1)</sup>	P <sup>(1)</sup>	P <sup>(4)</sup>	P <sup>(1)</sup>	P	P
<input type="checkbox"/> Retail Gasoline Outlets	N	P	N	N	P	N	P	P
<b>Project Priority Pollutant(s) of Concern</b>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>					

P = Potential

N = Not Potential

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

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

<sup>(3)</sup> A potential Pollutant is land use involving animal waste

<sup>(4)</sup> Specifically petroleum hydrocarbons

<sup>(5)</sup> Specifically solvents

<sup>(6)</sup> Bacterial indicators are routinely detected in pavement runoff

## E.2 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.2 Treatment Control BMP Selection

Selected Treatment Control BMP Name or ID <sup>1</sup>	Priority Pollutant(s) of Concern to Mitigate <sup>2</sup>	Removal Efficiency Percentage <sup>3</sup>
Extended Detention Basins	Bacteria, viruses, pathogens, nutrients, and metals in park parking lot.	High (H)

<sup>1</sup> 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.

<sup>2</sup> Cross Reference Table E.1 above to populate this column.

<sup>3</sup> 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 Committee 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<sup>1</sup> 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.

**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.

## 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.

**Condition C is being met. The project site is mimicking the pre-development hydrograph with the post-development hydrograph. It should be noted the project site has the inability to infiltration given the soil condition being dense and mostly of granitic bedrock. Given the inability to infiltrate, excess volume generated by the additional impervious area will be released downstream and cannot be contained on-site. Prior to the release of the excess volume the expected storm flows will be detained within the proposed extended detention basin and release at a rate that does not exceed the pre-development condition. Concerns raised by Riverside County Flood Control of the downstream facilities require the mitigation of the 2-,5-,10-, and 100-year storm events for the 1-,3-,6- and 24-year hour durations. The post-development flow rates were mitigated to not exceed 110% of the pre-development flow rate. The results of the 2-year storm event are shown below, the other remaining storms flows, hydrographs, and detention routings are shown within Appendix 7.**

Table F.1 Hydrologic Conditions of Concern Summary

DMA	SPECIFICATIONS						
	Existing Runoff Volume (ac.ft.)	Existing 2-year Peak Flow (cfs)	Proposed Runoff Volume (ac.ft.)	Volume Difference (ac.ft.)	BMP Volume (ac.ft.)	Proposed 2-year Peak Flow (cfs)	Incremental Increase Mitigated?
<b>EDB 1</b>	0.4084	0.883	2.0108	1.6024	2.4556	0.665	Yes (75.3%)
<b>EDB 2</b>	0.7911	1.661	3.8846	3.0935	2.7095	1.728	Yes (104%)
<b>EDB 3</b>	0.1190	0.256	0.5842	0.4652	0.6832	0.207	Yes (80.8%)

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. Committee 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
Onsite storm drain inlets	Mark with “Only rain in the drain”	Maintain regularly, provide educational materials to residents (good practices and discharge prohibitions)
Landscape/outdoor pesticide use	Landscaping plans to include: preservation of native trees, design for minimal irrigation, fertilizers & pesticides	Maintenance staff education and prohibitions
Sidewalks & Streets	n/a	Sweep regularly and prevent litter from accumulating (no cleaning agents or degreasers discharging to storm drain system).

## 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)
EDB 1	Extended Detention Basin 1	TTM 38605
EDB 2	Extended Detention Basin 2	TTM 38605
EDB 3	Extended Detention Basin 3	TTM 38605

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 Committee will periodically verify that Stormwater BMPs on your site are maintained and continue to operate as designed. To make this possible, your Committee 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:**

**Community Facilities District (Operated by Riverside County  
Transportation Department)**

**Riverside County Flood Control District**

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

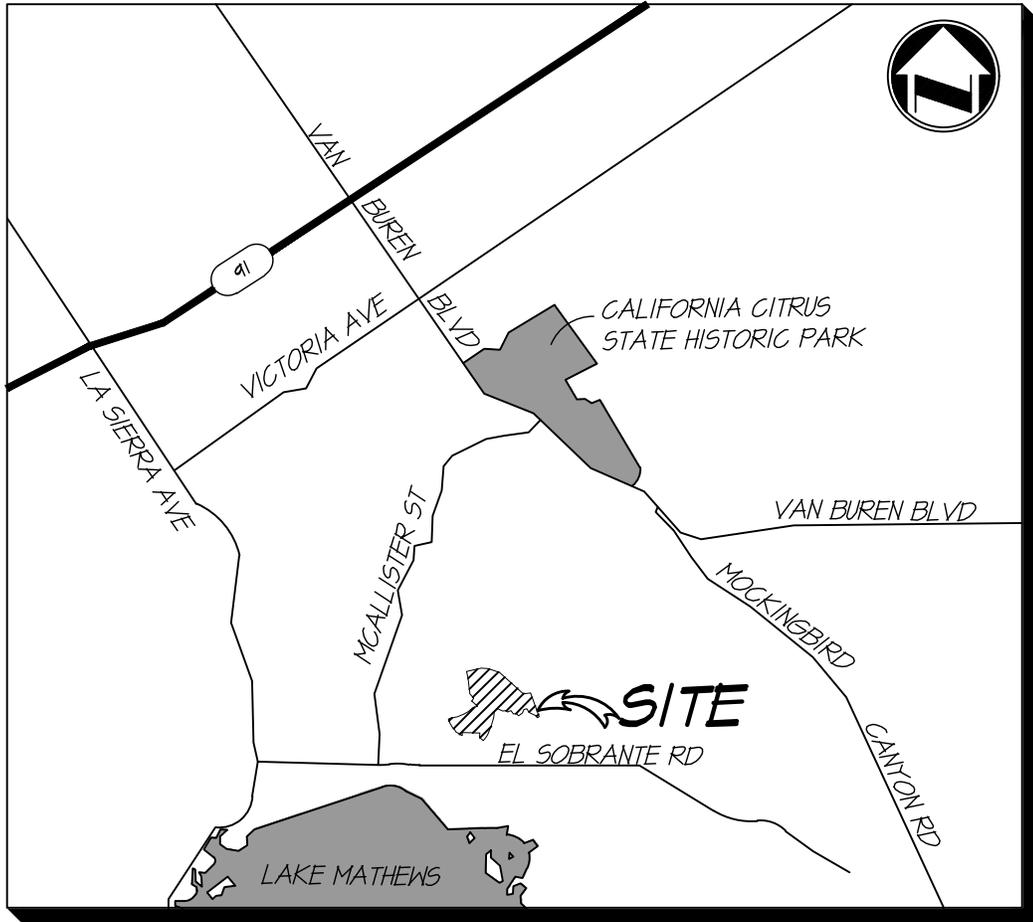
Y       N

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*

THOMAS BROS. GUIDE PAGE 145, GRID B6, C6

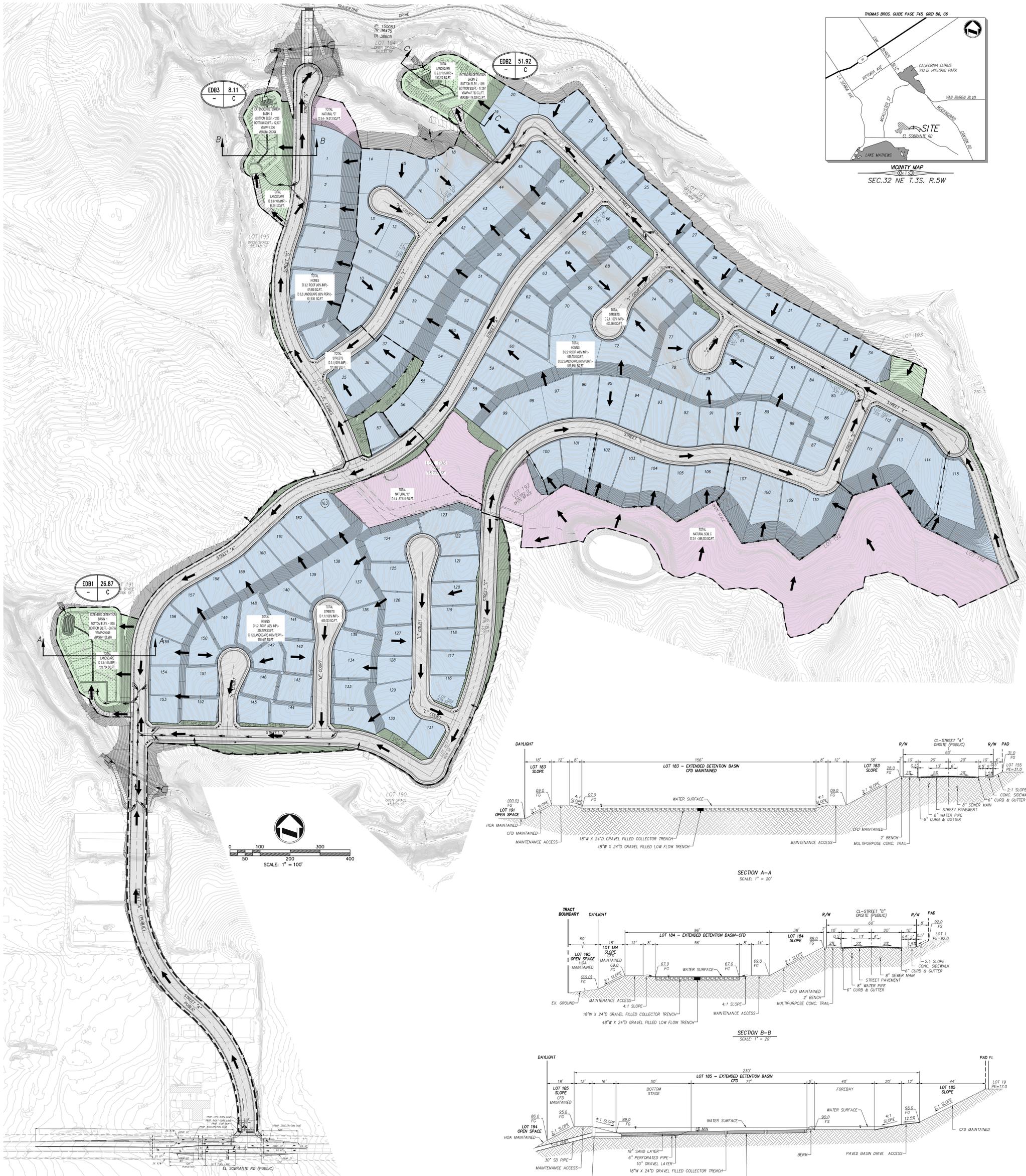


VICINITY MAP

(N.T.S.)

SEC.32 NE T.3S. R.5W

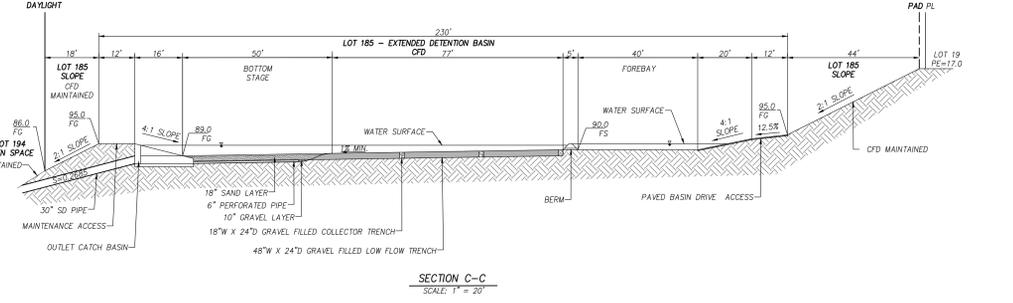
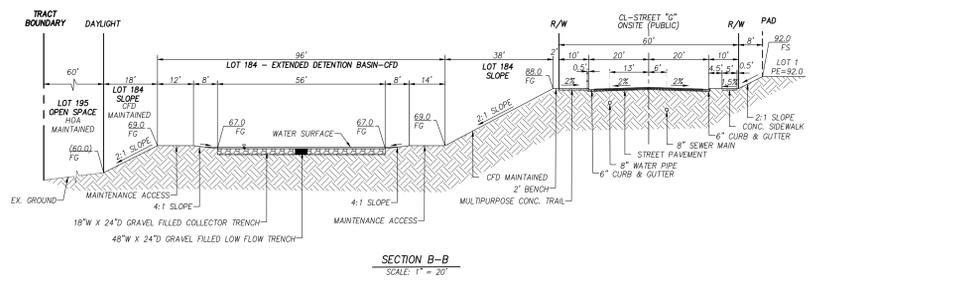
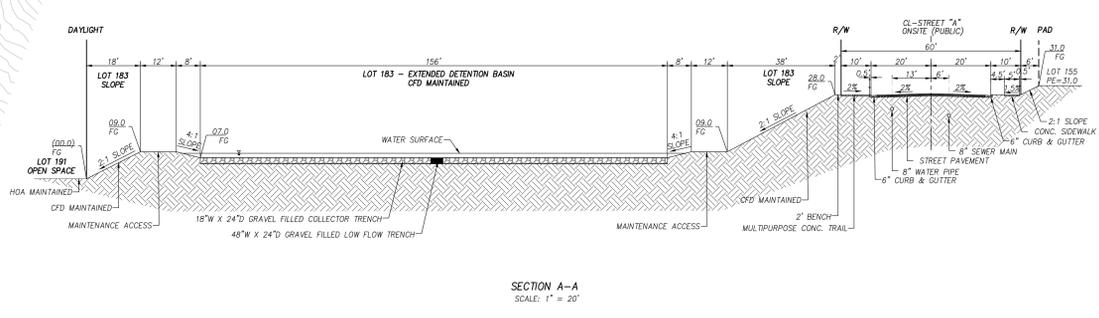
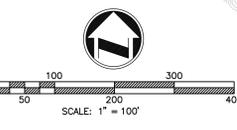
# TR 38605 BMP MAP



EDB3 8.11  
C

EDB2 51.92  
C

EDB1 26.87  
C

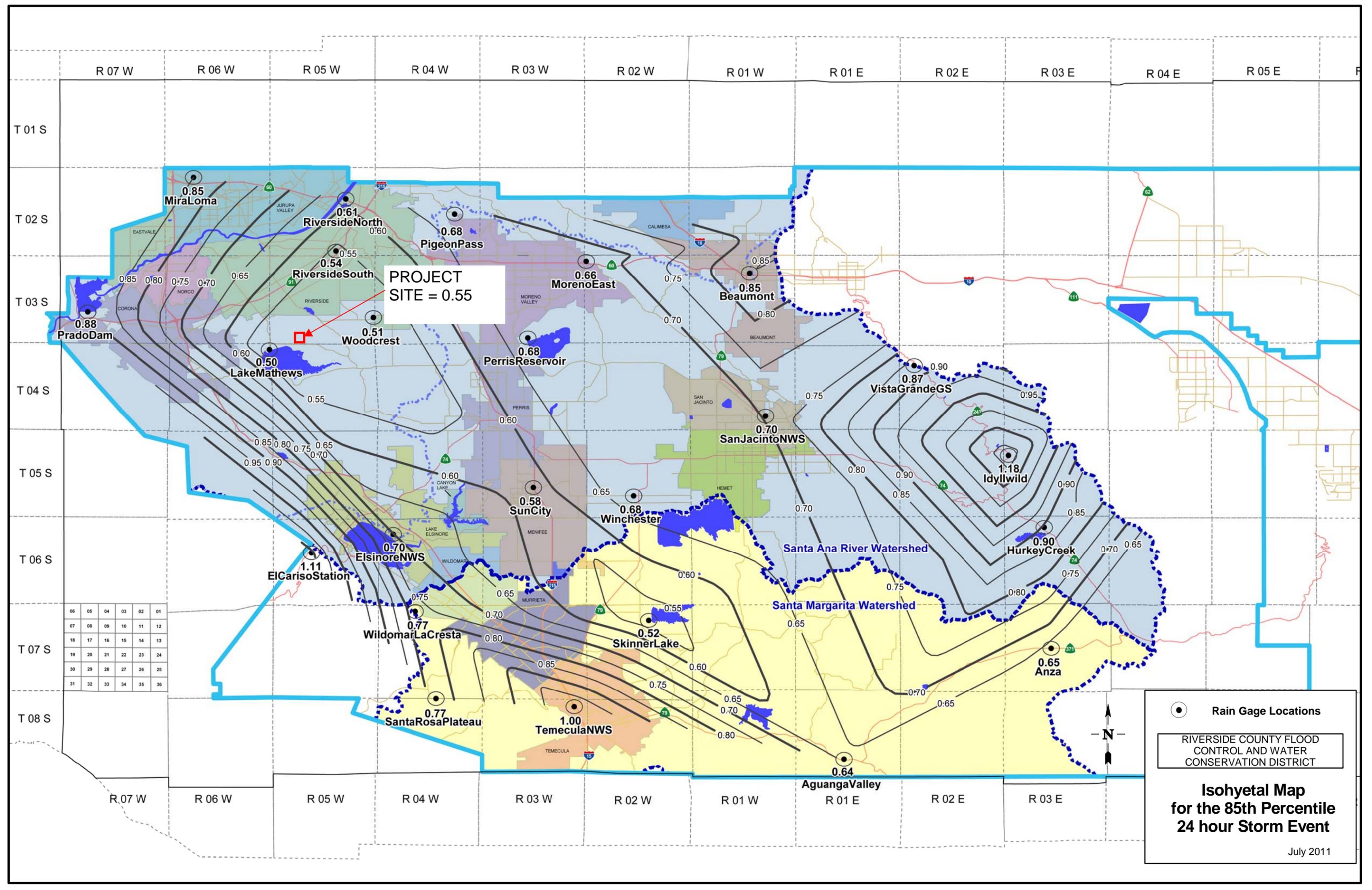


- LEGEND**
- RESIDENTIAL LOTS (40% IMPERVIOUS)
  - STREETS (100% IMPERVIOUS)
  - LANDSCAPING (10% IMPERVIOUS)
  - NATURAL SOIL C (30% IMPERVIOUS)
  - PROJECT BOUNDARY
  - DMA BOUNDARY
  - DRAINAGE PATH
  - UNDERGROUND DRAINAGE PATH
  - INTERCEPTOR DRAINAGE PATH
  - TERRACE DRAINAGE PATH

AREA DESIGNATION	DMA	DMA TYPE	AREA (S.F.)	BMP	BMP TYPE
AREA 1	D-1.1	CONCRETE & ASPHALT	400,033	BASIN-1	EXTENDED DETENTION BASIN
	D-1.2	ROOFS	236,979		
	D-1.2	LANDSCAPING	355,467		
	D-1.3	LANDSCAPING	120,784		
D-1.4	NATURAL (C SOIL)	57,511			
TREATED AREA (SF)			1,170,755		
DESIGN CAPTURE VOLUME (CF)			26,048		
PROPOSED VOLUME ON PLAN (CF)			106,966		

AREA DESIGNATION	DMA	DMA TYPE	AREA (S.F.)	BMP	BMP TYPE
AREA 2	D-2.1	CONCRETE & ASPHALT	403,868	BASIN-2	EXTENDED DETENTION BASIN
	D-2.2	ROOFS	555,793		
	D-2.2	LANDSCAPING	833,689		
	D-2.3	LANDSCAPING	100,210		
D-2.4	NATURAL (C SOIL)	368,003			
TREATED AREA (SF)			2,261,563		
DESIGN CAPTURE VOLUME (CF)			47,760		
PROPOSED VOLUME ON PLAN (CF)			118,029		

AREA DESIGNATION	DMA	DMA TYPE	AREA (S.F.)	BMP	BMP TYPE
AREA 3	D-3.1	CONCRETE & ASPHALT	101,880	BASIN-3	EXTENDED DETENTION BASIN
	D-3.2	ROOFS	67,690		
	D-3.2	LANDSCAPING	101,537		
	D-3.3	LANDSCAPING	68,151		
D-3.4	NATURAL (C SOIL)	14,013			
TREATED AREA (SF)			353,271		
DESIGN CAPTURE VOLUME (CF)			7,836		
PROPOSED VOLUME ON PLAN (CF)			28,764		



**PROJECT SITE = 0.55**

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

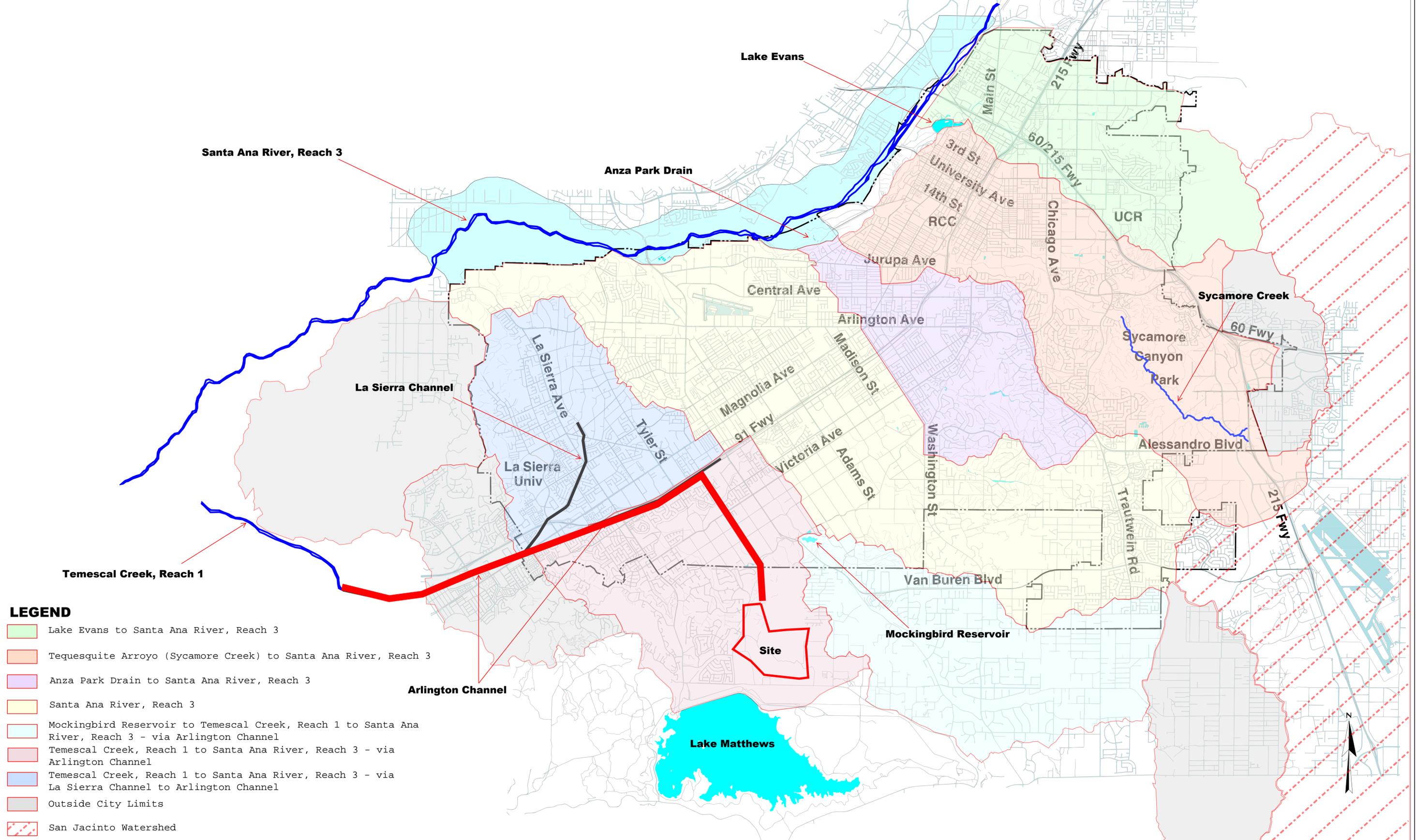
● Rain Gage Locations

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

**Isohyetal Map for the 85th Percentile 24 hour Storm Event**

July 2011

# RECEIVING WATERS MAP



- LEGEND**
- Lake Evans to Santa Ana River, Reach 3
  - Tequesquite Arroyo (Sycamore Creek) to Santa Ana River, Reach 3
  - Anza Park Drain to Santa Ana River, Reach 3
  - Santa Ana River, Reach 3
  - Mockingbird Reservoir to Temescal Creek, Reach 1 to Santa Ana River, Reach 3 - via Arlington Channel
  - Temescal Creek, Reach 1 to Santa Ana River, Reach 3 - via Arlington Channel
  - Temescal Creek, Reach 1 to Santa Ana River, Reach 3 - via La Sierra Channel to Arlington Channel
  - Outside City Limits
  - San Jacinto Watershed

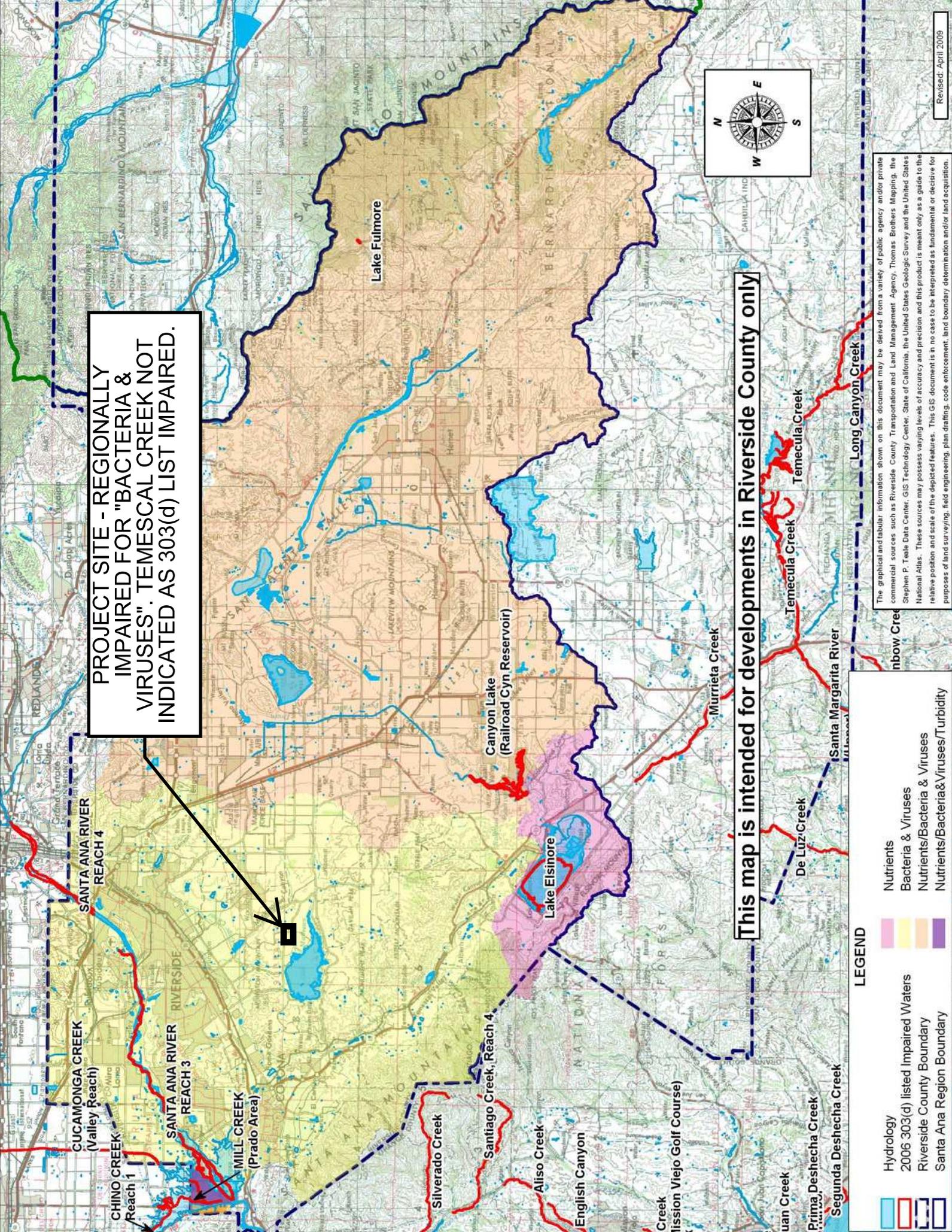


**PROJECT SITE - REGIONALLY IMPAIRED FOR "BACTERIA & VIRUSES". TEMESCAL CREEK NOT INDICATED AS 303(d) LIST IMPAIRED.**

**This map is intended for developments in Riverside County only**

The graphical and tabular information shown on this document may be derived from a variety of public agency and/or private commercial sources such as Riverside County Transportation and Land Management Agency, Thomas Brothers Mapping, the Stephen P. Teale Data Center, GIS Technology Center, State of California, the United States Geologic Survey and the United States National Atlas. These sources may possess varying levels of accuracy and precision and this product is meant only as a guide to the relative position and scale of the depicted features. This GIS document is in no case to be interpreted as fundamental or decisive for purposes of land surveying, field engineering, plan drafting, code enforcement, land boundary determination and/or land acquisition.

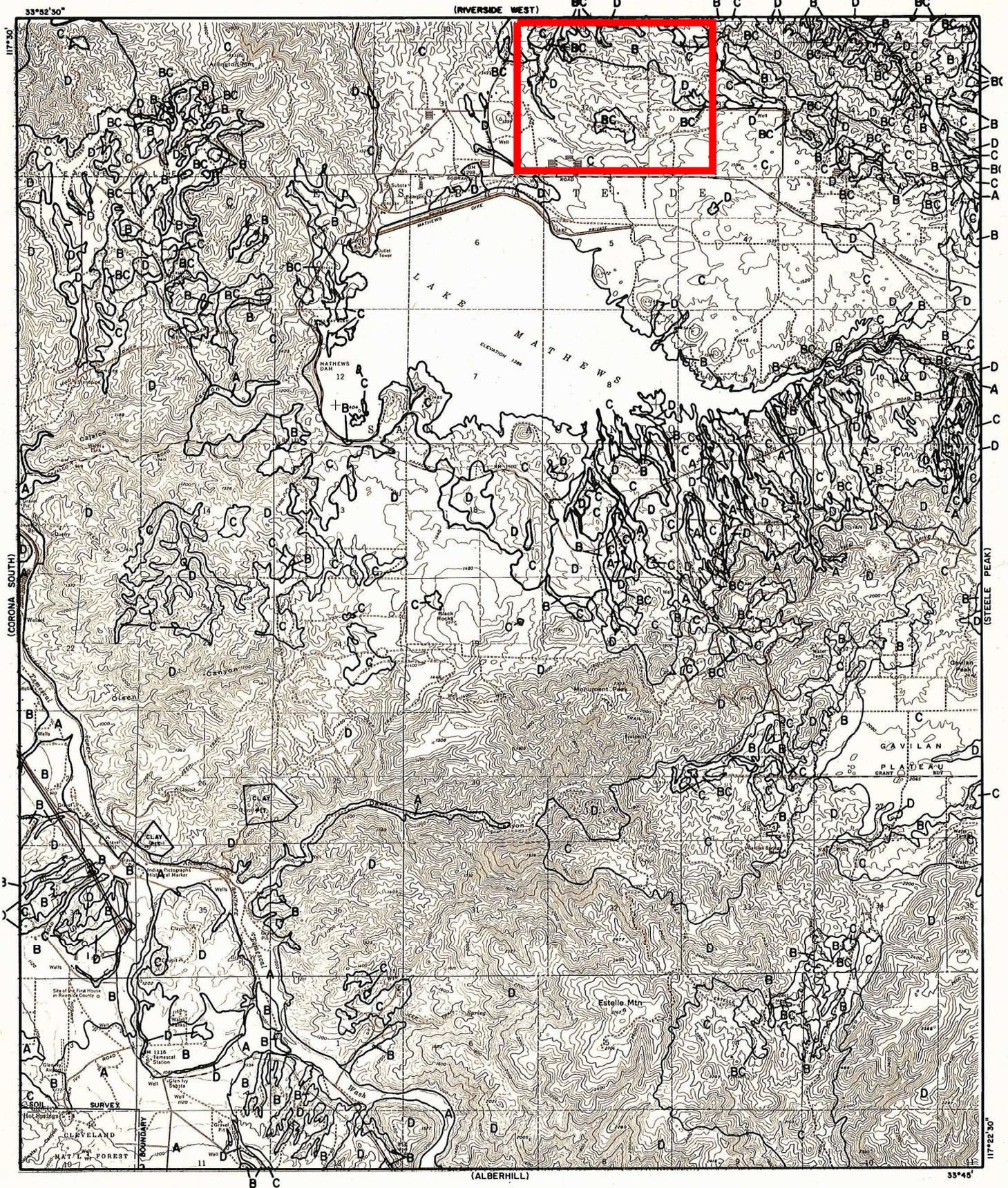
Revised: April 2009



**LEGEND**

-  Hydrology
-  2006 303(d) listed Impaired Waters
-  Riverside County Boundary
-  Santa Ana Region Boundary
-  Nutrients
-  Bacteria & Viruses
-  Nutrients/Bacteria & Viruses
-  Nutrients/Bacteria & Viruses/Turbidity





**LEGEND**

— SOILS GROUP BOUNDARY  
 A SOILS GROUP DESIGNATION

**RCFC & WCD**  
 HYDROLOGY MANUAL

0 FEET 5000

**HYDROLOGIC SOILS GROUP MAP**  
**FOR**  
**LAKE MATHEWS**

# Appendix 2: Construction Plans

*Grading and Drainage Plans*



# Appendix 3: Soils Information

*Geotechnical Study and Other Infiltration Testing Data*

March 14, 2024

Project No. 41.19909

Pulte Home Company, LLC  
27401 Los Altos, Suite 400  
Mission Viejo, California 92503

Attention: Mr. Patric Lynam

**Subject: Feasibility of Onsite infiltration  
Highland Grove 4, Tract 38927  
Lake Matthews Area  
County of Riverside, California**

*References: Geotechnical Due Diligence Evaluation, Proposed Highland Grove IV Residential Development, Lake Matthews Area, Riverside County, California, by Leighton and Associates, Inc., PN. 41.19909, dated November 17, 2023.*

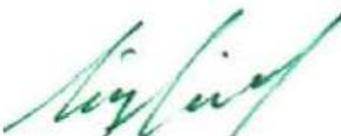
*Preliminary Infiltration Investigation, Greentree Ranch Project, Formerly Victoria Meadows Project, Tentative Tract Map No. 26826, County of Riverside, California, by Advanced Geotechnical Solutions (AGS), Report No. 1507-B-5, dated November 6, 2016.*

*Highland Grove 4 Site Plans, by Adkan Engineers, (undated).*

In accordance with your request, this letter is to provide our opinion regarding the infiltration rates in the areas of the proposed basins associated with the subject tract. Based on our review of the provided plans and the above referenced soils reports/percolation testing, the proposed basins will be generally underlain by either compacted fill or granitic rock. As such, these geologic conditions are expected to present unfavorable conditions for onsite infiltration.

The opportunity to be of service is sincerely appreciated. If you should have any questions, please do not hesitate to call our office.

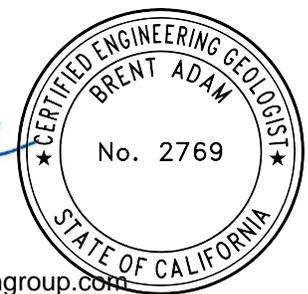
Respectfully submitted,  
LEIGHTON AND ASSOCIATES, INC.



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Brent Adam, CEG  
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# AGS

**ADVANCED GEOTECHNICAL SOLUTIONS, INC.**

485 Corporate Drive, Suite B

Escondido, California 92029

Telephone: (619) 867-0487 Fax: (714) 409-3287

**UPDATED PRELIMINARY GEOTECHNICAL INVESTIGATION  
TTM 37217  
GREENTREE RANCH PROJECT  
COUTY OF RIVERSIDE, CA**

**Prepared for:**

Forestar Victoria, LLC  
4590 MacArthur Boulevard, Suite 600  
Newport Beach, California 92660

**Prepared by:**

Advanced Geotechnical Solutions, Inc.  
485 Corporate Drive, Suite B  
Escondido, California 92029

May 25, 2018

Report No. 1507-05-B-10

P/W 1507-05



# AGS

**ADVANCED GEOTECHNICAL SOLUTIONS, INC.**

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Escondido, California 92029  
Telephone: (619) 867-0487 Fax: (714) 409-3287

**Forestar Victoria, LLC**  
4590 MacArthur Boulevard, Suite 600  
Newport Beach, California 92660

May 25, 2018  
P/W 1507-05  
Report No 1507-05-B-10

**Attention: Mr. Satish Lion**

**Subject: Updated Preliminary Geotechnical Investigation of 100-Scale Tentative Map, Greentree Ranch Project, Tentative Tract No. 37217, County of Riverside, California**

References: See Appendix

Gentlemen:

Pursuant to your request, Advanced Geotechnical Solutions, Inc. (AGS) presents herein our geotechnical review of the updated 100-scale Tentative Tract Map 37217 for the Greentree Ranch project located north of El Sobrante Road and east of McAllister Road, County of Riverside, California. This review has utilized geotechnical and geologic data and the geotechnical information presented in the referenced reports and supplemented with additional data from our recent study.

Advanced Geotechnical Solutions, Inc., appreciates the opportunity to provide you with geotechnical consulting services and professional opinions. If you have any questions, please contact the undersigned at (619) 867-0487.

Respectfully Submitted,  
Advanced Geotechnical Solutions, Inc.



SHANE P. SMITH  
Staff Engineer

ANDRES BERNAL, Sr. Geotechnical Engineer  
RCE 62366/GE 2715, Reg. Exp. 9-30-19

JEFFREY A. CHANEY, President  
RCE 46544/GE 2314, Reg. Exp. 6-30-19

PAUL J. DERISI, Vice President  
CEG 2536, Reg. Exp. 5-31-19



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**ATTACHMENTS:**

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- Figure 1 - Site Location Map
- Figure 2 - Regional Geologic Map
- Figure 3 - Map of Historic Earthquakes (1910-Present)
- Figure 4 - Slope Setback Dimensions (2016 CBC)
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**APPENDICES**

- Appendix A - References
- Appendix B - Subsurface Logs
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- Plates 1 through 4 - Geologic Map and Exploration Location Plan
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**UPDATED PRELIMINARY GEOTECHNICAL INVESTIGATION  
TENTATIVE TRACT MAP 37217  
COUNTY OF RIVERSIDE, CALIFORNIA**

**1.0 INTRODUCTION**

The purpose of this report is to provide a Preliminary Geotechnical Investigation for Tentative Tract Map (TTM) 37217, Greentree Ranch project, County of Riverside, California (site). This updated report addresses the current 100-scale TTM plans prepared by Adkan Engineers dated April 25, 2018. This report has been prepared in a manner consistent with County of Riverside geotechnical report guidelines and the current standard of practice. Geotechnical conclusions and recommendations presented in this report address the following items: 1) engineering and excavation characteristics of earth materials; 2) unsuitable soils removals; 3) recommendations for pad and street undercuts to facilitate improvement construction; 4) subsurface drainage; 5) grading recommendations; 6) slope stability; and 7) preliminary foundation design recommendations.

**1.1. Scope of Work**

This study is aimed at providing geotechnical/geologic conclusions and recommendations for development of the site for residential uses, attendant streets, parks, and open space areas. The scope of this study included the following tasks:

- Review of maps, literature and aerial photographs.
- Excavation logging and sampling of 32 backhoe test pits, 19 excavator test pits and 16 air-track borings.
- Seismic refraction survey of 10 seismic lines.
- Compilation of subsurface data by AGS and previous investigations at the site (Appendix B).
- Preparation of geologic maps and exploration location plans (Plates 1 through 4) based on 100-scale TTM plans (Sheets 2 to 5 of 8) which depict geologic contacts in accordance with subsurface exploration data by AGS and previous investigations at the site.
- Preparation of geologic cross sections (Plate 5).
- Compilation of laboratory test data by AGS and previous investigations at the site (Appendix C).
- Slope stability analyses of both highest cut and fill slopes (Appendix D).
- Analysis of the current tentative tract map as it relates to the existing geotechnical conditions and proposed development.
- Analysis of the excavation characteristics (i.e. rippability) of onsite bedrock materials.
- Discussion of pertinent geologic and geotechnical topics.
- Formulation of grading, remedial grading and earthwork recommendations.
- Determination of engineering parameters for use in preliminary design of structures and retaining walls.
- Preparation of this report and accompanying exhibits.

## **1.2. Geotechnical Study Limitations**

The conclusions and recommendations in this report are professional opinions based on the data developed during this and previous investigations. The conclusions presented herein are based upon the current design as reflected on the current TTM plans. Changes to the plans would necessitate further review.

The materials immediately adjacent to or beneath those observed and sampled may have different characteristics than those observed and sampled. No representations are made as to the quality or extent of materials not observed nor subjected to laboratory testing. Any evaluation regarding the presence or absence of hazardous material is beyond the scope of this firm's services.

## **2.0 SITE LOCATION AND DESCRIPTION**

The subject site is located north of El Sobrante Road and east of McAllister Road, in the County of Riverside, California (Figure 1). The site encompasses approximately 325.4 acres and is bounded to the west and north by existing or proposed residential developments, and to the east and south by existing citrus orchards and/or undeveloped properties. In the center of the property is a Western Municipal Water District Irrigation Pond supplied by a pipeline located along an existing dirt access road which ultimately ties into McAllister Road. The irregularly shaped site consists of rolling hills with a northwesterly flowing steeply incised drainage.

## **3.0 PROPOSED DEVELOPMENT**

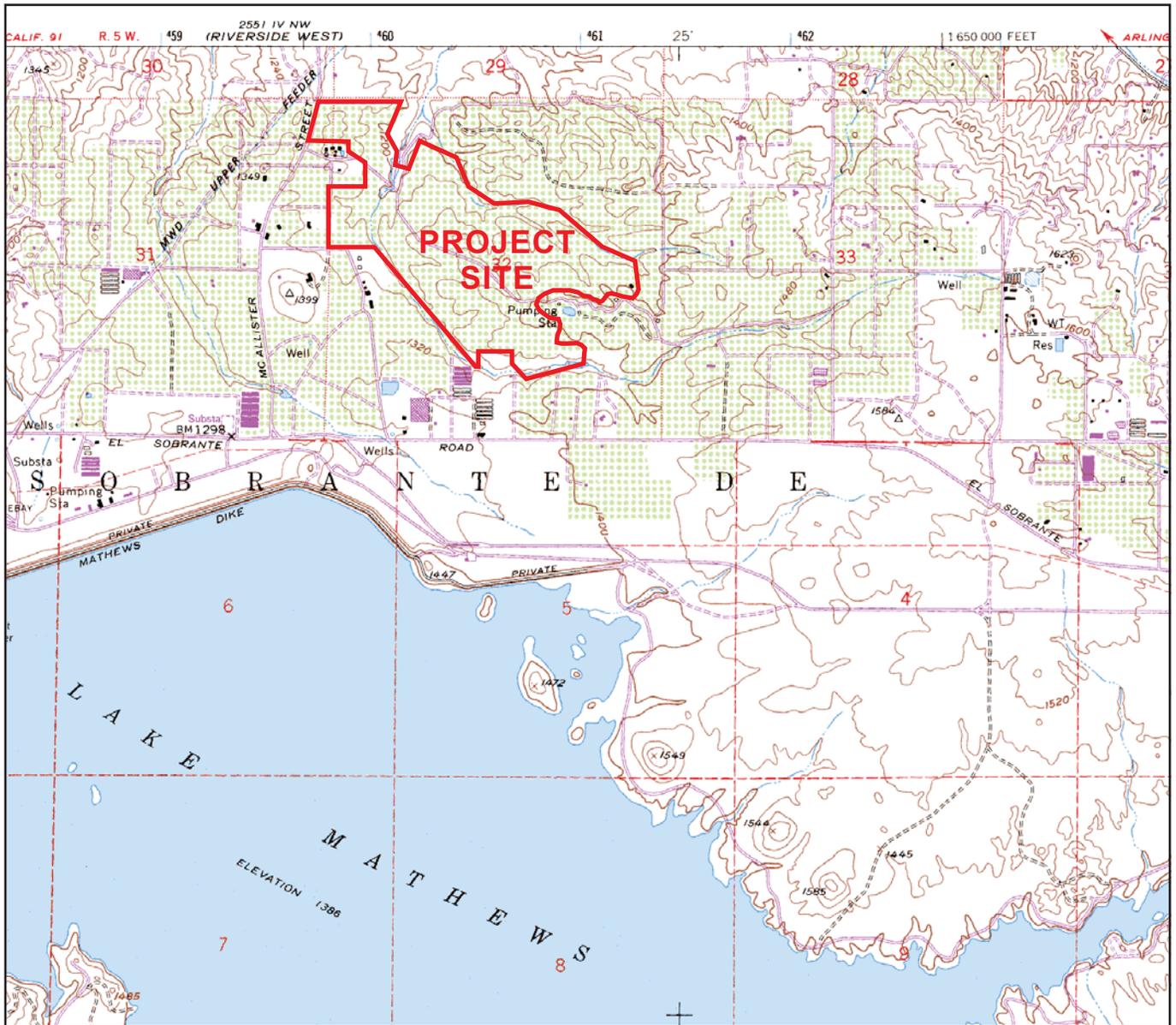
Current 100-scale TTM plans (Plates 1 through 4) prepared by Adkan (2018) call for the site to be developed to support approximately 513 single-family residential lots, associated streets and improvements, park and recreation sites, nine water quality basins, and associated open spaces as depicted in. It is anticipated that the proposed residential structures will be 1- to 2-stories in height, wood-framed, supported by conventional or post-tensioned slab-on-grade foundation systems.

Cut and fill grading techniques are planned to configure the site in general conformance with the design depicted on the TTM plans. Designed cuts are proposed to be as deep as 41 feet below natural ground (Lot 292, eastern area). Designed fills are proposed up to 48 feet (Lot 79, central area). Current design indicates that cut and fill slopes are designed at 2:1 ratios. The highest proposed cut slope is 45 feet below Lot 292. The highest proposed fill slope is 44 feet at Lot 72 (central area). Variable ratio slopes have also been proposed on the current design prepared by Adkan Engineers.

## **4.0 FIELD AND LABORATORY INVESTIGATION**

### **4.1. Previous Onsite Field Investigation**

Leighton Associates (Leighton, 2005) conducted a preliminary investigation within the westerly portion of the site. In addition, Albus-Keefe, Inc. (Albus-Keefe) performed an investigation within the subject site during the same general time frame. Albus-Keefe's study consisted of 83 test pits excavated using a rubber tire backhoe on December 21 through December 27, 2004, however their report was not available for review by AGS. Of the 83 test pits, 65 test pits were observed and logged jointly by Leighton and Albus-Keefe. The log data for test pits T-47 thru T-64 was not included in the Leighton (2005) report. Therefore, only the logs for test pits T-1 through T-46 and



**SITE LOCATION MAP  
VICTORIA HEIGHTS  
RIVERSIDE, CALIFORNIA**



P/W 1507-05

**FIGURE 1**

SOURCE MAP - TOPOGRAPHIC MAP OF THE  
LAKE MATTHEWS 7.5 MINUTE QUADRANGLE,  
RIVERSIDE COUNTY, CALIFORNIA



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T-65 through T-83 were available for our review and are included herein. The abbreviated logs of these test pits are presented on Plates 1 through 4. With the logs presented in Appendix B.

On January 24, 2005, Leighton logged and sampled six (6) hollow-stem auger soil borings (LB-1 through LB-6) at the site to a maximum depth of approximately 26 feet below ground surface (bgs). The approximate locations of the borings are depicted on the Plates 1 through 4, and the boring logs are included in Appendix B. Laboratory results from samples obtained from the test pits and borings conducted by Leighton are included herewith in Appendix C.

Additionally, air percussion borings were performed by Albus-Keefe during the same general time period. The air percussion boring logs were not available for our review, however the estimated depth to blasting was presented in Leighton's report. Accordingly, AGS has included this data on our Plates 1 through 4. It is assumed by AGS that the estimated depth to blasting is based upon an air-track drilling rate greater than 18 to 20 seconds/foot.

Pertinent information from the previous studies have been compiled herewith to provide an evaluation of the subject property and to supplement fieldwork collected by AGS during this investigation. A collection of the logs available for this project is provided in Appendix B. The associated laboratory test results are presented in Appendix C.

#### **4.2. Current Investigation**

On August 27 and 28, 2016, AGS conducted subsurface exploration for this study which included the advancement, logging, and sampling of 32 backhoe test pits (TP-1 through TP-32) and 19 excavator test pits (EX-1 through EX-19). On April 13, 2018 an AGS geologist monitored seismic refraction surveys performed along various slopes and ridges by our subcontractor Southwest Geophysics (SGI) which included lines SL-1 through SL-10 onsite. Based on the results of previous exploration, on April 18, 2018, AGS logged sixteen air percussion borings (AP-1 through AP-16) advanced with an Ingersoll-Rand ECM-370 air/hydraulic drill to further evaluate rock rippability at the site.

Due to the reduced development area shown in the current TTM plans, several of AGS previous and recent excavations (EX-1, EX-12 and EX-13) and test pits (TP-1 through TP-18) are no longer within the project area and were removed from this report. Logs of the excavations and the results of the seismic survey are presented in Appendix B. The approximate locations of exploratory trenches, air track boreholes and the seismic refraction lines are shown on Plates 1 through 4.

AGS also conducted preliminary infiltration testing within the water quality basins proposed for the site. Nine backhoe pits (BP-A through BP-F) were excavated and five percolation tests were performed as part of the infiltration study at the site. The findings were presented in a separate report dated November 6, 2016 (AGS, 2016). Several of the previous water quality basin locations were modified in the current TTM plan.

## **5.0 ENGINEERING GEOLOGY**

### **5.1. Geologic Analysis**

#### **5.1.1. Literature Review**

AGS has reviewed the referenced geologic documents in preparing this study. Where deemed appropriate, this information has been included with this document.

#### **5.1.2. Aerial Photograph Review**

AGS has reviewed current and historical aerial photographs and satellite imagery available through sources on the internet.

#### **5.1.3. Field Mapping**

The site geology was mapped during our subsurface exploration by a Registered Engineering Geologist. This mapping is presented in the attached geologic maps (Plates 1 through 4) included herewith.

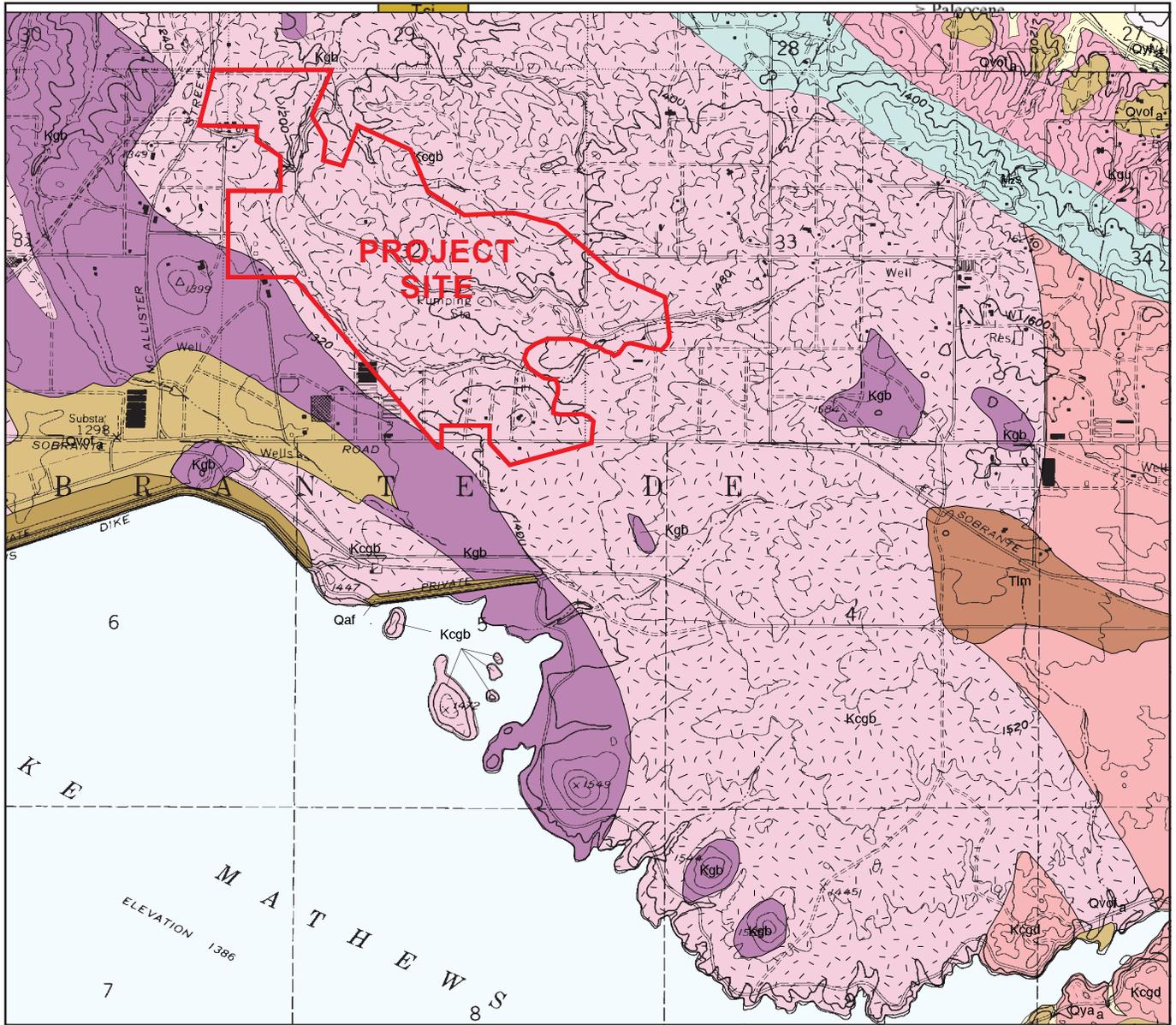
### **5.2. Geologic and Geomorphic Setting**

The project occupies part of the western edge of the Perris Block within the Peninsular Ranges Geomorphic Province. Cretaceous age crystalline rock associated with the southern California Batholith, and specifically the Cajalco Pluton, underlie the site (Morton and Webber 2001). This bedrock has been mapped as undifferentiated Granodiorite and Gabbro (Figure 2). Generally thin, non-marine, Pleistocene age deposits lay uncomfortably on the bedrock. These deposits are remnants of ancient stream bed deposits and alluvial fan deposits. Holocene-age (recent) alluvium is found within the current drainage courses at the site.

Drainage across the site is by sheet flow. The site may experience high-flow volumes during periods of prolonged rainfall, but otherwise the site remains dry throughout most of the year.

### **5.3. Stratigraphy**

Mapping and nomenclature following Morton and Weber (2001) place the site within the Cretaceous age Cajalco Pluton which is composed of crystalline plutonic rock that varies in the site vicinity from predominantly Granodiorite to more mafic rocks such as Gabbro. Remnants of Pleistocene age older alluvial deposits lay unconformably upon the bedrock at the site. This unit is essentially flat-lying and is found within some of the lower elevations at the site. In addition, paleosols have developed on the many of the flatter slopes and ridges at the site where erosion has not been as active. Recent (Holocene) alluvium exists within the well-established drainages on site. Undocumented fill exists in areas where the land surface has been modified in order to support agriculture, access roads, water pipelines, a water reservoir, and a residential pad. A more detailed description of these geologic units is presented below in order of oldest to youngest. Approximate geologic contacts are shown on Plates 1 through 4.



**SITE GEOLOGIC MAP  
VICTORIA HEIGHTS  
RIVERSIDE, CALIFORNIA**

- Qoa Old axial channel deposits (late to middle Pleistocene)
- Qvof Very old alluvial fan deposits (early Pleistocene)
- Kcgb Granodiorite and gabbro, undifferentiated
- Kgr Gabbro (Cretaceous)

P/W 1507-05

FIGURE 2

SOURCE MAP - MORTON & WEBER, 2001, GEOLOGIC MAP OF THE LAKE MATTHEWS 7.5 MINUTE QUADRANGLE, RIVERSIDE COUNTY, CALIFORNIA



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### **5.3.1. Undocumented Artificial Fill (afu)**

Undocumented fills associated with access roads, past citrus orchards, waterlines, and a reservoir exist at the site. The fills were observed by AGS to be composed mainly of light yellowish brown, brown, and grayish brown, clayey, fine- to medium-grained sand, that is dry and loose. Portions of the undocumented fill could contain trash and debris. Artificial fill was encountered to a maximum depth of two and a half (2.5) feet (test pit TP-21). Thicker layers of undocumented fill may be encountered in localized areas.

### **5.3.2. Topsoil (No Map Symbol)**

A thin veneer of topsoil was encountered in many of the subsurface excavations across the site. Topsoil was observed to consist primarily of light brown to reddish brown, clayey to silty, fine- to medium-grained sand, in a dry and loose condition. The thickness of this material was found to be up to two (2.0) feet thick during our investigation.

### **5.3.3. Alluvium (Map Symbol Qal)**

Holocene-age (recent) alluvial deposits are present in the well-developed modern drainages at the site, which appear to mainly be outside the limits of the proposed grading. The alluvium was found to be composed of reddish brown to yellowish brown clayey fine to medium grained sand, dry, loose to medium dense, with visible porosity. The alluvium is anticipated to range from a few feet to depths of greater than 13 feet (boring LB-4).

### **5.3.4. Colluvium (Map Symbol Qcol)**

Holocene-age (recent) colluvial deposits are present on the flatter areas at the base of slopes, at the site. Colluvium was reported to be up to ten (10) feet thick in T-79 (Leighton, 2015). Colluvium has been mapped on Plates 1 through 4 where significant amounts (3 feet or more) are thought to be present. This material is composed of reddish brown to light brown, clayey, fine- to medium-grained sand, moist to dry, medium dense, visibly porous and locally root-filled. These sediments are derived from adjacent topographic highs which were transported mainly by gravity.

### **5.3.5. Older Alluvium (Map Symbol Qoa)**

Pleistocene-age older alluvium deposits were observed to consist of reddish to yellowish brown, silty sand and clayey sand that is dry, loose, visibly porous, and highly weathered within the upper three (3) to six (6) feet. At depths in excess of three (3) to six (6) feet the older alluvium becomes moist and medium dense.

Leighton (2005) also encountered older alluvium at the site which was designated using map symbol Qalo. For mapping purposes, and to use symbols and nomenclature generally following Morton (2001), map symbol Qoa is used herein to designate older alluvium. For consistency the abbreviated logs on Plates 1 through 4 show Leighton's map symbols as reported (Leighton, 2005).

#### **5.3.6. Very Old Alluvial Fan Deposits (Map Symbol Qvof)**

Very old alluvial fan deposits were encountered within excavator test pit TP-32. This unit was encountered below older alluvium at a depth of seven (7) feet, where refusal was reached at eight (8) feet. This unit was observed to be composed of a dark yellowish brown silty, fine-grained sandstone, slightly moist to moist, very dense, which exhibits cementation and was observed to have abundant carbonate stringers. The upper six (6) to twelve (12) inches can be highly weathered.

#### **5.3.7. Granodiorite and Gabbro - Undifferentiated (Map Symbol Kcgb)**

Cretaceous-age Granodiorite, Gabbro, and Quartz Latite were encountered during our subsurface investigation. For mapping purposes, these plutonic rocks were combined into one unit (Granodiorite and Gabbro - undifferentiated) as described by Morton, 2001. Leighton designated the plutonic rock that they encountered as “granitic rock”, which has been combined into the same unit Granodiorite and Gabbro - undifferentiated herein. Some differentiation of the plutonic rock types was made within the logs by AGS as well as Leighton when it was obvious that the mineralogy of the rock fit into a certain category. However, the majority of the rock encountered during our investigation appeared to have a mineralogy that was somewhere in-between that of a Gabbro and a Granodiorite, and therefore no distinction was made in the logs.

The Granodiorite to Gabbro plutonic rock encountered during our investigation was found to be yellowish brown to reddish brown, slightly moist, moderately hard to hard and moderately to highly weathered within the upper few feet below ground surface. However, weathering to depths of 21 feet or more was observed within the excavator test pits.

### **5.4. Geologic Structure and Tectonic Setting**

#### **5.4.1. Tectonic Setting**

Structurally, the project site is located near the western edge of the Perris Block within the Peninsular Ranges geomorphic province, which extends south into Baja California and terminates in the north against the Transverse Ranges province. The tectonically active Elsinore and San Jacinto Faults reside on the respective west and east margins of the Perris Block.

#### **5.4.2. Regional Faulting**

The Greentree project lies in close proximity to the boundary between the North American and Pacific Plates. This regime dominates the regional tectonic setting in southern California. This fault systems consist of a series of en echelon, northwest-striking right-lateral strike-slip faults. The plate boundary is essentially defined by the San Andreas Fault Zone system and its major secondary faults systems, including the Elsinore and the San Jacinto Fault Zones. Portions of the Elsinore, Chino, and the San Jacinto Faults offset Holocene-age sediment and are therefore considered active.

5.4.2.1. *Elsinore Fault Zone*

The active Elsinore Fault Zone is a northwest trending right-lateral, strike-slip zone with at least local thrust- and normal-slip components that can be further subdivided into at least eight (8) known segments. Recent geological studies have shown that this fault has had historic activity.

5.4.2.2. *Chino Fault*

The active Chino Fault is a north trending strike-slip fault that detaches from the Elsinore Fault in the south Corona area, and trends north toward Chino Hills, where it apparently dies-out. The slip rate on various portions of the fault varies, but an average rate of 1 mm/yr. has been reported. The Chino Fault is divided into two separate segments.

5.4.2.3. *San Jacinto Fault Zone*

The active San Jacinto Fault Zone is a complex zone of stepping, bending, splaying and overlapping strike-slip fault segments. Slip rates for segments of this fault are estimated to be 7-15 mm/yr.

5.4.2.4. *Other Active Faults*

A list of the known active faults within 100 km of the site include:

<b>TABLE 5.4.2.4 SITE DISTANCE FROM ACTIVE FAULTS</b>		
<b>Fault Name</b>	<b>Distance from Site (km)</b>	<b>Maximum Magnitude</b>
Elsinore	8.8	7.29
Chino	9.4	6.50
San Jacinto	27.8	7.62
Cucamonga	33.5	6.70
San Jose	33.8	6.70
San Joaquin Hills	34.1	7.10
Puente Hills	36.4	6.90
Sierra Madre	37.6	7.20
San Andreas	38.9	7.98
Cleghorn	47.4	6.80
Newport-Inglewood	49.5	7.50
North Frontal (west)	53.7	7.20
Clamshell-Sawpit	53.8	6.70
Raymond	57.8	6.80
Elysian Park	61.9	6.70
Verdugo	69.2	6.90
Palos Verdes	69.4	7.70
Pinto Mountain	73.0	7.30
Hollywood	75.1	6.70

<b>Fault Name</b>	<b>Distance from Site (km)</b>	<b>Maximum Magnitude</b>
Coronado Bank	76.7	7.40
Santa Monica	79.4	7.40
Helendale-So Lockhart	79.5	7.40
North Frontal (East)	81.5	7.00
Rose Canyon	82.5	6.90
San Gabriel	89.6	7.30
Lenwood-Old Woman	93.8	7.50
Northridge	96.7	6.90

Source: USGS, 2008, Ellsworth Model.

### **5.4.3. Geologic Structure**

The Quaternary deposits at the site are essentially flat-lying. Structure within the underlying plutonic rock of the Cajalco Pluton is relatively massive and is characterized by the predominantly steeply dipping joint sets within it. Joint sets observed within this unit were mapped from outcrops and within test pits. No faults have been mapped within the site or site vicinity.

### **5.5. Groundwater**

Groundwater was not encountered in the exploratory borings or excavations within the subject site. No depth to groundwater information was readily available, however due to the crystalline bedrock beneath the site, groundwater is considered to be over 100 feet deep.

It should be assumed that surface water will be present within the major drainages at the property in winter months. Nuisance seepage from cut and fill slopes in a post-graded environment is likely to occur due to the expected use of landscaping and irrigation water. This condition may require toe drains or other measures and is discussed in further detail in Section 7.3.

### **5.6. Non-seismic Geologic Hazards**

#### **5.6.1. Mass Wasting**

No evidence of mass wasting was observed onsite nor was any noted on the reviewed maps. Land sliding at the site is not considered to be an issue, due to the hard and relatively massive nature of the underlying granitic bedrock at the site. No evidence of mass wasting was observed during our investigation.

#### **5.6.2. Flooding**

Based on our review of the relevant FEMA (2008) flood map, the site is within Area X corresponding to areas outside the 0.2% annual chance (500-year) flood plain.

### **5.6.3. Subsidence and Ground Fissuring**

Due to the presence of the hard underlying bedrock at the site, and the limited thickness of sediments below the site, the potential for subsidence and ground fissuring due to settlement is very unlikely.

## **5.7. Seismic Hazards**

The subject site is located in southern California, which is a tectonically active area. The type and magnitude of seismic hazards affecting a site are dependent upon the distance to the causative fault and the intensity and magnitude of the seismic event. The seismic hazard may be primary, such as surface rupture and/or ground shaking, or secondary, such as liquefaction and/or ground lurching. The State of California has mandated by the Alquist-Priolo (A-P) Earthquake Fault Zoning Act to delineate Fault-Rupture Hazard Zones in California and by the Urban Seismic Hazards Mapping Act (USHMA) to delineate zones identified as being potentially susceptible to the secondary seismic hazards of liquefaction and earthquake induced landsliding. The Greentree Ranch project is not located in either of these special studies zones.

The type or severity of seismic hazards affecting the site is chiefly dependent upon the distance to and direction from causative faults, the intensity and duration of the seismic events, and the onsite soil characteristics. The seismic hazard may be primary, such as surface rupture and/or ground shaking, or secondary, such as liquefaction or landsliding. The following is a brief seismic hazards assessment for the project

### **5.7.1. Surface Fault Rupture**

Surface rupture is a break in the ground surface during, or as a consequence of, seismic activity. Fault rupture occurs most often along pre-existing fault traces. No faults have been mapped onsite, nor in the immediate site vicinity. Accordingly, the potential for surface rupture is low.

### **5.7.2. Seismicity**

As noted, the site is within the tectonically active southern California area, and is approximately 8.8 km (5.5 miles) from the active Elsinore fault zone. The potential exists for strong ground motion that may affect future improvements.

At this point in time, non-critical structures (commercial, residential, and industrial) are usually designed according to the California Building Code (2016) and that of the controlling local agency. However, liquefaction/seismic slope stability analyses, critical structures, water tanks and unusual structural designs will likely require site specific ground motion input.

### **5.7.3. Seiches, Tsunamis & Dam Inundation**

A seiche is a free-standing wave oscillation on the surface of water in an enclosed or semi-enclosed basin. The wave can be initiated by an earthquake and can vary in height from several centimeters to a few meters.

The site is near a large body of water (Lake Mathews), however flooding at the site due to a seiche is considered to be very low, due to the fact that the County of Riverside General Plan lists only two water bodies in Riverside County with the potential for a seismically induced seiche (Lake Elsinore and Perris Reservoir).

The Inundation area from a failure of the Lake Mathews reservoir is presented in Amendment 960 to the County of Riverside General Plan. The area of inundation does not enter the site and is restricted to the southwest of the project.

#### 5.7.4. Historical Earthquakes

Earthquakes that have historically impacted the area include the 1857 Fort Tejon Earthquake, the 1858 San Bernardino Earthquake, the 1899 Cajon Pass earthquake, the 6.8 magnitude 1918 San Jacinto earthquake near Hemet, the 6.3 magnitude 1923 North San Jacinto earthquake near Highgrove, the 1981 Sylmar Earthquake, the 5.9 magnitude 1987 Whittier Narrows Earthquake, the 6.4 magnitude Big Bear earthquake, 6.7 magnitude 1994 Northridge Earthquake, and 5.4 magnitude 1990 Upland earthquake.

**FIGURE 3 - MAP OF HISTORIC EARTHQUAKES (1910-PRESENT)**



#### 5.7.5. Seismic Design Parameters

It is anticipated that after implementation of the grading recommendations provided in this report, some lots will be underlain by less than 10 feet of compacted fill on plutonic rock and other lots will be underlain by more than 10 feet of compacted fill. It is recommended

that lots underlain by less than 10 feet of fill be classified as Seismic Site Class B consisting of a rock profile with average shear wave velocity greater than 5,000 ft/sec. Lots underlain by more than 10 feet of fill may be classified as Seismic Site Class D consisting of stiff soil profile with average SPT (N) values between 15 and 50 bpf. Tables 5.7.5.1 and 5.7.5.2 present seismic design parameters in accordance with 2016 CBC and mapped spectral acceleration parameters (United States Geological Survey, 2018) for seismic site classes B and D, respectively. A site location of Latitude 33.865°N and Longitude 117.427°W was utilized. Determination of the applicable seismic site class to individual lots will be provided after site grading is completed.

<b>TABLE 5.7.5.1</b>	
<b>2016 CALIFORNIA BUILDING CODE DESIGN PARAMETERS</b>	
Seismic Site Class	B
Mapped Spectral Acceleration Parameter at Period of 0.2-Second, $S_s$	1.500g
Mapped Spectral Acceleration Parameter at Period 1-Second, $S_l$	0.600g
Site Coefficient, $F_a$	1.000
Site Coefficient, $F_v$	1.000
Adjusted $MCE_R^1$ Spectral Response Acceleration Parameter at Short Period, $S_{MS}$	1.500g
1-Second Period Adjusted $MCE_R^1$ Spectral Response Acceleration Parameter, $S_{Ml}$	0.600g
Short Period Design Spectral Response Acceleration Parameter, $S_{DS}$	1.000g
1-Second Period Design Spectral Response Acceleration Parameter, $S_{Dl}$	0.400g
Peak Ground Acceleration, $PGA_M^2$	0.507g
Seismic Design Category	D
Notes: <sup>1</sup> Risk-Targeted Maximum Considered Earthquake <sup>2</sup> Peak Ground Acceleration adjusted for site effects	

<b>TABLE 5.7.5.2</b>	
<b>2016 CALIFORNIA BUILDING CODE DESIGN PARAMETERS</b>	
Seismic Site Class	D
Mapped Spectral Acceleration Parameter at Period of 0.2-Second, $S_s$	1.500g
Mapped Spectral Acceleration Parameter at Period 1-Second, $S_l$	0.600g
Site Coefficient, $F_a$	1.000
Site Coefficient, $F_v$	1.500
Adjusted $MCE_R^1$ Spectral Response Acceleration Parameter at Short Period, $S_{MS}$	1.500g
1-Second Period Adjusted $MCE_R^1$ Spectral Response Acceleration Parameter, $S_{Ml}$	0.900g
Short Period Design Spectral Response Acceleration Parameter, $S_{DS}$	1.000g
1-Second Period Design Spectral Response Acceleration Parameter, $S_{Dl}$	0.600g
Peak Ground Acceleration, $PGA_M^2$	0.507g
Seismic Design Category	D
Notes: <sup>1</sup> Risk-Targeted Maximum Considered Earthquake <sup>2</sup> Peak Ground Acceleration adjusted for site effects	

#### **5.7.6. Liquefaction/Dynamic Settlement**

Liquefaction is the phenomenon where seismic agitation of loose, saturated sands and silty sands can result in a buildup of pore pressures that, if sufficient to overcome overburden stresses, can produce a temporary quick condition known as liquefaction. Localized, loose lenses/layers of sandy soils may be subject to liquefaction when a large, prolonged, seismic event affects the site. As the excess pore water pressure dissipates, the liquefied zones/lenses can consolidate causing settlement. Post liquefaction effects at a site can manifest in several ways and may include: 1) ground deformations; 2) loss of shear strength; 3) lateral spread; 4) dynamic settlement; and 5) flow failure.

In general, the more recent a sediment has been deposited, the more likely it is to be susceptible to liquefaction. Further, liquefaction potential is greatest in loose, poorly graded sands and silty sands with mean grain size in the range of 0.1 to 0.2 mm. Other factors that must be considered are groundwater, confining stresses, relative density, intensity and duration of ground shaking. It is generally held that soils possessing a clay content (particle size < 0.005mm) greater than fifteen (15) to twenty (20) percent may be considered non-liquefiable (Southern California Earthquake Center, 1999).

Due to the dense nature of the granitic rock; the relatively thin veneer of granular soils; the lack of shallow groundwater; and the proposed remedial grading as outlined herein; the subject site is not considered to be susceptible to liquefaction.

#### **5.7.7. Lateral Spreading**

Liquefaction-induced lateral spreading is defined as the finite, lateral displacement of gently sloping ground as a result of pore pressure build-up or liquefaction in a shallow underlying deposit during an earthquake. Due to the lack of shallow ground water and the proposed remedial grading recommended herein, the potential for lateral spreading is remote.

#### **5.7.8. Seismically Induced Landsliding**

Owing to the hard granitic rock below the site, and given the proposed post-grading environment, the potential of seismically induced landsliding is considered to be “very low” at the site.

## **6.0 GEOTECHNICAL ENGINEERING**

Presented herein is a discussion of the geotechnical properties of the various soil types and earth materials that have been encountered during our site-specific analyses, and how it relates to the design as shown on Plates 1 through 4.

**6.1. Material Properties**

**6.1.1. Excavation Characteristics**

It is anticipated that excavations within the undocumented artificial fill, topsoil, alluvium, older alluvium, and very old alluvial fan deposits, as well as the highly to moderately weathered portions of the Granodiorite-Gabbro, can be accomplished with conventional equipment. It is likely that oversized "float" will be encountered in surface outcrops of the Granodiorite-Gabbro and will require special handling. The slightly weathered Granodiorite-Gabbro found within the deeper cuts will require heavy ripping and possibly blasting to excavate.

As a means to help determine the rippability of the bedrock AGS observed track hoe excavator pits and air track borings at the site. Logs of the excavator pits and air track borings are presented in Appendix B. Locations of the air track borings with estimated depths to non-rippable rock as determined by AGS and Albus-Keefe are presented on Plates 1 through 4. It is assumed by AGS that the estimated depth to non-rippable rock by Albus-Keefe was based on an air-track drilling rates greater than 18 to 20 seconds/foot.

To further evaluate rippability, Southwest Geophysics, Inc. (SGI, 2018) performed ten (10) seismic refraction survey lines (SL-1 thru SL-10) within slopes and ridges onsite. The report by SGI is presented in Appendix B. The approximate locations of the survey lines are shown on Plates 1 through 4. Table 6.1.1 below summarizes the approximate depths at which the interface between rippable (wave velocity <5,500 ft/s) and marginally rippable to non-rippable materials (>5,500 ft/s) is anticipated based upon the seismic refraction lines.

<b>TABLE 6.1.1 SEISMIC REFRACTION SURVEY DATA</b>	
<b>Survey Line</b>	<b>Approximate Depth of Rippable/ Non-rippable Interface (ft)</b>
SL-1	55
SL-2	23
SL-3	16
SL-4	9
SL-5	0
SL-6	7
SL-7	16
SL-8	30
SL-9	24
SL -10	25

Generally, it has been AGS's experience that when wave velocities are higher than 5,500 feet/sec, blasting will be required for efficient excavation utilizing a D-9 bulldozer equipped with a single-shank ripper. Although it is possible that in certain instances velocities approaching 5,500 ft/s can be ripped, production rates are typically too low, and drilling and shooting is typically preferred in order to increase production. Velocities greater than 4,000 to 5,000 ft/s may require localized blasting for efficiency during grading and will probably contain common boulders that will require special handling. It should be anticipated that oversized materials will be generated from cuts in the bedrock. These oversized materials should be handled as discussed in Section 7.5.8. Recommended undercuts to remove hard rock from the near pad grade and within utility alignments are presented in Section 7.1.

Based on the drilling and excavator test pits, the rippability of the rock is expected to be variable. This is due to varying degrees of fracturing, weathering, and quartz content. Irregular rippable/non-rippable horizons can also be expected. The determination of rippable/non-rippable quantities should be evaluated by the contractor. It has been AGS's experience that the following factors and combinations thereof, determine production rates and therefore dictate the need for blasting. These factors include: 1) fracture pattern; 2) frequency of quartz rich zones; 3) equipment type and condition; and 4) skill of equipment operators. It is AGS's opinion that isolated areas of hard rock may be encountered in these upper rippable zones requiring the use of blasting or hoe-rams (i.e., secondary breaking) as a means to efficiently excavate and place these materials. Additional rippability studies could be undertaken after detailed 40-scale plans become available.

#### **6.1.2. Compressibility**

Onsite materials that are significantly compressible include undocumented fill, topsoil, alluvium, weathered portions of older alluvium as well as the highly weathered portions of the crystalline bedrock. These materials will require complete removal prior to placement of fill, where exposed at design grade and possibly where exposed in cut slopes. Recommended removal depths are presented in Section 7.1 and earthwork adjustment shrink/bulk estimates are presented in Section 6.1.6.

#### **6.1.3. Expansion Potential**

Based upon our observations and preliminary testing, the expansion potential of the onsite materials will range from "very low" to "low" when classified in accordance with ASTM D4829. Although not anticipated, we have also provided design recommendations for soils in the "medium" expansion potential range.

#### **6.1.4. Shear Strength**

The average shear strength parameters used by AGS for design and analysis are presented in Table 6.1.4. Specific shear strength testing is presented in Appendix C.

<b>TABLE 6.1.4 SHEAR STRENGTH PARAMETERS USED FOR DESIGN (ULTIMATE)</b>			
<b>Material</b>	<b>Cohesion (psf)</b>	<b>Friction Angle (degrees)</b>	<b>Moist Density (pcf)</b>
Compacted Fill	150	31	120
Older Alluvium, Very Old Fan (Qoa, Qvof)	150	32	125
Granodiorite/Gabbro (Kcgb)	500	35	130

**6.1.5. Chemical and Resistivity Test Results**

The results of preliminary chemical/resistivity testing are presented in Appendix C. Consultation with a corrosion engineer is recommended. Final determination of actual chemical/resistivity design parameters for the foundation will be determined at the conclusion of the grading and will be presented in the grading report.

**6.1.6. Earthwork Adjustments**

In consideration of the proposed mass grading to develop the project as currently proposed on the Tentative Tract Maps, the following average earthwork adjustment factors presented in Table 6.1.6. have been formulated for use in the earthwork design of the project.

<b>TABLE 6.1.6 EARTHWORK ADJUSTMENTS</b>		
<b>Geologic Unit</b>	<b>Approximate Range</b>	
Undocumented Artificial Fill, Topsoil, Alluvium, and Colluvium (afu, Topsoil, Qal/Qcol):	10% - 12% Shrink	
Older Alluvium, Very Old Alluvial Fan Deposits (Qoa, Ovof):	0% - 5% Shrink	
Granodiorite and Gabbro (Kcgb):	<i>Heavy Ripping</i>	15% - 18% Bulk
	<i>Blasting</i>	18% - 25% Bulk

These values may be used in an effort to balance the earthwork quantities. As is the case with every project, contingencies should be made to adjust the earthwork balance when grading is in progress and actual conditions are better defined.

**6.1.7. Pavement Support Characteristics**

Compacted fill derived from onsite soils is expected to possess “moderate” to “good” pavement support characteristics. Testing should be completed once subgrade elevations are reached for the onsite roadways. For preliminary pavement design we have used an assumed R-Value of 30 for the subgrade soil onsite.

**6.1.8. Infiltration Rates**

Preliminary infiltration testing was conducted as part of our overall review of the recent infiltration design recommendation report prepared by AGS (AGS report no. 1507-05-B-5). As part of our testing five (5) infiltration test areas were analyzed for their infiltration rates. Table 6.1.8 summarizes the as-tested infiltration rates and the recommended design rates utilizing a factor of safety (FS) of 2.0.

<b>TABLE 6.1.8 SUMMARY OF INFILTRATION TEST RESULTS</b>						
<b>Test Hole No.</b>	<b>Depth of Test Hole (inch)</b>	<b>Approximate Test Elevation (feet, msl)</b>	<b>Geologic Unit</b>	<b>Description</b>	<b>Test Infiltration Rate (inch/hour)</b>	<b>Recommended* Infiltration Rate (inch/hour)</b>
P-1	60	1399.5	Qoa	Clayey Sand	0.43	0.22
P-2	48	1399.0	Qoa	Clayey Sand	0.72	0.36
P-3	60	1302.9	Qoa	Clayey Sand	0.41	0.20
P-4	54	1302.0	Qoa	Clayey Sand	0.52	0.26
P-5	42	1208.0	Kcgb	Granitic Bedrock	0.07	0.04

\* Factor of Safety 2.0

**6.2. Analytical Methods**

**6.2.1. Slope Stability Analysis**

Slope stability analyses were performed using the Simplified Janbu Method for circular failure surfaces. Stability calculations were compiled using STEDwin in conjunction with GSTABL7 computer code.

**6.2.2. Pavement Design**

Asphalt concrete pavement sections have been designed using the recommendations and methods presented in the Caltrans Highway Design Manual.

**7.0 EARTHWORK CONCLUSIONS AND RECOMMENDATIONS**

Development of the subject property is considered feasible, from a geotechnical standpoint, provided that the conclusions and recommendations presented herein are incorporated into the design and construction of the project. Presented below are specific issues identified by this study as possibly affecting site development. Recommendations to mitigate these issues are presented in the text of this report.

**7.1. Site Preparation and Removals/Overexcavation**

Grading should be accomplished under the observation and testing of the project geotechnical engineer and engineering geologist or their authorized representative in accordance with the recommendations contained herein, the current grading ordinance of the County of Riverside and AGS's Earthwork Specifications (Appendix E). Existing vegetation, trash, debris, and other deleterious materials should be removed and wasted from the site prior to commencing removal of unsuitable soils and placement of compacted fill materials. Additionally, all pre-existing

foundations elements, standpipes, irrigation lines, and utility conduits should be removed and wasted off-site. Concrete can be placed in the fill provided it is broken down into pieces smaller than 12 inches (largest dimension). Cesspools and septic systems should be properly removed and/or backfilled in accordance with the local governing agency.

Soil, undocumented fills, alluvium and weathered portions of the older alluvium, and bedrock should be removed in areas planned to receive compacted fill intended to support settlement-sensitive structures such as buildings, roads and underground improvements. The resulting undercuts should be replaced with engineered fill. Estimated depths of removals based upon the geologic unit are presented in Table 7.1. It should be noted that local variations can be expected requiring an increase in the depth of removal for unsuitable and weathered deposits. The extent of removals can best be determined in the field during grading when observation and evaluation can be performed by the soil engineer and/or engineering geologist. Removal bottoms should finally expose saturated (S>85%) alluvium, very old alluvial fan deposit and/or bedrock. The removal bottom should be observed and mapped by the engineering geologist prior to fill placement. Although unlikely, if removals are completed to saturated alluvium or older alluvium will require monitoring of time-dependent settlement.

In general, soils removed during remedial grading will be suitable for reuse in compacted fills provided they are properly moisture conditioned and do not contain deleterious materials.

<b>TABLE 7.1 ESTIMATED DEPTH OF REMOVALS</b>	
<b>Geologic Unit (map symbol)</b>	<b>Estimated Removal Depth (feet)</b>
Topsoil (No Map Symbol)	1 - 2
Artificial Fill – undocumented (afu)	1 - 10
Alluvium (Qal)	1 - 13
Colluvium (Qcol)	1 - 10
Older Alluvium (Qoa)	3 - 6
Very Old Alluvial Fan Deposits (Qvof)	0.5 - 1
Granodiorite and Gabbro (Kcgb)	1 - 2

**7.1.1. Stripping and Deleterious Material Removal**

Existing vegetation, trash, debris, and other deleterious materials should be removed and wasted from the site prior to commencing removal of unsuitable soils and placement of compacted fill materials. Additionally, all pre-existing foundations elements, standpipes, irrigation lines, and utility conduits should be removed and wasted off-site. Concrete can be placed in the fill provided it is broken down into pieces smaller than 12 inches (largest dimension). Cesspools and septic systems should be properly removed and/or backfilled in accordance with the local governing agency.

## **7.1.2. Overexcavation of Building Pads and Streets**

### *7.1.2.1. Cut/Fill Transition Lots*

Where design grades and/or remedial grading activities create a cut/fill transition, the cut and shallow fill portions of the building pad should be overexcavated a minimum depth of three (3) feet and replaced to design grade with compacted fill. Lots anticipated to require replacement fills due to cut/fill transitions are indicated with a © on the enclosed plans. All undercuts should be graded such that a gradient of at least one (1) percent is maintained toward deeper fill areas or the front of the pad. The entire pad area of these lots should be undercut. Replacement fills should be compacted to project specifications as discussed in Section 7.5.

### *7.1.2.2. Cut Lots Underlain by Hard Rock*

In order to facilitate foundation trenching and future homeowner improvements, it is recommended that all cut lots be overexcavated at least three (3) feet and capped with "select" material. Deeper undercuts are recommended in front yard areas in order to facilitate service utility construction. Lots anticipated to require replacement fills due to hard rock conditions are indicated with an ® on the enclosed plans. This undercut should have a minimum one (1) percent gradient toward the front of the lots to allow for potential subsurface drainage. "Select" replacement material should be eight- (8) inch minus and be compacted to project specifications as discussed in Section 7.5.

### *7.1.2.3. Steep Cut and Cut/Fill Transitions*

In order to reduce the differential settlement potential on lots with steep fill or cut/fill transitions, or highly variable fill thickness, the cut or shallow fill portion of steep transitions shall be overexcavated to a depth equal to one-third (1/3) the deepest fill section within the lot to a maximum thickness of seventeen (17) feet. As an alternative to overexcavation on steep cut and cut/fill transition lots founded in hard rock, foundation design combined with increased compaction criteria can be considered. By increasing the compaction of the fill, differential settlement can be reduced.

### *7.1.2.4. Overexcavation of Streets*

It is suggested that the street areas with design cut or shallow fill located in the hard bedrock areas be overexcavated a minimum of one (1) feet below the deepest utility and replaced with compacted, eight- (8) inch minus, select soils. This will facilitate the use of conventional trenching equipment for utility construction.

### *7.1.2.5. Selective Grading of Backbone Streets*

Where cast-in-place pipe (CIPP) is proposed, selective grading will be required. Besides a maximum rock size of 3-inches, select soils consisting of soil types SC

and SM soil types are generally recommended for the “pipe zone” area where CIPP will be used. Selective grading in these areas should be anticipated.

### **7.1.3. Removals Along Grading Limits and Property Lines**

Removals of unsuitable soils will be required prior to fill placement along the grading limit. Where possible, a 1:1 (H:V) projection from toe of slope or grading limit outward to competent materials should be established. Where removals are not possible due to grading limits, property line or easement restrictions, removals should be initiated at the grading boundary (property line, easement, grading limit or outside the improvement) at a 1:1 ratio inward to competent materials. This reduced removal criteria should not be implemented prior to review by the Geotechnical Consultant and approval by the Owner. Where this reduced removal criteria is implemented, special maintenance zones may be necessary. These areas, if present, will need to be identified during grading. Alternatively, grading limits can be initiated offsite.

## **7.2. Slope Stability and Remediation**

Close geologic inspection should be conducted during grading to observe if soil and geologic conditions differ significantly from those anticipated. Should field conditions dictate, modifications to the recommendations presented herein may be necessary and should be based upon conditions exposed in the field during grading.

### **7.2.1. Cut Slopes**

Proposed cut slopes have been designed at slope ratios of 2:1 (horizontal to vertical). The highest proposed cut slope is approximately 45 feet. It is anticipated that slopes excavated in hard rock will be stable to the proposed heights. Stability calculations supporting this conclusion are presented on Plates D-1 through D-3 (Appendix D).

Rockfall issues can develop when large cut slopes are designed. However, unattached rounded boulders are not found frequently within the site and site vicinity. Possible mitigations for any adverse rock fall conditions could include dedicated impact zones at the toe of slope, catchment fencing, and other restraints. All cut slopes should be observed by the engineering geologist during grading. Modifications to the recommendations presented herein may be necessary and should be based upon conditions exposed in the field at the time of grading.

If conditions exposed during grading determine the need for stabilization fills, then the backcuts for stabilization fills should be made no steeper than 1:1 (H:V). Shallower backcuts may be required if conditions dictate. Final determination should be made in the field by the project geologist. All stabilization fills will require backdrain systems as shown on Detail 3 (Appendix E). Additional backdrains could be required in backcuts where geologic contacts daylight in the backcut. Terrace drains and benches should be constructed on cut slopes in accordance with the County of Riverside Grading Ordinance.

### **7.2.2. Fill Slopes**

Fill slopes are designed at ratios of 2:1 (horizontal to vertical) or flatter. The highest design fill slopes are approximately 44 feet. Fill slopes, when properly constructed with onsite materials, are expected to be grossly and surficially stable as designed. Stability calculations are presented on Plates D-4 through D-6 (Appendix D).

Fill slopes constructed at 2:1 ratios or flatter can be expected to perform satisfactorily when properly constructed with onsite materials and maintained as described in Appendix E. Marginal surficial stability may exist if slopes are not properly maintained or are subjected to inappropriate irrigation practices. Slope protection and appropriate landscaping will improve surficial stability and should be considered.

Keyways should be constructed at the toe of all fill slopes toeing on existing or cut grade. Fill keys should have a minimum width equal to fifteen (15) feet or one-half (1/2) the height of ascending slope, whichever is greater. Where possible, unsuitable soil removals below the toe of proposed fill slopes should extend outward from the catch point of the design toe at a minimum 1:1 (H:V) projection to an approved cleanout as shown on Detail 5 (Appendix E). Backcuts should be cut no steeper than 1:1 (H:V) ratio or as recommended by the geotechnical engineer. Terrace drains and benches should be constructed on fill slopes in accordance with the County of Riverside Grading Ordinance.

### **7.2.3. Natural Slopes and Skin Fills**

Where possible, skin fills or thin fill sections against natural slopes should be avoided. If skin fill conditions are identified in the field or are created by remedial grading, it is recommended that a backcut and keyway be established such that a minimum fill thickness equal to one-half (1/2) the remaining slope height but not less than fifteen (15) feet is provided for all skin fill conditions. This criterion should be implemented for the entire slope height. Drains are required at the heel of keyways and will be designed based upon exposed conditions.

### **7.2.4. Fill over Cut Slopes**

Several fill over cut slopes are proposed for this project. For fill over cut slopes, the fill portion should not be constructed until the cut portion of the slope has been cut to finish grade. The materials and geologic structure exposed along the cut slope will be evaluated for: 1) suitability as a foundation medium; 2) suitability for receiving compacted fill; and 3) surficial and gross stability. Once the cut portion of the slope has been evaluated, it will be released for construction of the fill key or recommendations for further remedial grading will be provided. If it is determined that the exposed materials require remediation, the slope would then become a stabilization fill and should be constructed as discussed in Section 7.2.1.

### **7.2.5. Surficial Stability**

The surficial stability of 2:1 fill and cut slopes have been analyzed, and the analysis presented in Appendix D indicates a factor-of-safety in excess of code minimums. When fill and cut slopes are properly constructed and maintained, satisfactory performance can

be anticipated although slopes will be subject to erosion, particularly before landscaping is fully established.

#### **7.2.6. Temporary Backcut Stability**

Temporary backcuts should be laid back at gradients no steeper than 1:1 to heights of up to 10 feet, and 1½:1 (horizontal:vertical) for heights greater than 10 feet. Flatter backcuts may be necessary where geologic conditions dictate and where minimum width dimensions are to be maintained.

Care should be taken during remedial grading operations in order to minimize risk of failure. Should failure occur, complete removal of the disturbed material will be required. In consideration of the inherent instability created by temporary construction of backcuts, it is imperative that grading schedules be coordinated to minimize the unsupported exposure time of these excavations. Once started the excavations and subsequent fill operations should be maintained to completion without intervening delays imposed by avoidable circumstances. In cases where five-day workweeks comprise a normal schedule, grading should be planned to avoid exposing at-grade or near-grade excavations through a non-work weekend. Where improvements may be affected by temporary instability, either on or offsite, further restrictions such as slot cutting, extending work days, implementing weekend schedules, and/or other requirements considered critical to serving specific circumstances may be imposed.

#### **7.2.7. Geologic Observation During Grading**

All temporary slope excavations, including front, side and backcuts, and all cut slopes should be mapped to verify the geologic conditions that were modeled prior to grading are consistent with the exposures during the grading. It is likely that slope stability analyses and designed keyways may have to be modified based on conditions exposed during grading.

### **7.3. Subsurface Drainage**

#### **7.3.1. Canyon Drains**

Six- (6) and eight- (8) inch diameter canyon subdrains are recommended along the deeper canyons on the project. The drains are to be placed along the lowest alignment of canyon removals to intercept, transport and dispose of infiltrating water. The diameter and approximate locations of proposed subdrains are shown on Plates 1 through 4. Final determination of drain locations will be made in the field, based on exposed conditions. Drains should be constructed in accordance with the details shown on Details 1 and 2 (Appendix E).

#### **7.3.2. Heel Drains**

Heel drains will be required for all stabilization fill keyways and fill-over-cut keyways. Heel drains should be constructed in accordance with the details shown on Detail 3 (Appendix E).

### **7.3.3. Cut Slope Toe Drains and Subdrains**

Due to the fractured nature of the bedrock, it is common for post-grading irrigation runoff to surface on cut slopes. Consideration should be given to placing a toe drain on all major cut slopes in order to provide drainage for possible future nuisance water on the cut slopes.

Subdrains on the cut slope face may be required if nuisance water surfaces on the slope face during grading. These drains may be tied into the toe drain if it is installed, or if no toe drains are installed, it will need to be tied to adjacent canyon subdrains or the storm drain system.

### **7.4. Seepage**

Seepage, when encountered during grading, should be evaluated by the Geotechnical Consultant. In general, seepage is not anticipated to adversely affect grading. If seepage is excessive, remedial measures such as horizontal drains or under drains may need to be installed. No groundwater or seepage was encountered during the investigation; therefore, seepage is not expected.

### **7.5. Earthwork Considerations**

#### **7.5.1. Compaction Standards**

Fill and processed natural ground shall be compacted to a minimum relative compaction of 90 percent as determined by ASTM Test Method D1557. All fill to be placed below fifty (50) feet from ultimate grade and/or below subdrains should be compacted to at least 93 percent of maximum dry density. Care should be taken that the ultimate grade be considered when determining the compaction requirements for disposal fill and "super pad" areas. Compaction shall be achieved at slightly above the optimum moisture content, and as generally discussed in the attached Earthwork Specifications (Appendix E).

#### **7.5.2. Documentation of Removals and Drains**

Removal bottoms, canyon subdrains, fill keys, backcuts, backdrains and their outlets should be observed by the engineering geologist and/or geotechnical engineer and documented by the civil engineer prior to fill placement.

#### **7.5.3. Treatment of Removal Bottoms**

At the completion of removals, the exposed bottom should be scarified to a depth of approximately 8 to 12 inches, moisture conditioned to above optimum moisture content, and compacted in-place to the standards set forth in this report.

#### **7.5.4. Fill Placement**

After removals, scarification, and compaction of in-place materials are completed, additional fill may be placed. Fill should be placed in thin lifts [eight- (8) inch bulk], moisture conditioned to slightly above the optimum moisture content, mixed, compacted, and tested as grading progresses until final grades are attained.

#### **7.5.5. Benching**

Where the natural slope is steeper than 5-horizontal to 1-vertical and where determined by the Geotechnical Consultant, compacted fill material shall be keyed and benched into competent materials.

#### **7.5.6. Mixing and Moisture Control**

In order to provide thorough moisture conditioning and proper compaction, processing (mixing) of materials is necessary. Mixing should be accomplished prior to, and as part of the compaction of each fill lift.

#### **7.5.7. Fill Slope Construction**

Fill slopes may be constructed by preferably overbuilding and cutting back to the compacted core or by back-rolling and compacting the slope face. The following recommendations should be incorporated into construction of the proposed fill slopes.

Care should be taken to avoid spillage of loose materials down the face of any slopes during grading. Spill fill will require complete removal before compaction, shaping and grid rolling.

Seeding and planting of the slopes should follow as soon as practical to inhibit erosion and deterioration of the slope surfaces. Proper moisture control will enhance the long-term stability of the finish slope surface.

##### *7.5.7.1. Overbuilding Fill Slopes*

Fill slopes should be overfilled to an extent determined by the contractor, but not less than 2 feet measured perpendicular to the slope face, so that when trimmed back to the compacted core, the compaction of the slope face meets the minimum project requirements for compaction.

Compaction of each lift should extend out to the temporary slope face. The slope should be back-rolled at fill intervals not exceeding 4 feet in height unless a more extensive overfilling is undertaken.

##### *7.5.7.2. Compacting the Slope Face*

As an alternative to overbuilding the fill slopes, the slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Back-rolling at more frequent intervals may be required. Compaction of each fill should extend to the face of the slope. Upon completion, the slopes should be watered, shaped, and track-walked with a D-8 bulldozer or similar equipment until the compaction of the slope face meets the minimum project requirements. Multiple passes may be required.

#### **7.5.8. Oversized Materials**

Oversized rock material [i.e., rock fragments greater than eight (8) inches] will be produced during the excavation of the design cuts and undercuts. Provided that the procedure is

acceptable to the developer and governing agency, this rock may be incorporated into the compacted fill section to within three (3) feet of finish grade within residential areas and to two (2) foot below the deepest utility in street and house utility connection areas. Maximum rock size in the upper portion of the hold-down zone is restricted to eight (8) inches. Disclosure of the above rock hold-down zone should be made to prospective homebuyers explaining that excavations to accommodate swimming pools, spas, and other appurtenances will likely encounter oversize rock [i.e., rocks greater than eight (8) inches] below three (3) feet. Rock disposal details are presented on Detail 10 (Appendix E). Rocks in excess of eight (8) inches in maximum dimension may be placed within the deeper fills, provided rock fills are handled in a manner described below. In order to separate oversized materials from the rock hold-down zones, the use of a rock rake may be necessary.

#### 7.5.8.1. *Rock Blankets*

Rock blankets consisting of a mixture of gravel, sand and rock to a maximum dimension of two (2) feet may be constructed. The rocks should be placed on prepared grade, mixed with sand and gravel, watered and worked forward with bulldozers and pneumatic compaction equipment such that the resulting fill is comprised of a mixture of the various particle sizes, contains no significant voids, and forms a dense, compact, fill matrix.

Rock blankets may be extended to the slope face provided the following additional conditions are met:

- 1) no rocks greater than twelve (12) inches in diameter are allowed within six (6) horizontal feet of the slope face;
- 2) 50 percent (by volume) of the material is three-quarter- (3/4) inch minus; and,
- 3) bankrolling of the slope face is conducted at four- (4) foot vertical intervals and satisfies project compaction specifications.

#### 7.5.8.2. *Rock Windrows*

Rocks to maximum dimension of four (4) feet may be placed in windrows in deeper fill areas in accordance with the details on Detail 10 (Appendix E). The base of the windrow should be excavated an equipment-width into the compacted fill core with rocks placed in single file within the excavation. Sands and gravels should be added and thoroughly flooded and tracked until voids are filled. Windrows should be separated horizontally by at least fifteen (15) feet of compacted fill, be staggered vertically, and separated by at least four (4) vertical feet of compacted fill. Windrows should not be placed within ten (10) feet of finish grade, within two (2) vertical feet of the lowest buried utility conduit in structural fills, or within fifteen (15) feet of the finish slope surface unless specifically approved by the developer, geotechnical consultant, and governing agency.

#### 7.5.8.3. *Individual Rock Burial*

Rocks in excess of four (4) feet, but no greater than eight (8) feet may be buried in the compacted fill mass on an individual basis. Rocks of this size may be buried

separately within the compacted fill by excavating a trench and covering the rock with sand/gravel, and compacting the fines surrounding the rock. Distances from slope face, utilities, and building pad areas (i.e., hold-down depth) should be the same as windrows.

#### *7.5.8.4. Rock Disposal Logistics*

The grading contractor should consider the amount of available rock disposal volume afforded by the design when excavation techniques and grading logistics are formulated. Rock disposal techniques should be discussed and approved by the geotechnical consultant and developer prior to implementation

#### **7.5.9. Haul Roads**

Haul roads, ramp fills, and tailing areas should be removed prior to placement of fill.

#### **7.5.10. Import Materials**

Import materials, if required, should have similar engineering characteristics as the onsite soils and should be approved by the soil engineer at the source prior to importation to the site.

#### **7.5.11. Utility Trench Excavation and Backfill**

All utility trenches should be shored or laid back in accordance with applicable OSHA standards. Excavations in bedrock areas should be made in consideration of underlying geologic structure. The project geotechnical consultant should be consulted on these issues during construction.

Mainline and lateral utility trench backfill should be compacted to at least 90 percent of maximum dry density as determined by ASTM D1557. Onsite soils will not be suitable for use as bedding material but will be suitable for use in backfill, provided oversized materials are removed. No surcharge loads should be imposed above excavations. This includes spoil piles, lumber, concrete trucks, or other construction materials and equipment. Drainage above excavations should be directed away from the banks. Care should be taken to avoid saturation of the soils.

Compaction should be accomplished by mechanical means. Jetting of native soils will not be acceptable. Under-slab trenches should also be compacted to project specifications. If native soils are used, mechanical compaction is recommended. If select granular backfill ( $SE > 30$ ) is used, compaction by flooding will be acceptable. The soil engineer should be notified for inspection prior to placement of the membrane and slab reinforcement.

## **8.0 DESIGN RECOMMENDATIONS**

From a geotechnical perspective, the proposed development is feasible provided the following recommendations are incorporated into the design and construction. Preliminary design recommendations presented herein are based on the general soils conditions encountered during the referenced geotechnical investigations. As such, recommendations provided herein are considered preliminary and subject to change based on the results of additional observation and testing that will occur during grading operations. Final design recommendations should be provided in a final rough/precise grading report.

### **8.1. Structural Design Recommendations**

Precise building products, loading conditions, and locations are not currently available. It is expected that for typical one- to three-story residential products and loading conditions (1 to 3 ksf for spread and continuous footings), conventional shallow slab-on-grade foundations will be utilized in areas with low expansive and shallow fill areas (<50 feet).

Upon the completion of rough grading, finish grade samples should be collected and tested to develop specific recommendations as they relate to final foundation design recommendations for individual lots. These test results and corresponding design recommendations should be presented in a Final Rough Grading Report.

It is anticipated that the as-graded near-surface soils could vary from "very low" to "medium" in expansion potential with the majority of the lots consisting of "very low" to "low" when tested in accordance with ASTM D4829 procedures.

### **8.2. Preliminary Foundation Design Recommendations**

It is anticipated that wood-frame residential structures with shallow foundations will be constructed for this project. Detailed structural plans, loading conditions and structural sittings are not currently available; however, it can be expected that residential structures can be supported on conventional shallow foundations with slab-on-grade or post-tensioned slab/foundation systems. The design of foundation systems should be based on as-graded conditions as determined after grading completion. The following values may be used in preliminary foundation design:

<b>Allowable Bearing:</b>	2,000 lbs./sq.ft. (assuming a minimum embedment depth of 12 inches and a minimum width of 12 inches).
<b>Lateral Bearing:</b>	350 lbs./sq.ft. per foot of depth to a maximum of 2,000 lbs./sq.ft. (based on level conditions at the toe)
	150 lbs./sq.ft. per foot of depth to a maximum of 1,500 lbs./sq.ft. (based on descending 2:1 slope at the toe)
<b>Sliding Coefficient:</b>	0.35

The above values may be increased as allowed by Code to resist transient loads such as wind or seismic. Building code and structural design considerations may govern. Depth and reinforcement requirements should be provided by the structural engineer.

#### **8.2.1. Conventional Foundation Design Recommendations**

Based upon the observed soil conditions, the expansion potential categories for the building pads are anticipated to range from "Very Low" to "Low". Conventional foundation systems

should be designed in accordance with 2016 CBC guidelines and recommendations provided in the following table.

<b>TABLE 8.2.1 CONVENTIONAL SLAB-ON-GRADE FOUNDATION DESIGN RECOMMENDATIONS</b>		
<b>Expansion Potential</b>	Very Low to Low (Cat. I)	Medium (Cat. II)
<b>Footing Depth Below Lowest Adjacent Finish Grade</b>		
<b>One-Story</b>	12 inches	18 inches
<b>Two-Story</b>	18 inches	18 inches
<b>Footing Width</b>		
<b>One-Story</b>	12 inches	12 inches
<b>Two-Story</b>	15 inches	15 inches
<b>Footing Reinforcement</b>		
<b>One-Story</b>	No. 4 rebar, one (1) on top and one (1) on bottom	No. 4 rebar, two (2) on top and two (2) on bottom or No. 5 rebar one (1) on top and one (1) on bottom
<b>Two-Story</b>	No. 4 rebar, one (1) on top and one (1) on bottom	No. 4 rebar, two (2) on top and two (2) on bottom or No. 5 rebar one (1) on top and one (1) on bottom
<b>Slab Thickness</b>	4 inches (actual)	4 inches (actual)
<b>Slab Reinforcement</b>	No. 3 rebar spaced 18 inches on center, each way	No. 3 rebar spaced 15 inches on center, each way
<b>Slab Subgrade Moisture</b>	Minimum of optimum moisture prior to placing concrete.	Minimum of 120% of optimum moisture 24 hours prior to placing concrete.
<b>Footing Embedment Next to Swales and Slopes</b>		
If exterior footings adjacent to drainage swales are to exist within five (5) feet horizontally of the swale, the footing should be embedded sufficiently to assure embedment below the swale bottom is maintained. Footings adjacent to slopes should be embedded such that a least seven (7) feet are provided horizontally from edge of the footing to the face of the slope.		
<b>Garages</b>		
A grade beam reinforced continuously with the garage footings shall be constructed across the garage entrance, tying together the ends of the perimeter footings and between individual spread footings. This grade beam should be embedded at the same depth as the adjacent perimeter footings. A thickened slab, separated by a cold joint from the garage beam, should be provided at the garage entrance. Minimum dimensions of the thickened edge shall be six (6) inches deep. Footing depth, width and reinforcement should be the same as the structure. Slab thickness, reinforcement and underslab treatment should be the same as the structure.		
<b>Isolated Spread Footings</b>		
Isolated spread footings should be embedded a minimum of 18 inches below lowest adjacent finish grade and should be at least 24 inches wide. A grade beam should also be constructed for interior and exterior spread footings and should be tied into the structure in two orthogonal directions, footing dimensions and reinforcement should be similar to the aforementioned continuous footing recommendations. Final depth, width and reinforcement should be determined by the structural engineer		

### 8.2.2. Post Tensioned Slab/Foundation Design

Post-tensioned foundations may be designed using the values provided in the following table. For preliminary estimating purposes, post-tensioned foundations may be designed assuming “Low” expansion potential. However, final post-tensioned foundations design recommendations should be based on as-graded conditions.

TABLE 8.2.2 POST-TENSIONED FOUNDATION DESIGN PARAMETERS							
Soil Category	Expansion Index	Lot Nos.	Edge Beam Embedment (inches)	Edge Lift <sup>1</sup>		Center Lift <sup>1</sup>	
				Em (ft.)	Ym (in.)	Em (ft.)	Ym (in.)
I	Low	TBD <sup>2</sup>	12	5.4	0.54	9.0	0.23
II	Medium	TBD <sup>2</sup>	18	4.6	0.90	9.0	0.38
<b>Moisture Barrier</b>		An approved moisture and vapor barrier should be placed below all slabs-on-grade within living and moisture sensitive areas as discussed in Section 8.2.8.					
<b>Slab Subgrade Moisture</b>		Soil Category I	Minimum of 110 percent of optimum moisture to a depth of 12 inches prior to placing concrete.				
		Soil Category II	Minimum of 130 percent of optimum moisture to a depth of 12 inches prior to placing concrete.				
<b>Foundation Embedment</b>		Depth of embedment should be measured below lowest adjacent finish grade. <b><u>Foundations Adjacent to Swales and Slopes:</u></b> If exterior footings adjacent to drainage swales are to exist within 5 feet horizontally of the swale, the footing should be embedded sufficiently to assure embedment below the swale bottom is maintained. Footings adjacent to slopes should be embedded such that at least 5 feet is provided horizontally from edge of the footing to the face of the slope.					
<p><b>Notes:</b> <sup>1</sup>The values of predicted lift are based on the procedures outlined in the <i>Design of Post-Tensioned Slabs-on-Ground</i>, Third Edition and related addendums. No corrections for vertical barriers at the edge of the slab or other corrections (e.g. horizontal barriers, tree roots, adjacent planters) are assumed. <u>The values assume Post-Equilibrium conditions exist (as defined by the Post Tensioning Institute), and these conditions created during construction should be maintained throughout the life of the structure.</u> Please refer to the appended Homeowner Maintenance Guidelines for a summary of recommended practices to maintain the conditions created during construction.</p> <p><sup>2</sup> Final design parameters should be provided in a final grading report and should be based on as-graded soil conditions.</p>							

Design and construction of post-tensioned foundations should be undertaken by firms experienced in this field. It is the responsibility of the foundation design engineer to select the design methodology and properly design the foundation system for site-specific soils conditions. The slab designer should provide deflection potential to the project architect/structural engineer for incorporation into the design of the structure.

**8.2.3. Total and Differential Settlement**

In addition to the potential effects of expansive soils, the proposed residential structures in shallow fills (fill depth less than 50 feet) should be designed for a total settlement of 3/4-inch and differential settlement 3/8 inch in twenty (20) feet. Residential structures on deep fills (fill depth greater than 50 feet) should be designed for a total settlement of 1-inch and differential settlement 1/2 inch in twenty (20) feet.

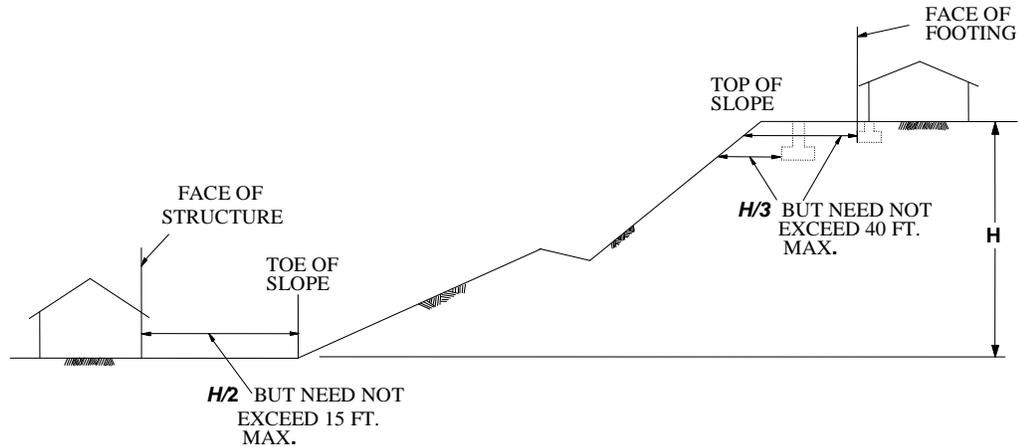
**8.2.4. Isolated Footings**

Isolated footings outside the structure footprint should be tied with grade beams to the structure in two orthogonal directions.

### 8.2.5. Deepened Footings and Setbacks

It is generally recognized that improvements constructed in proximity to natural slopes or properly-constructed slopes can, over a period of time, be affected by natural processes including gravity forces, weathering of surficial soils, and long-term (secondary) settlement. In accordance with 2016 CBC guidelines, where foundations for residential structures are to exist in proximity to slopes, the footings should be embedded to satisfy the requirements presented in following figure.

**FIGURE 4 – SLOPE SETBACK DIMENSIONS (2016 CBC)**



### 8.2.6. Footing Excavations

Footing excavations should be observed by the geotechnical consultant. Spoils from the footing excavations should not be placed on slab-on-grade areas unless the soils are properly compacted. The footing excavations should not be allowed to dry back and should be kept moist until concrete is poured. The excavations should be free of all loose and sloughed materials, be neatly trimmed, and moisture conditioned at the time of concrete placement.

### 8.2.7. Garage Entrances

A grade beam reinforced continuously with the garage footings should be constructed across the garage entrance, tying together the ends of the perimeter footings and between individual spread footings. This grade beam should be embedded at the same depth as the adjacent perimeter footings. A thickened slab, separated by a cold joint from the garage beam, should be provided at the garage entrance. The thickened edge should be a minimum of 6 inches deep.

### 8.2.8. Moisture and Vapor Barrier

A moisture and vapor retarding system should be placed below the slab-on-grade in portions of the structure considered to be moisture sensitive. The retarder should be of suitable composition, thickness, strength and low permeance to effectively prevent the migration of water and reduce the transmission of water vapor to acceptable levels.

Historically, a 10-mil plastic membrane, such as *Visqueen*, placed between one to four inches of clean sand, has been used for this purpose. More recently 15-mil Stego® Wrap or similar underlayments have been used to lower permeance to effectively prevent the migration of water and reduce the transmission of water vapor to acceptable levels. The use of this system or other systems, materials or techniques can be considered, at the discretion of the designer, provided the system reduces the vapor transmission rates to acceptable levels.

**8.3. Retaining Wall Design**

Retaining wall foundations should be supported on compacted fill and may be designed in accordance with the recommendations provided in Section 8.2. When calculating lateral resistance, the upper 12 inches of soil cover should be ignored in areas that are not covered with hardscape. Retaining wall footings should be designed to resist the lateral forces by passive soil resistance and/or base friction as recommended for foundation lateral resistance.

Retaining walls should be designed to resist earth pressures presented in the following table. These values assume that the retaining walls will be backfilled non-expansive free draining materials (Sand Equivalent of 20 or better and an Expansion Index of 20 or less). Most of the materials onsite are considered free-draining and will be suitable for placement behind these walls. If non-free draining materials are utilized, revised values will need to be provided to design the retaining walls. Retaining walls should be designed to resist additional loads such as construction loads, temporary loads, and other surcharges as evaluated by the structural engineer.

<b>TABLE 8.1.3 RETAINING WALL EARTH PRESSURES</b>				
<b>“Native” Backfill Materials (<math>\gamma=125</math> pcf, <math>EI&lt;20</math>)</b>				
	<b>Level Backfill</b>		<b>2:1 Backfill</b>	
	<b>Rankine Coefficients</b>	<b>Equivalent Fluid Pressure (psf / lineal foot)</b>	<b>Rankine Coefficients</b>	<b>Equivalent Fluid Pressure (psf / lineal foot)</b>
<b>Active Pressure</b>	$K_a = 0.32$	40	$K_a = 0.50$	63
<b>Passive Pressure</b>	$K_p = 3.12$	390	$K_p = 1.18$	148
<b>At Rest Pressure</b>	$K_o = 0.48$	60	$K_o = 0.88$	110

In addition to the above static pressures, retaining walls supporting more than 6 feet of backfill height should be designed to resist seismic loading as required by the 2016 CBC. The seismic load can be modeled as a thrust load applied at a point  $0.6H$  above the base of the wall, where  $H$  is equal to the height of the wall. This seismic load (in pounds per lineal foot of wall) is represented by the following equation:

$$P_e = \frac{3}{8} * \gamma * H^2 * k_h$$

Where:

- $P_e$  = Seismic thrust load
- $H$  = Height of the wall (feet)
- $\gamma$  = soil density = 130 pounds per cubic foot (pcf)
- $k_h$  = seismic pseudostatic coefficient =  $0.5 * PG_{AM}$

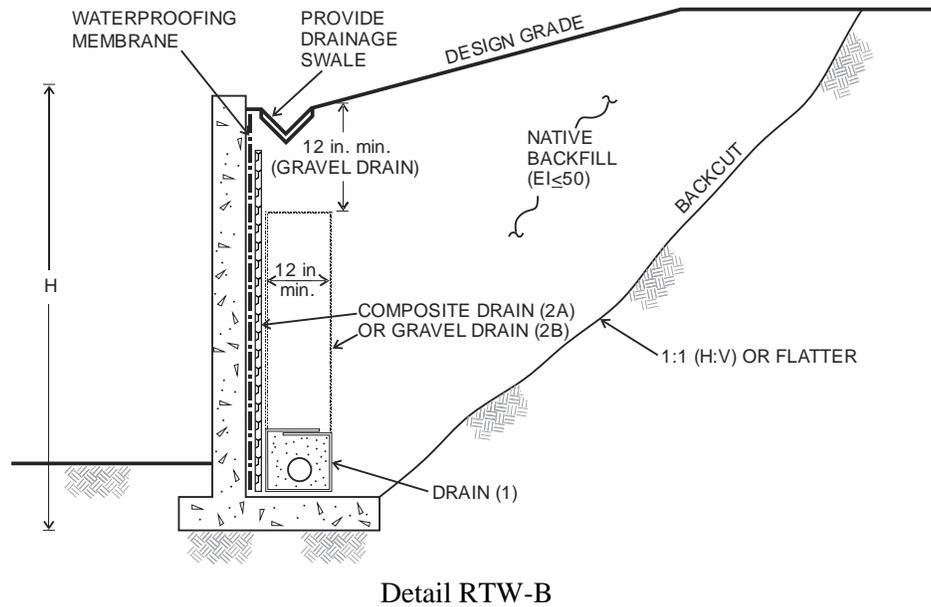
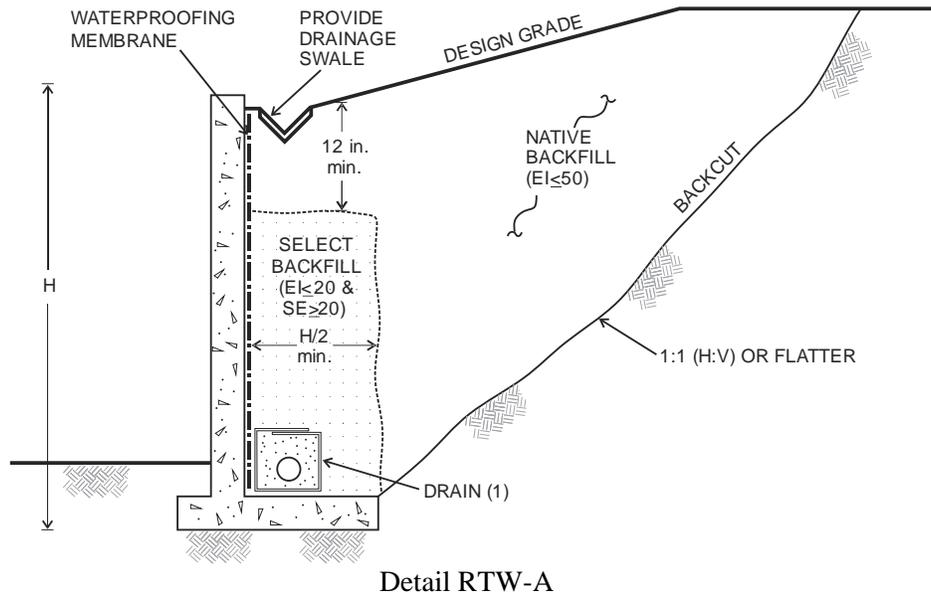
The site-specific peak horizontal ground acceleration ( $PG_{AM}$ ) is provided in Section 5.7.5. Walls should be designed to resist the combined effects of static pressures and the above seismic thrust load.

The foundations for retaining walls of appurtenant structures structurally separated from the building structure may bear on properly compacted fill. Retaining wall footings should be designed to resist the lateral forces by passive soil resistance and/or base friction as recommended for foundation lateral resistance. To relieve the potential for hydrostatic pressure wall backfill should consist of a free draining backfill (sand equivalent “SE” >20) and a heel drain should be constructed. The heel drain should be placed at the heel of the wall and should consist of a 4-inch diameter perforated pipe (SDR35 or SCHD 40) surrounded by 4 cubic feet of crushed rock (3/4-inch) per lineal foot, wrapped in filter fabric (Mirafi® 140N or equivalent) as shown in Figure 5.

Proper drainage devices should be installed along the top of the wall backfill, which should be properly sloped to prevent surface water ponding adjacent to the wall. In addition to the wall drainage system, for building perimeter walls extending below the finished grade, the wall should be waterproofed and/or damp-proofed to effectively seal the wall from moisture infiltration through the wall section to the interior wall face.

The wall should be backfilled with granular soils placed in loose lifts no greater than 8-inches thick, at or near optimum moisture content, and mechanically compacted to a minimum 90 percent relative compaction as determined by ASTM Test Method D1557. Flooding or jetting of backfill materials generally do not result in the required degree and uniformity of compaction and, therefore, is not recommended. The soils engineer or his representative should observe the retaining wall footings, backdrain installation and be present during placement of the wall backfill to confirm that the walls are properly backfilled and compacted.

**FIGURE 5 - RETAINING WALL BACKFILL AND DRAINAGE DETAILS**



- NOTES:** (1) DRAIN: 4-INCH PERFORATED ABS OR PVC PIPE OR APPROVED EQUIVALENT SUBSTITUTE PLACED PERFORATIONS DOWN AND SURROUNDED BY A MINIMUM OF 1 CUBIC FEET OF 3/4 INCH ROCK OR APPROVED EQUIVALENT SUBSTITUTE AND WRAPPED IN MIRAFI 140 FILTER FABRIC OR APPROVED EQUIVALENT SUBSTITUTE
- (2A) COMPOSITE DRAIN SYSTEM: MIRAFI G200N, DELTA DRAIN 2000/6000/6200 OR APPROVED EQUIVALENT SUBSTITUTE CONNECTED TO DRAIN (1)
- (2B) GRAVEL DRAIN: MINIMUM 12-INCH WIDE 3/4-INCH GRAVEL BLANKET WRAPPED IN MIRAFI FILTER FABRIC (140 OR APPROVED EQUIVALENT SUBSTITUTE)

#### **8.4. Civil Design Recommendations**

##### **8.4.1. Site Drainage**

Final site grading should assure positive drainage away from structures. Planter areas should be provided with area drains to transmit irrigation and rain water away from structures. The use of gutters and down spouts to carry roof drainage well away from structures is recommended. Raised planters should be provided with a positive means to remove water through the face of the containment wall.

##### **8.4.2. Rear and Side Yard Walls and Fences**

Block wall footings should be founded a minimum of 24-inches below the lowest adjacent grade. To reduce the potential for uncontrolled, unsightly cracks, it is recommended that a construction joint be incorporated at regular intervals. Spacing of the joints should be between 10 and 20 feet.

##### **8.4.3. Concrete Flatwork and Lot Improvements**

- In an effort to minimize shrinkage cracking, concrete flatwork should be constructed of uniformly cured, low-slump concrete and should contain sufficient control/contraction joints (typically spaced at 8 to 10 feet, maximum).
- Additional provisions need to be incorporated into the design and construction of all improvements exterior to the proposed structures (pools, spas, walls, patios, walkways, planters, etc.) to account for the hillside nature of the project, as well as being designed to account for potential expansive soil conditions. Design considerations on any given lot may need to include provisions for differential bearing materials (bedrock vs. compacted fill), ascending/descending slope conditions, bedrock structure, perched (irrigation) water, special surcharge loading conditions, potential expansive soil pressure, and differential settlement/heave.
- All exterior improvements should be designed and constructed by qualified professionals using appropriate design methodologies that account for the onsite soils and geologic conditions. The aforementioned considerations should be used when designing, constructing, and evaluating long-term performance of the exterior improvements on the lots.
- The homeowners should be advised of their maintenance responsibilities as well as geotechnical issues that could affect design and construction of future homeowner improvements. The information presented in Appendix F should be considered for inclusion in homeowner packages in order to inform the homeowner of issues relative to drainage, expansive soils, landscaping, irrigation, sulfate exposure, and slope maintenance.

##### **8.4.4. Preliminary Pavement Design**

Preliminary pavement recommendations for streets and driveways are provided below. The performance of pavement is highly dependent on providing positive surface drainage away from the edge of pavement. Ponding of water on or adjacent to the pavement will likely

result in pavement distress and subgrade failure. Drainage from landscaped areas should be directed towards controlled drainage structures and not towards pavement areas. Landscaped areas adjacent to pavement areas are not recommended due the potential for surface or irrigation water infiltrating into the aggregate base and pavement subgrade. If landscaped areas are placed adjacent to pavement areas, consideration should be given to implementing measures that will reduce the potential for water to be introduced into the aggregate base. Such measures may include installing impermeable vertical barriers between the landscaped area and pavement areas including deepened curbs or 10 mil thick plastic liners. Such barriers should extend a minimum of 6 inches below the bottom of the aggregate base.

8.4.4.1. *Asphalt Concrete Pavement*

Presented below are preliminary pavement sections for a range of traffic indices and an assumed R-Value of 30 for the subgrade soils. Testing of the subgrade soils should be performed during precise grading operations to verify the actual R-Value. The project Civil Engineer or Traffic Engineer should select traffic indices that are appropriate for the anticipated pavement usage and level of maintenance desired through the pavement life. Final pavement structural sections will be dependent on the R-value of the subgrade materials and the traffic index for the specific street or area being addressed. The pavement sections are subject to the review and approval of the County of Riverside.

<b>TABLE 8.4.4.1 PRELIMINARY ASPHALT PAVEMENT SECTIONS</b>			
<b>Traffic Index (T.I.)</b>	<b>Design R-Value</b>	<b>Asphaltic Concrete (in.)</b>	<b>Class 2 Aggregate Base (in.)</b>
5.0	30	3.0	4.0
6.0	30	3.0	9.0

Pavement subgrade soils should be at or near optimum moisture content and should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D1557. Aggregate base should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D1557 and should conform with the specifications listed in Section 26 of the *Standard Specifications for the State of California Department of Transportation* (Caltrans) or Section 200-2 of the *Standard Specifications for Public Works Construction* (Green Book). The asphalt concrete should conform to Section 26 of the Caltrans *Standard Specifications* or Section 203-6 of the Green Book.

8.4.4.2. *Portland Cement Concrete Pavement*

We suggest that consideration be given to using Portland cement concrete (PCC) pavements in areas where dumpsters will be stored and where buses and garbage trucks will stop and load. We recommend for these areas a 6-inch thick PCC pavement section placed over 6 inches of aggregate base compacted to 95 percent relative compaction.

Concrete with minimum 28-day Modulus of Rupture (M-R) of 550 psi and compressive strength of 3,000 psi is recommended. Transverse contraction joints should not be spaced more than 15 feet and should be cut to a depth of  $\frac{1}{4}$  the thickness of the slab. Longitudinal joints should not be spaced more than 15 feet apart, however, are not necessary in the pavement adjacent to the curb and gutter section.

## **8.5. Soil Corrosivity**

Laboratory testing was performed on a representative sample of on-site soils to evaluate pH and electrical resistivity, as well as chloride and sulfate contents. The pH value of the tested sample was 7.2. The electrical resistivity value was 980 ohm-centimeters. Chloride content was 507 parts per million (ppm). Sulfate content was 1,074 ppm (i.e. 0.107%). Previous testing by Leighton (2005) indicated pH values of 7.35 and 7.96, chloride contents of 127 and 264 ppm, sulfate contents of 0.03% and 0.015%, and electrical resistivity values of 2,698 and 2,563 ohm-centimeters. Additional details and laboratory test results are presented in Appendix C. Based on Caltrans (2018) corrosion criteria, the site is not considered corrosive which corresponds to the following conditions: chloride concentration above 500 ppm, sulfate concentration above 2,000 ppm, or the pH is 5.5 or less.

### **8.5.1. Concrete**

Concrete in contact with soil or water that contains high concentrations of soluble sulfates can be subject to chemical deterioration. Laboratory testing by AGS indicated a sulfate content of 1,074 ppm (i.e. 0.107%). According to American Concrete Institute (ACI) 318-11, the potential for sulfate attack is Class S1 – Moderate for water-soluble sulfate content in soil between 0.10 percent and 0.20 percent by weight (i.e., 1,000 ppm to 2,000 ppm). Therefore, the site earth materials may be considered to have moderate potential for sulfate attack. According to ACI 318 guidelines, we recommend using Type V cement for concrete structures in contact with soil and water-cement ratio of no more than 0.50.

### **8.5.2. Metals in Contact with Soil**

A factor for evaluating corrosivity to buried metal is electrical resistivity. The electrical resistivity of a soil is a measure of resistance to electrical current. Corrosion of buried metal is directly proportional to the flow of electrical current from the metal into the soil. As resistivity of the soil decreases, the corrosivity generally increases. The sample tested resulted in electrical resistivity value of 980 ohm-centimeters.

Correlations between resistivity and corrosion potential (NACE, 1984) indicate that the soils have corrosive potential to buried metals. As such, corrosion protection for metal in contact with site soils should be considered. Corrosion protection may include the use of epoxy or asphalt coatings. We recommend that a corrosion engineer be consulted regarding corrosion protection recommendations for the project.

## **9.0 SLOPE AND LOT MAINTENANCE**

Maintenance of improvements is essential to the long-term performance of structures and slopes. Although the design and construction during mass grading created slopes that are considered both grossly and surficially stable, certain factors are beyond the control of the soil engineer and geologist. The homeowners must implement certain maintenance procedures.

In addition to the appended Homeowners Maintenance Guidelines, the following recommendations should be implemented.

### **9.1. Slope Planting**

Slope planting should consist of ground cover, shrubs and trees that possess deep, dense root structures and require a minimum of irrigation. The resident should be advised of their responsibility to maintain such planting.

### **9.2. Lot Drainage**

Roof, pad and lot drainage should be collected and directed away from structures and slopes and toward approved disposal areas. Design fine-grade elevations should be maintained through the life of the structure, or if design fine grade elevations are altered, adequate area drains should be installed in order to provide rapid discharge of water away from structures and slopes. Residents should be made aware that they are responsible for maintenance and cleaning of all drainage terraces, down drains, and other devices that have been installed to promote structure and slope stability.

### **9.3. Slope Irrigation**

The resident, homeowner and Homeowner Association should be advised of their responsibility to maintain irrigation systems. Leaks should be repaired immediately. Sprinklers should be adjusted to provide maximum uniform coverage with a minimum of water usage and overlap. Overwatering with consequent wasteful run-off and ground saturation should be avoided. If automatic sprinkler systems are installed, their use must be adjusted to account for natural rainfall conditions.

### **9.4. Burrowing Animals**

Residents or homeowners should undertake a program for the elimination of burrowing animals. This should be an ongoing program in order to maintain slope stability.

## **10.0 FUTURE STUDY NEEDS**

### **10.1. In-Grading Observation**

Geologic exposures afforded during remedial and rough grading operations provide the best opportunity to evaluate the anticipated site geologic structure. Continuous geologic and geotechnical observations, testing, and mapping should be provided throughout site development. Additional near-surface samples should be collected by the geotechnical consultant during grading and subjected to laboratory testing. Final design recommendations should be provided in a grading report based on the observation and test results collected during grading.

## 11.0

## CLOSURE

### 11.1. Geotechnical Review

As is the case in any grading project, multiple working hypotheses are established utilizing the available data, and the most probable model is used for the analysis. Information collected during the grading and construction operations is intended to evaluate the hypotheses, and some of the assumptions summarized herein may need to be changed as more information becomes available. Some modification of the grading and construction recommendations may become necessary, should the conditions encountered in the field differ significantly than those hypothesized to exist.

AGS should review the pertinent plans and sections of the project specifications, to evaluate conformance with the intent of the recommendations contained in this report.

If the project description or final design varies from that described in this report, AGS must be consulted regarding the applicability of, and the necessity for, any revisions to the recommendations presented herein. AGS accepts no liability for any use of its recommendations if the project description or final design varies and AGS is not consulted regarding the changes.

### 11.2. Limitations

This report is based on the project as described and the information obtained from referenced reports and the exploratory excavations at the locations indicated on the plans. The findings are based on the review of the field and laboratory data combined with an interpolation and extrapolation of conditions between and beyond the exploratory excavations. The results reflect an interpretation of the direct evidence obtained. Services performed by AGS have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, either expressed or implied, and no warranty or guarantee is included or intended.

The recommendations presented in this report are based on the assumption that an appropriate level of field review will be provided by geotechnical engineers and engineering geologists who are familiar with the design and site geologic conditions. That field review shall be sufficient to confirm that geotechnical and geologic conditions exposed during grading are consistent with the geologic representations and corresponding recommendations presented in this report. AGS should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations of this report are applicable to the specific design of this project as discussed in this report. They have no applicability to any other project or to any other location, and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of AGS.

AGS has no responsibility for construction means, methods, techniques, sequences, or procedures, or for safety precautions or programs in connection with the construction, for the acts or omissions of the CONTRACTOR, or any other person performing any of the construction, or for the failure of any of them to carry out the construction in accordance with the final design drawings and specifications.

**APPENDIX A**  
**REFERENCES**

## REFERENCES

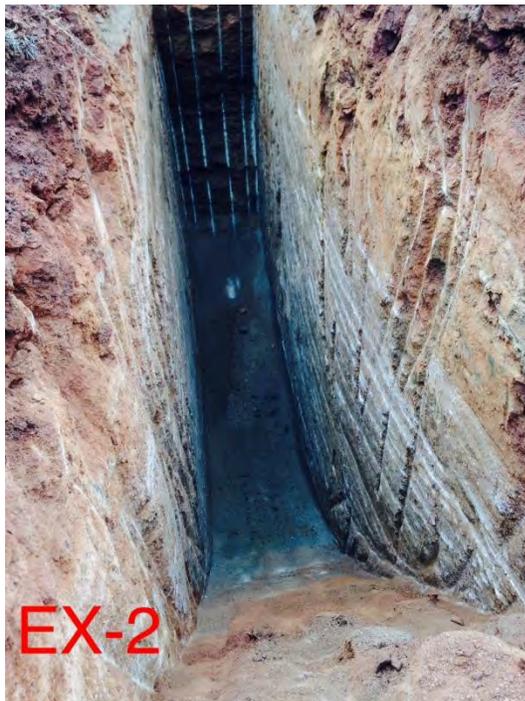
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**APPENDIX B1**  
**SUBSURFACE LOGS (AGS)**

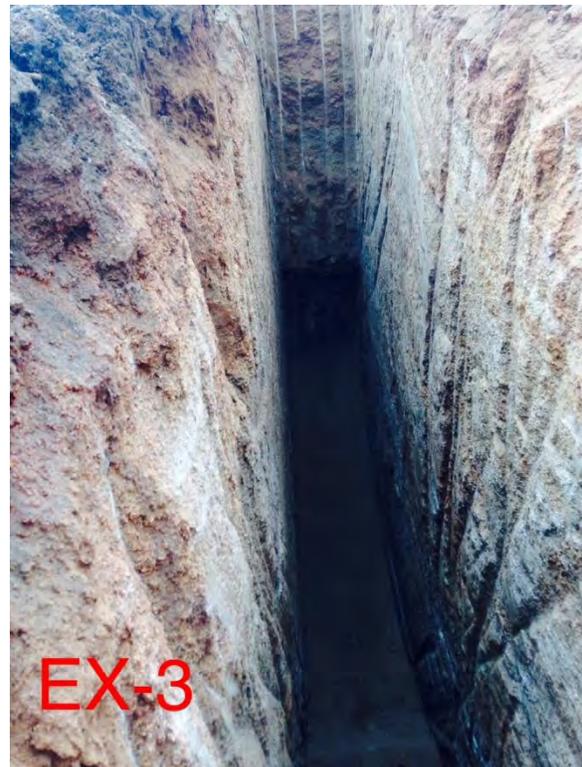
Project Victoria Heights  
Date Excavated 8/27/2015  
Logged by FE  
Equipment Kobelco 82,000 lb. Excavator  
with 30 inch bucket and Tiger teeth

**LOG OF TEST PITS**

Test Pit No.	Depth (ft.)	USCS	Description
EX-2	0.0 – 1.0	SC	<b><u>Topsoil:</u></b> CLAYEY SAND; reddish brown, dry, loose, fine to medium grained.
	1.0 – 21.0		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Reddish yellow, slightly moist, soft, fine to medium grained, highly weathered, abundant secondary clays. @ 7 ft. light olive to light yellowish brown, large crystal size (Biotite hornblende Granodiorite), moderately soft, breaks into sand with some silt and clay. @ 8 ft. N-S, 60 E – Joint @ 15 ft. light gray @ 18 ft. moderately hard, some fine flat-lying fractures with iron oxide. @ 19 ft. hard @ 20.5 ft. still rippable  TOTAL DEPTH 21 FT./MAXIMUM REACH NO WATER, NO CAVING



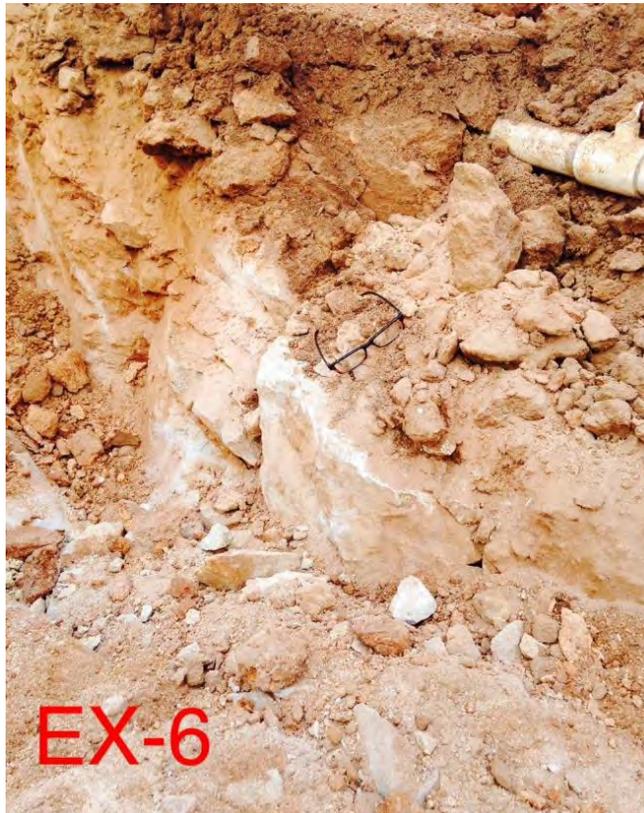
Test Pit No.	Depth (ft.)	USCS	Description
EX-3	0.0 – 0.5	SC	<b><u>Topsoil:</u></b> CLAYEY SAND; reddish brown, dry, loose, fine to medium grained.
	0.5 – 21.0		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Red, dry, soft, fine to medium grained, highly weathered, abundant secondary clays. Breaks into sand with some silt and clay. @ 3.5 ft. reddish yellow and olive, some fine flat-lying fractures with iron oxide. @ 15 ft. light gray. @ 19 ft. hard. @ 18 ft. olive, moderately hard. @ 21 ft. still rippable  TOTAL DEPTH 21 FT./MAXIMUM REACH NO WATER, NO CAVING



Test Pit No.	Depth (ft.)	USCS	Description
EX-4	0.0 – 1.0	SC	<b><u>Topsoil:</u></b> CLAYEY SAND; reddish brown, dry, loose, fine to medium grained.
	1.0 – 16.5		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Yellowish red, dry, soft, fine to medium grained, highly weathered, abundant secondary clays. @ 3 ft. light olive with horizontal iron oxide staining along fine fractures, moderately soft, breaks into sand with some silt and clay. @ 15 ft. light olive, hard  TOTAL DEPTH 16.5 FT./PRACTICAL REFUSAL NO WATER, NO CAVING
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EX-5	0.0 – 0.5	SM	<b><u>Topsoil:</u></b> SILTY SAND, grayish brown, dry, loose, fine to medium grained.
	0.5 – 4.0		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Yellowish brown and reddish brown, dry, moderately hard, fine to medium grained, moderately weathered. @ 2.5 ft. light gray to gray, fine grained, hard. @ 3.0 ft. very hard @ 3.0 ft. N 45 E, 85 SE – Joint @ 3.0 ft. N 35 E, 70 NE – Joint  TOTAL DEPTH 4 FT./REFUSAL NO WATER, NO CAVING

Test	Depth (ft.)	USCS	Description
Pit No.			
EX-6	0.0 – 1.0	SC	<b><u>Topsoil:</u></b> CLAYEY SAND; reddish brown, slightly moist, loose, fine to medium grained.
	1.0 – 2.5		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Quartz Latite; yellowish brown, slightly moist, moderately hard, moderately weathered, fine grained, soft. @1.5 ft. white, dry, very hard, slightly weathered.  TOTAL DEPTH 2.5 FT./REFUSAL NO WATER, NO CAVING





Test			
Pit No.	Depth (ft.)	USCS	Description
EX-7	0.0 – 7.0	SC	<b><u>Artificial Fill - undocumented:</u></b> CLAYEY SAND; yellowish brown and grayish brown, moist, loose, fine to medium grained. @ 6 ft. 4-inch clay pipe.
	7.0 – 8.0		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Light olive, slightly moist, moderately hard, coarse grained/large crystal size.  TOTAL DEPTH 8 FT. / REFUSAL NO WATER, NO CAVING

Test			
Pit No.	Depth (ft.)	USCS	Description
EX-8	0.0 – 18.5		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Brownish red, dry, soft, fine to medium grained, highly weathered, abundant secondary clays. @ 2 ft. yellowish brown, moderately soft, breaks into sand with some silt and clay. @ 6 ft. moderately hard, slow digging. @ 16 ft. light gray, hard, still rippable.  TOTAL DEPTH 18.5 FT./PRACTICAL REFUSAL NO WATER, NO CAVING



Date Excavated 8/28/2015

Test Pit No.	Depth (ft.)	USCS	Description
EX-9	0.0 – 2.0	SM	<b><u>Artificial Fill - undocumented:</u></b> SILTY SAND; brown, moist, loose, fine to coarse grained.
	2.0 – 20.0		<b><u>Granodiorite/Gabbro undifferentiated (Kcgb):</u></b> Red, dry, soft, fine to medium grained, highly weathered to clayey sand, abundant secondary clays. @ 4 ft. brownish gray, moderately soft, breaks into clayey sand. @ 6 ft. breaks into fine to coarse grained sand, some silt and clay. @ 7 ft. Some ½ inch thick pegmatite dikes. @ 11 ft. gray, large crystal size/coarse grained. @ 15 ft. moderately hard. @ 16 ft. light gray, breaks into fine to coarse grained sand, (SE 30+) @ 20 ft. still rippable.  TOTAL DEPTH 20 FT. NO WATER, NO CAVING



Test Pit No.	Depth (ft.)	USCS	Description
EX-10	0.0 – 2.0	SM	<b><u>Artificial Fill - undocumented:</u></b> SILTY SAND; reddish brown and brown, slightly moist, loose, fine to coarse grained.
	2.0 – 20.5		<b><u>Granodiorite/Gabbro undifferentiated (Kcgb):</u></b> Yellowish brown and gray, dry, moderately hard, coarse grained, moderately weathered, breaks into fine to coarse grained sand with some silt and clay. Steeply dipping clay-lined joints, approximately 8-inch spacing. @ 7 ft. N32E, 82SE - Joint @ 7 ft. N33W, 85N - Joint @ 10 ft. moderately hard. @ 16 ft. gray with trace of iron oxide, moderately hard to hard. @ 19 ft. bluish gray, hard, very slow digging. @ 20.5 ft. still rippable.  TOTAL DEPTH 20.5 FT. NO WATER, NO CAVING



Test			
Pit No.	Depth (ft.)	USCS	Description
EX-11	0.0 – 1.0	SM	<b><u>Topsoil:</u></b> SILTY SAND; reddish brown, dry, loose, fine to coarse grained, some angular granitic gravel.
	1.0 – 20.0		<b><u>Granodiorite/Gabbro undifferentiated (Kcgb):</u></b> Red, dry, soft, fine to medium grained, highly weathered, densely fractured, abundant secondary clays. @ 2.5 ft. gray to dark gray (Gabbro), hard, some flat-lying to shallowly dipping fine fractures with iron oxide. @ 5 ft. N20W, 55NE – parallel joints. @ 18 ft. very slow digging. @ 20 ft. still rippable.  TOTAL DEPTH 20 FT. NO WATER, NO CAVING



Test			
Pit No.	Depth (ft.)	USCS	Description
EX-14	0.0 – 16.5		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Brownish red, slightly moist, moderately soft, fine to coarse grained, highly to moderately weathered. @4 ft. light yellowish brown, moderately hard, breaks-up to fine to coarse grained sand. @ 5 ft. gray, hard, slow digging. @ 6 ft. N60E, Vertical - Joint @ 6 ft. N40W, 80NE - Joint @ 12 ft. gray, very slow digging. @ 16.5 ft. Practical Refusal.  TOTAL DEPTH 16.5 FT NO WATER, NO CAVING





Test

Pit No.	Depth (ft.)	USCS	Description
EX-15	0.0 – 3.5		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Reddish brown, slightly moist, moderately soft, fine to medium grained, moderately weathered, densely fractured. @ 2.5 ft. gray to light gray (Gabbro), breaks into sand with angular clasts to 8-inch diameter. @ 2.5 ft. N30W, 60NE  TOTAL DEPTH 3.5 FT./REFUSAL NO WATER, NO CAVING



Test			
Pit No.	Depth (ft.)	USCS	Description
EX-16	0.0 – 1.0	SM	<b><u>Artificial Fill - undocumented:</u></b> SILTY SAND; reddish brown, slightly moist, loose, fine to coarse grained.
	1.0 – 3.5		<b><u>Granodiorite/Gabbro undifferentiated (Kcgb):</u></b> Yellowish brown and gray, dry, moderately hard, very fine grained, moderately weathered, thinly foliated along mica minerals (Phyllite). @ 3 ft. gray, hard  TOTAL DEPTH 3.5 FT./REFUSAL NO WATER, NO CAVING



Test Pit No.	Depth (ft.)	USCS	Description
EX-17	0.0 – 0.5	SC	<b><u>Topsoil:</u></b> CLAYEY SAND; reddish brown, dry, loose, fine grained.
	0.5 – 19.0		<b><u>Granodiorite/Gabbro undifferentiated (Kcgb):</u></b> Reddish brown, dry, soft, fine to medium grained, highly weathered, abundant secondary clays. @ 2.5 ft. yellowish brown, slightly moist, fine to coarse grained. @ 16 ft. olive with iron oxide staining, slow digging. @ 18 ft. very hard.  TOTAL DEPTH 19 FT./PRACTICAL REFUSAL NO WATER, NO CAVING



Test	Depth (ft.)	USCS	Description
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EX-18	0.0 – 1.5	SC	<b><u>Older Alluvium (Qoa):</u></b> CLAYEY SAND, yellowish brown, dry, medium dense, fine to medium grained, highly weathered, some clay, some visible porosity. Sharp contact with underlying Kcgb.
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1.5 – 17.5

**Granodiorite/Gabbro - undifferentiated (Kcgb):**  
Gray with iron oxide along fine fractures, dry, moderately soft, fine grained, moderately weathered.  
@ 7.0 ft. moderately hard, moderately weathered.  
@ 11 ft. hard, some clay lined steeply dipping joints.  
@ 11 ft. N5E, 70SW – Joint

TOTAL DEPTH 17.5 FT./ PRACTICAL REFUSAL  
NO WATER, NO CAVING



Test			
Pit No.	Depth (ft.)	USCS	Description
EX-19	0.0 – 2.0	SC	<b><u>Artificial Fill-undocumented:</u></b> CLAYEY SAND, grayish brown and gray, dry, loose, fine to medium grained.
	2.0 – 16.0		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Red, dry, soft, coarse grained, large Biotite crystals, highly weathered. @ 4.0 ft. light gray and yellowish brown, moderately hard, moderately weathered. @ 12.0 ft. hard, slow digging. @ 15.0 ft. Blueish gray, very hard, very slow digging.  TOTAL DEPTH 16.0 FT./PRACTICAL REFUSAL NO WATER, NO CAVING



Project Victoria Heights  
Date Excavated 8/27/2015  
Logged by FE  
Equipment JD 460

**LOG OF TEST PITS**

Test Pit No.	Depth (ft.)	USCS	Description
TP-19	0.0 – 2.0	SC	<b><u>Older Alluvium (Qoa):</u></b> CLAYEY SAND, yellowish brown and gray, dry, loose, fine to medium grained, highly weathered, some clay, some visible porosity. @ 5.0 ft. grayish brown, slightly moist, medium dense, abundant white carbonates.
	2.0 – 3.5		<b><u>Granodiorite and Gabbro - undifferentiated (Kcgb):</u></b> Granodiorite, light gray, dry, moderately hard, medium grained, moderately weathered. @ 3.0 ft. hard, slightly weathered @ 3.5 ft. Refusal  TOTAL DEPTH 3.5 FT. NO WATER, NO CAVING

Date Excavated 8/28/2015

**LOG OF TEST PITS**

Test Pit No.	Depth (ft.)	USCS	Description
TP-20	0.0 – 8.5	SC	<b><u>Older Alluvium (Qoa):</u></b> Clayey SAND; light yellowish brown, dry, loose, fine grained, weathered, visible porosity. @ 2.5 ft. reddish brown and light yellowish brown, slightly moist, medium dense, some trans-located clays, clay cemented, some visible porosity. @ 4 ft. dense, no visible porosity.
	8.5 – 9.0		<b><u>Granodiorite and Gabbro - undifferentiated (Kcgb):</u></b> Grayish brown, moderately weathered moderately hard, feldspar minerals are weathered to clay, dry, moderately hard, moderately weathered, clay cemented. @ 9.0 ft. Practical Refusal on Cemented Granitic Paleosol.  TOTAL DEPTH 9.0 FT. NO WATER, NO CAVING
TP-21	0.0 – 2.5	SC	<b><u>Artificial Fill - undocumented (afu):</u></b> CLAYEY SAND; light yellowish brown, dry, loose, fine to medium grained, layered, some roots to 1/2-inch diameter.
	2.5 – 9.0	SC	<b><u>Older Alluvium – (Qoa):</u></b> CLAYEY SAND; reddish brown dry, dense, clay cemented, some pin-hole porosity, slow digging. @ 6.0 ft. slightly moist, very dense, no visible porosity. @ 7.0 ft. abundant Iron oxide along fine fractures. @ 8.5 ft. grayish brown and reddish yellow.  TOTAL DEPTH 9.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-22	0.0 – 1.5	SC	<b><u>Topsoil:</u></b> CLAYEY SAND; light yellowish brown, dry, loose, fine grained.
	1.5 – 14	SM	<b><u>Older Alluvium – (Qoa):</u></b> SILTY SAND; brownish gray and yellowish brown, moist, dense, fine to medium grained, some clay, some white carbonates, roots to 9 ft. @ 14 ft. some sub-rounded granitic clasts to 2 1/2-inch diameter with dark red iron oxide and black manganese oxide coatings (Old Pleistocene surface?).
	14 – 15		<b><u>Granodiorite and Gabbro - undifferentiated (Kcgb):</u></b> Reddish brown. dry, moderately hard, fine grained, moderately weathered, @ 7.0 ft. reddish brown, slightly moist, moderately hard, moderately weathered.  TOTAL DEPTH 15 FT. NO WATER, NO CAVING
<hr/>			
TP-23	0.0 – 0.5	SC	<b><u>Topsoil:</u></b> CLAYEY SAND; light gray and yellowish brown, dry, loose, fine to medium grained.
	0.5 – 2.5	SC	<b><u>Older Alluvium – (Qoa):</u></b> CLAYEY SAND; reddish brown slightly moist to moist, highly weathered, medium dense, visible porosity. @ 2.5 ft. dense.
	2.5 – 3.5		<b><u>Granodiorite and Gabbro - undifferentiated (Kcgb):</u></b> Yellowish brown. dry, soft, fine grained, moderately weathered. @ 3.5 ft. gray, hard, slightly weathered. @ 3.5 ft. Refusal  TOTAL DEPTH 3.5 FT. NO WATER, NO CAVING

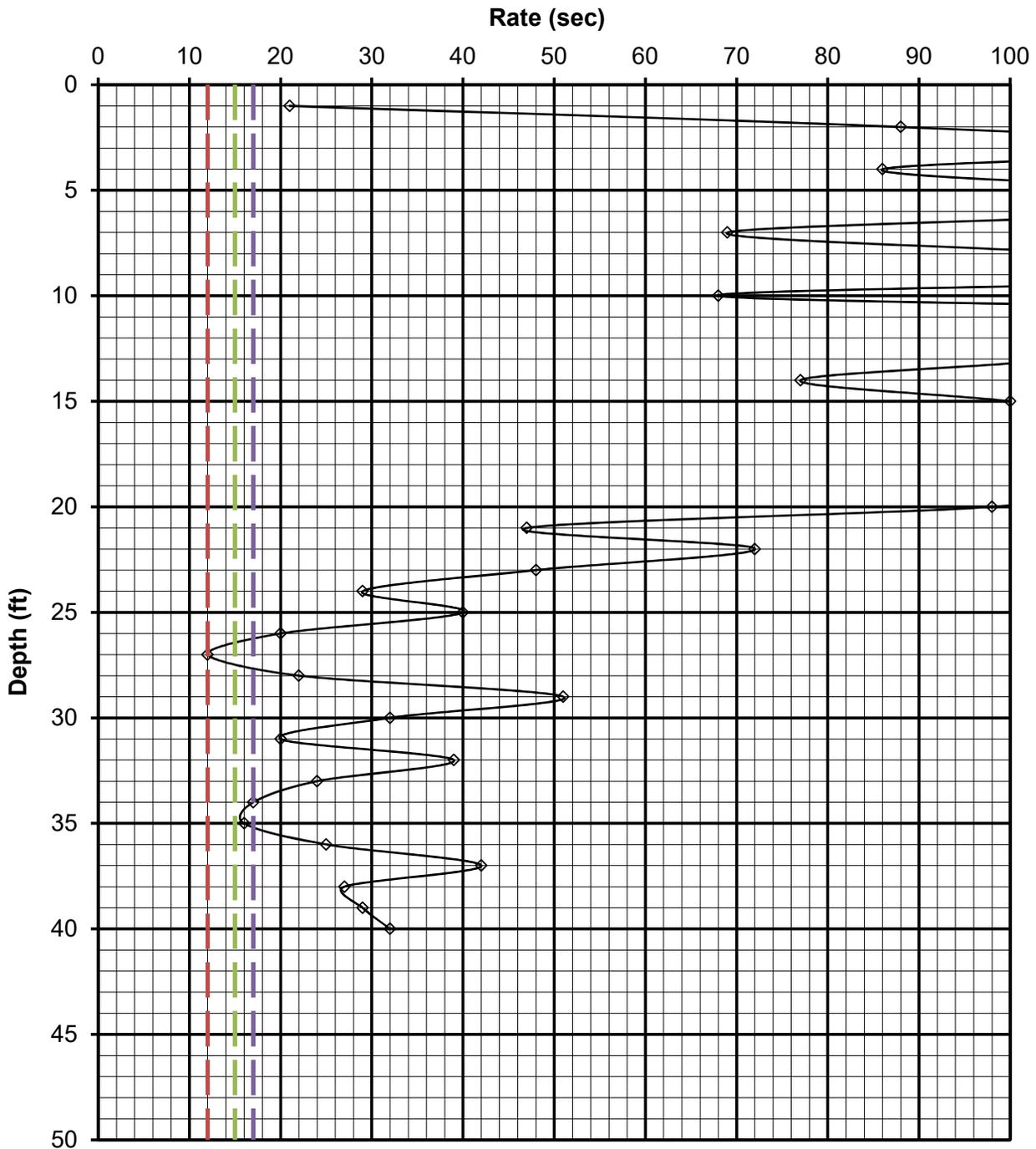
Test Pit No.	Depth (ft.)	USCS	Description
TP-24	0.0 – 1.0	SP	<b><u>Alluvium (Qal):</u></b> SAND; gray and yellowish brown, dry, loose, fine to medium grained, some silt.
	1.0 – 6.0	SC	<b><u>Older Alluvium – (Qoa):</u></b> CLAYEY SAND; reddish brown and yellowish brown, dry, medium dense, fine to medium grained, some visible porosity. @ 3.0 ft. slightly moist, dense, no visible porosity.
	6.0 – 6.5		<b><u>Granodiorite and Gabbro - undifferentiated (Kcgb):</u></b> Gray, slightly moist, moderately hard, fine grained, moderately weathered.  TOTAL DEPTH 6.5 FT. NO WATER, NO CAVING
<hr/>			
TP-25	0.0 – 1.0	SM	<b><u>Topsoil:</u></b> SILTY SAND; yellowish brown, dry, loose, fine to medium grained.
	1.0 – 3.0		<b><u>Granodiorite and Gabbro - undifferentiated (Kcgb):</u></b> Yellowish brown, dry, soft, fine to coarse grained, highly weathered. @ 2.5 ft. gray, moderately hard, moderately weathered.  TOTAL DEPTH 3.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-26	0.0 – 1.0	SM	<b><u>Artificial Fill - undocumented:</u></b> SILTY SAND; gray and light yellowish brown, dry, medium dense, fine to medium grained, some visible porosity.
	1.0 – 2.5		<b><u>Older Alluvium – (Qoa):</u></b> SILTY SAND; yellowish brown slightly moist, medium dense, highly weathered, medium dense, visible porosity.
	2.5 – 3.0		<b><u>Granodiorite and Gabbro - undifferentiated (Kcgb):</u></b> Gray, dry, moderately hard, fine to medium grained, moderately hard, moderately weathered. @ 2.5 ft. moderately weathered, hard, slow digging. @ 3.0 ft. Practical Refusal  TOTAL DEPTH 3.0 FT. NO WATER, NO CAVING
<hr/>			
TP-27	0.0 – 1.5	SC	<b><u>Artificial Fill - undocumented:</u></b> CLAYEY SAND; yellowish brown, dry, loose, fine grained, some granitic angular clasts to 4-inch diameter.
	1.5 – 3.0		<b><u>Granodiorite and Gabbro - undifferentiated (Kcgb):</u></b> Reddish brown, dry, soft, fine grained, highly weathered. @ 2.0 ft. grayish brown and reddish brown, moderately weathered, moderately hard.  TOTAL DEPTH 3.0 FT. NO WATER, NO CAVING
<hr/>			
TP-28	0.0 – 2.5		<b><u>Granodiorite and Gabbro - undifferentiated (Kcgb):</u></b> Red, slightly moist, soft, fine grained, highly weathered. @ 2.5 ft. reddish brown and grayish brown, hard, moderately weathered.  TOTAL DEPTH 2.5 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-29	0.0 – 1.5	SC	<b><u>Artificial Fill - undocumented:</u></b> CLAYEY SAND; light yellowish brown, dry, loose, fine grained.
	1.5 – 2.0		<b><u>Granodiorite and Gabbro - undifferentiated (Kcgb):</u></b> Quartz Diorite, pale yellow, dry, hard, fine grained, slightly weathered, appears to have a higher silica/quartz content than the typical Granodiorite at the site. @ 2.0 ft. Refusal on hard rock, outcrops in the vicinity.  TOTAL DEPTH 2.0 FT. NO WATER, NO CAVING
TP-30	0.0 – 1.0	SM	<b><u>Artificial Fill - undocumented:</u></b> SILTY SAND; gray and light yellowish brown, dry, medium dense, fine to medium grained, some visible porosity.
	1.0 – 4.0	SC	<b><u>Older Alluvium – (Qoa):</u></b> CLAYEY SAND; yellowish brown dry, medium dense, visible porosity.
	4.0 – 5.0		<b><u>Granodiorite and Gabbro - undifferentiated (Kcgb):</u></b> Reddish brown, dry, soft, fine to medium grained, moderately hard, moderately weathered. @ 5 ft. moderately hard  TOTAL DEPTH 5.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-31	0.0 – 1.0	SM	<b><u>Artificial Fill - undocumented:</u></b> SILTY SAND; gray and light yellowish brown, dry, medium dense, fine to medium grained, some visible porosity.
	1.0 – 4.0	SC	<b><u>Older Alluvium – (Qoa):</u></b> CLAYEY SAND; yellowish brown dry, medium dense, visible porosity.
	4.0 – 5.0		<b><u>Granodiorite and Gabbro - undifferentiated (Kcgb):</u></b> Reddish brown, dry, soft, fine to medium grained, moderately hard, moderately weathered. @ 5 ft. moderately hard  TOTAL DEPTH 5.0 FT. NO WATER, NO CAVING
<hr/>			
TP-32	0.0 – 1.0	SM	<b><u>Artificial Fill - undocumented:</u></b> SILTY SAND; gray and light yellowish brown, dry, medium dense, fine to medium grained.
	1.0 – 7.0	SM	<b><u>Older Alluvium – (Qoa):</u></b> SILTY SAND; light yellowish brown dry, loose, highly weathered, medium dense, visible porosity. @ 2.5 ft. yellowish brown, slightly moist, medium dense, fine grained, no visible porosity.
	7.0 – 8.0		<b><u>Very Old Alluvium (Qvoa):</u></b> Dark yellowish brown, dry, very dense, fine grained, some carbonate stringers, cemented, very slow digging. @ 8.0 ft. Practical Refusal  TOTAL DEPTH 8.0 FT. NO WATER, NO CAVING

# AP-1

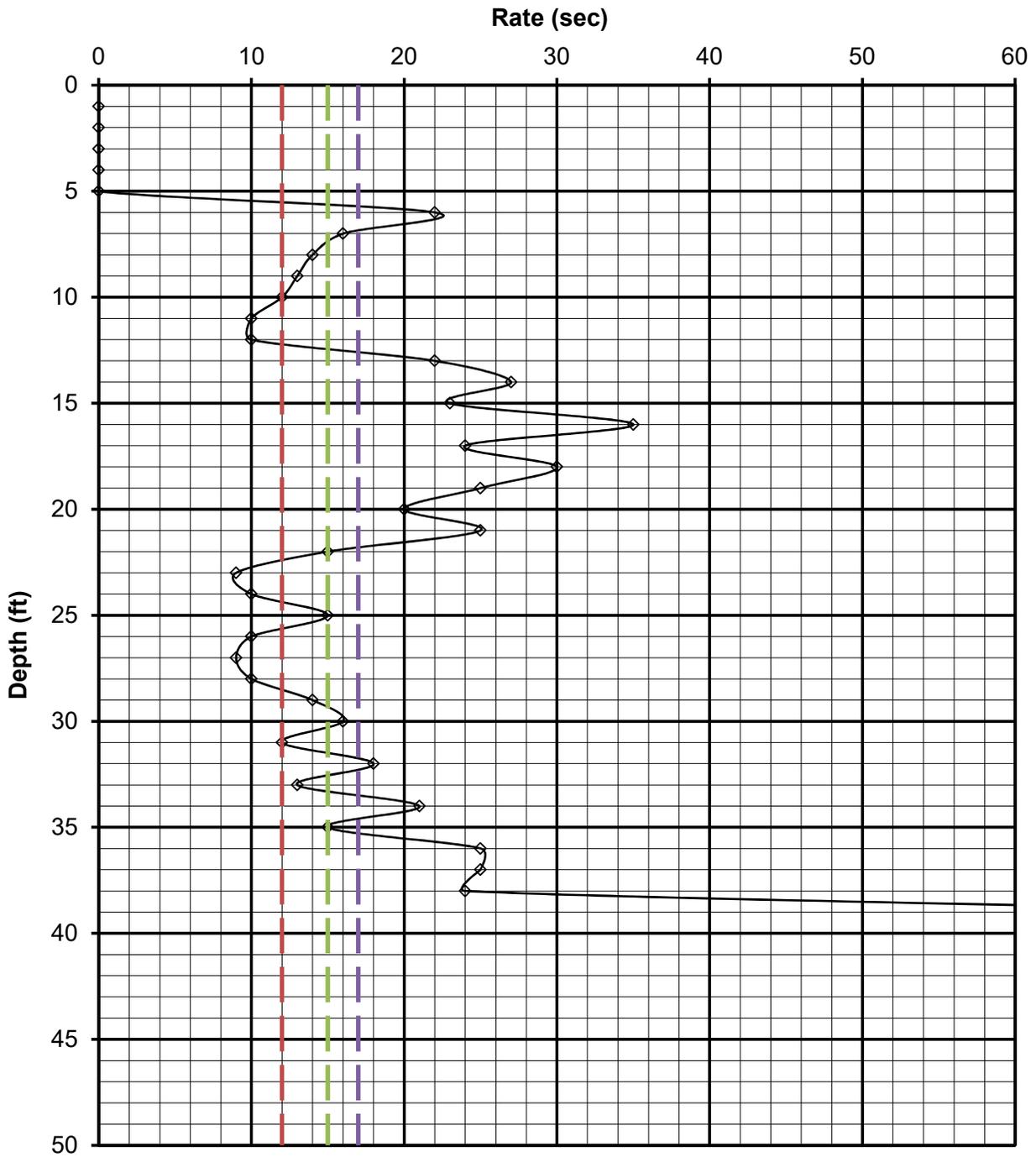


Equipment  
Ingersoll-Rand ECM-370  
Excavated April 18, 2018  
PW 1507-05

<12 Rippable  
12-15 Marginally Rippable  
15-17 Heavy Ripping  
>17 Drill & Shoot



# AP-2

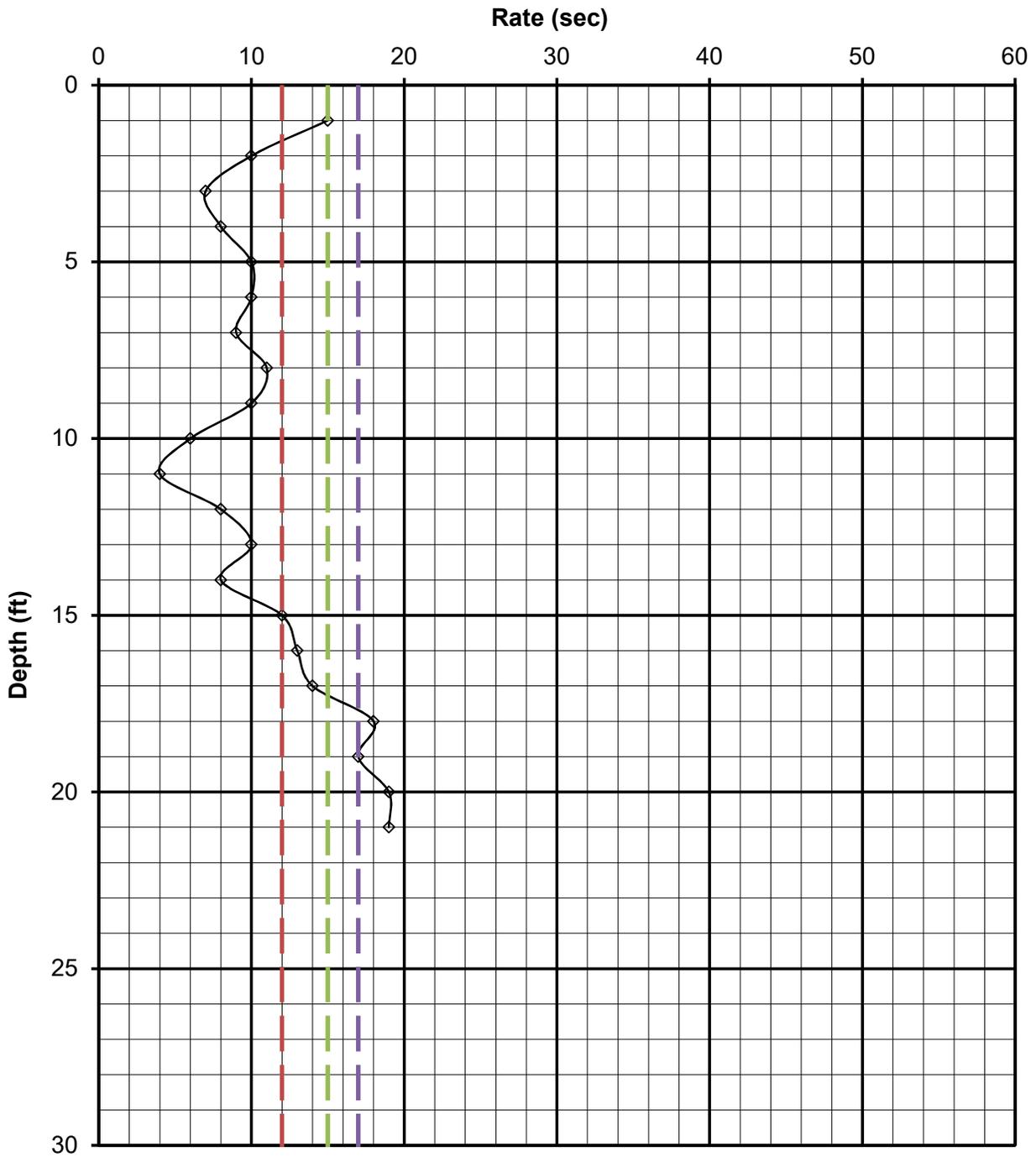


Equipment  
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Excavated April 18, 2018  
PW 1507-05

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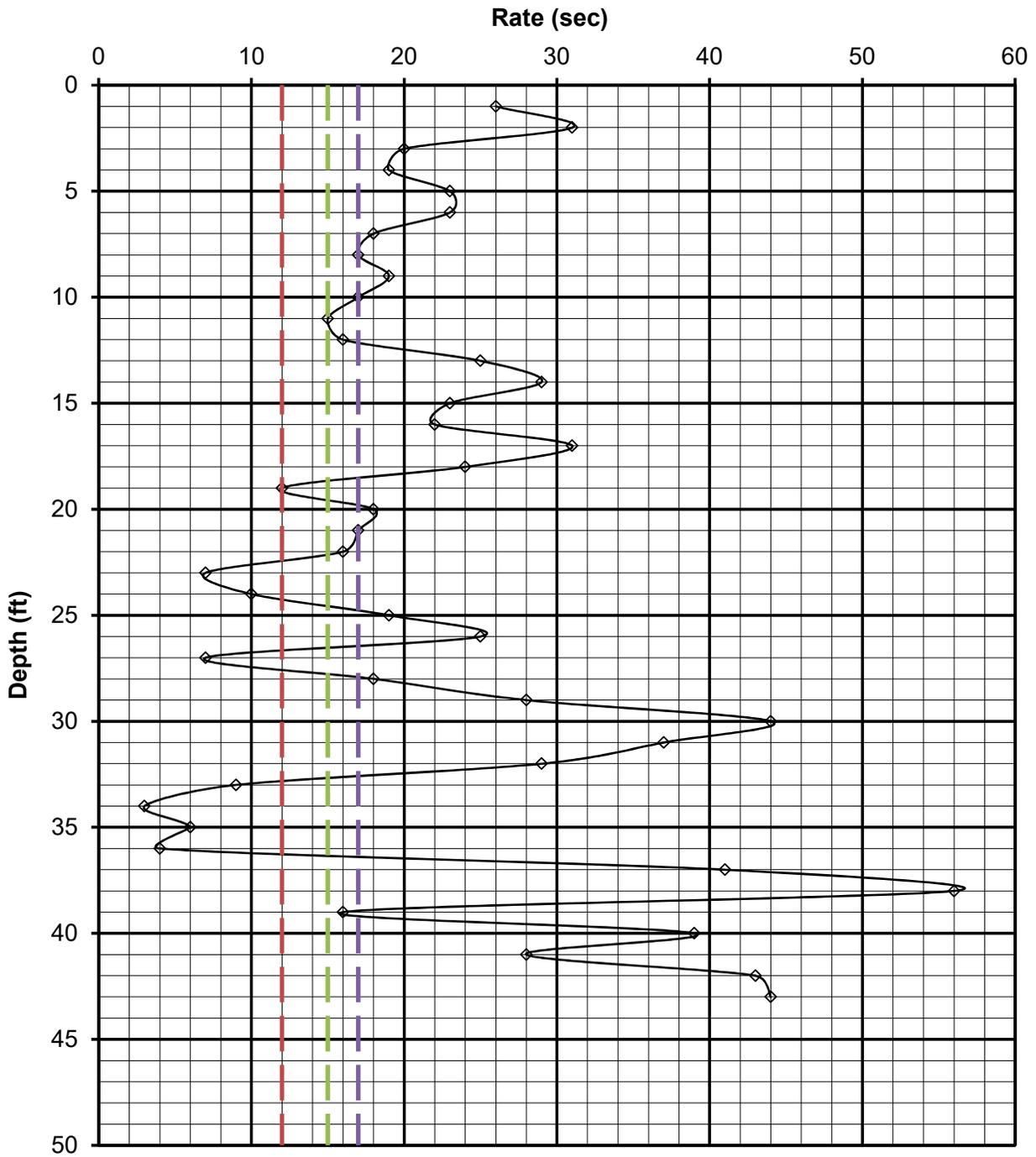


Equipment  
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Excavated April 18, 2018  
PW 1507-05

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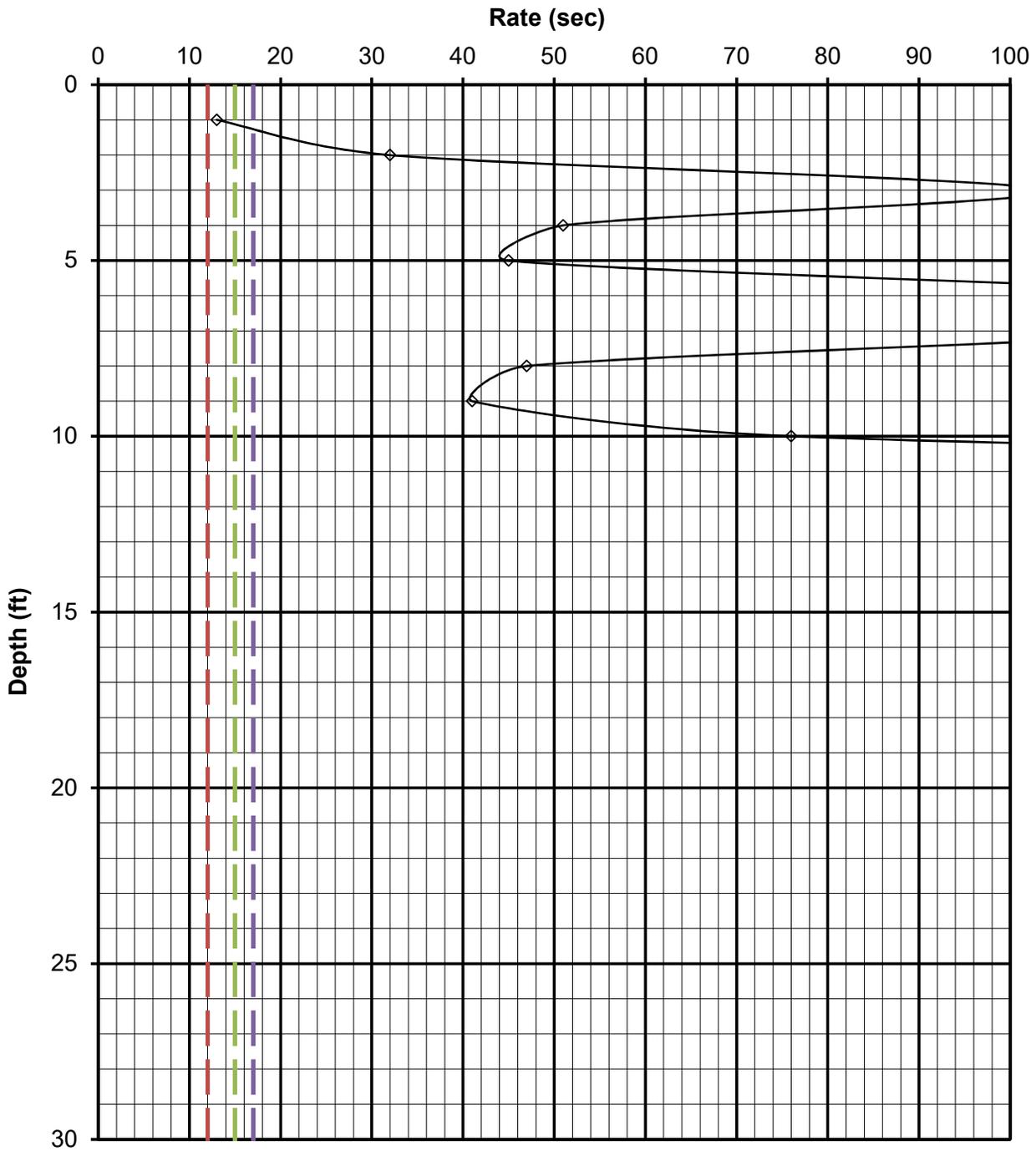


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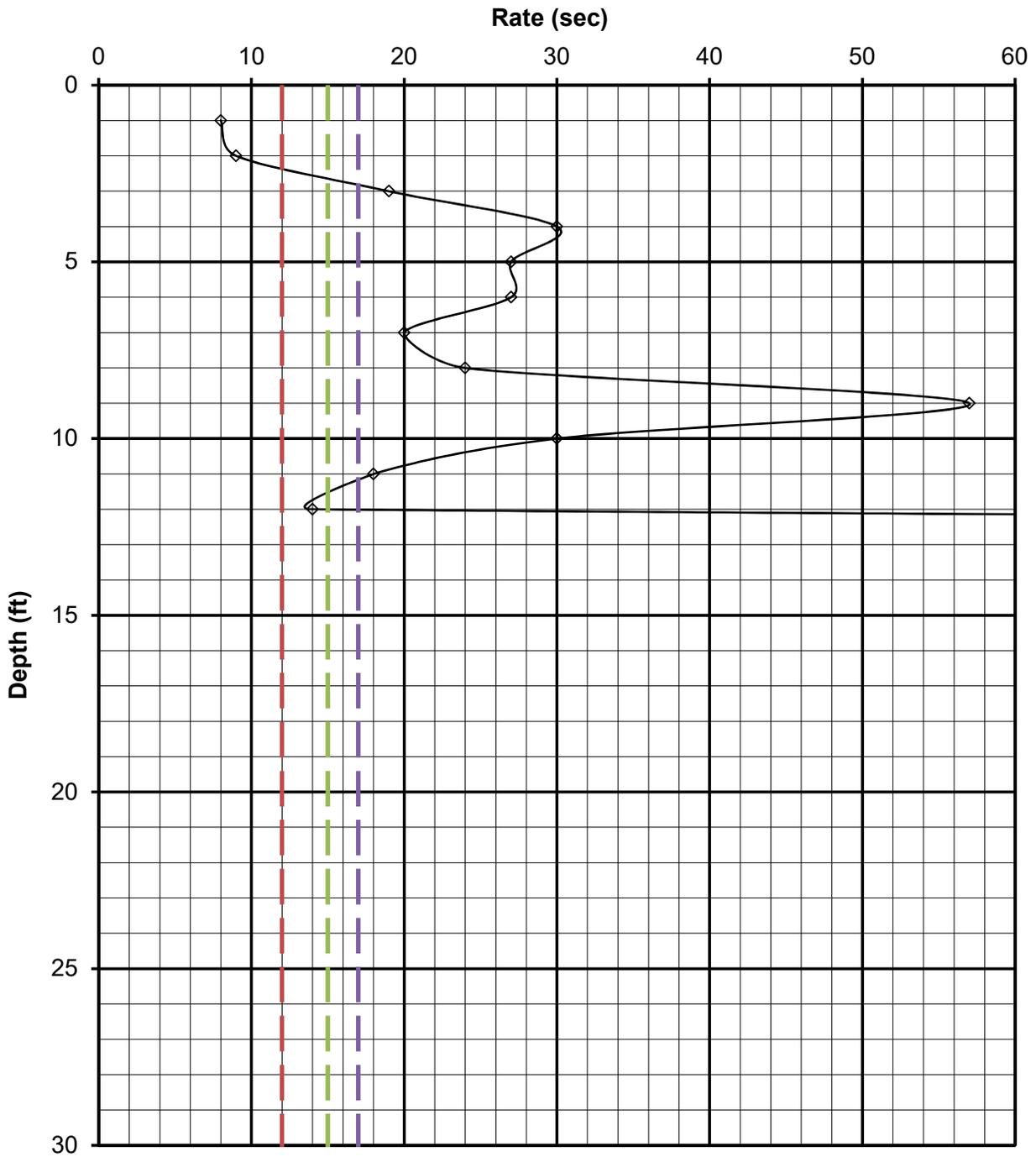


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PW 1507-05

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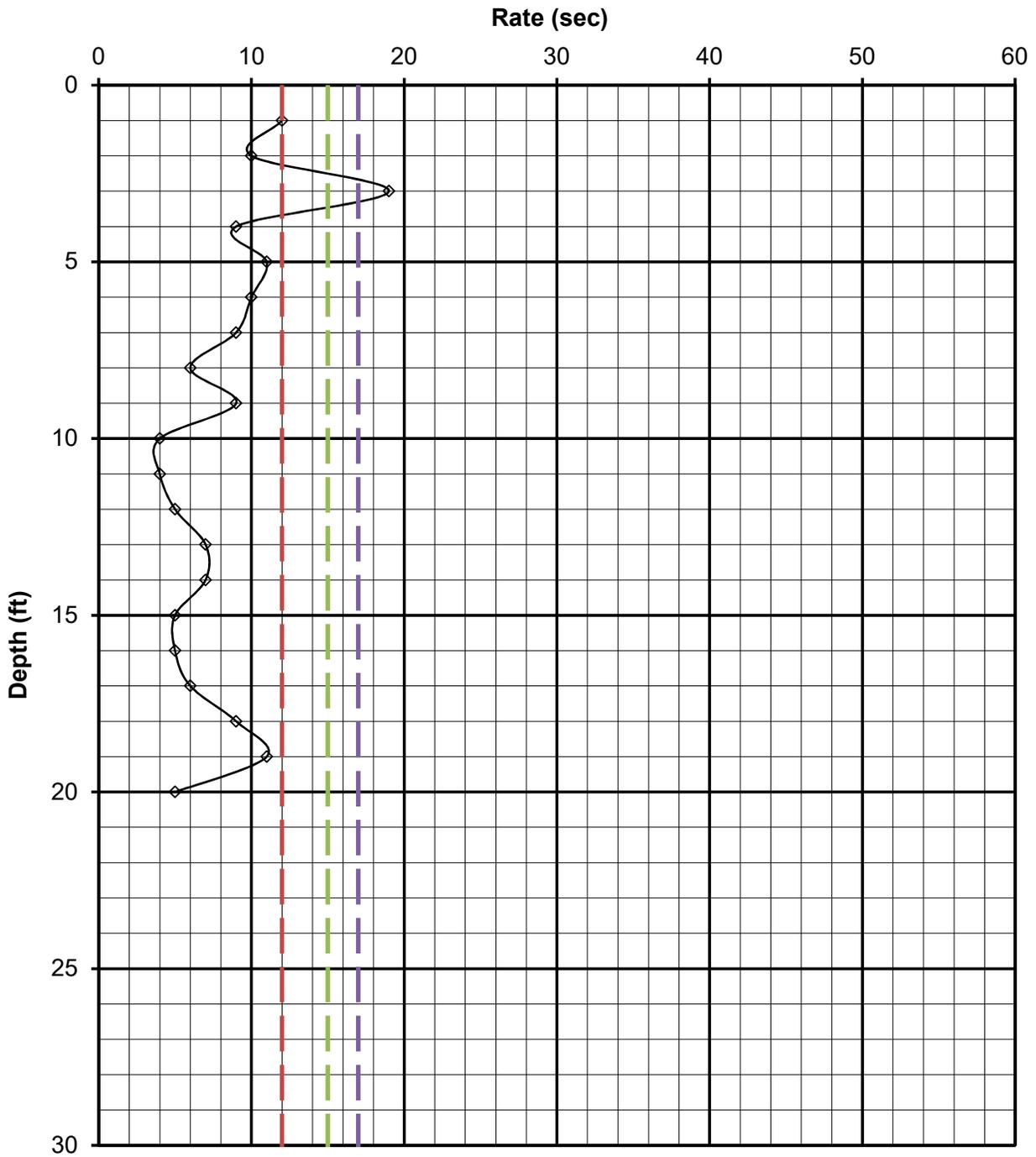


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PW 1507-05

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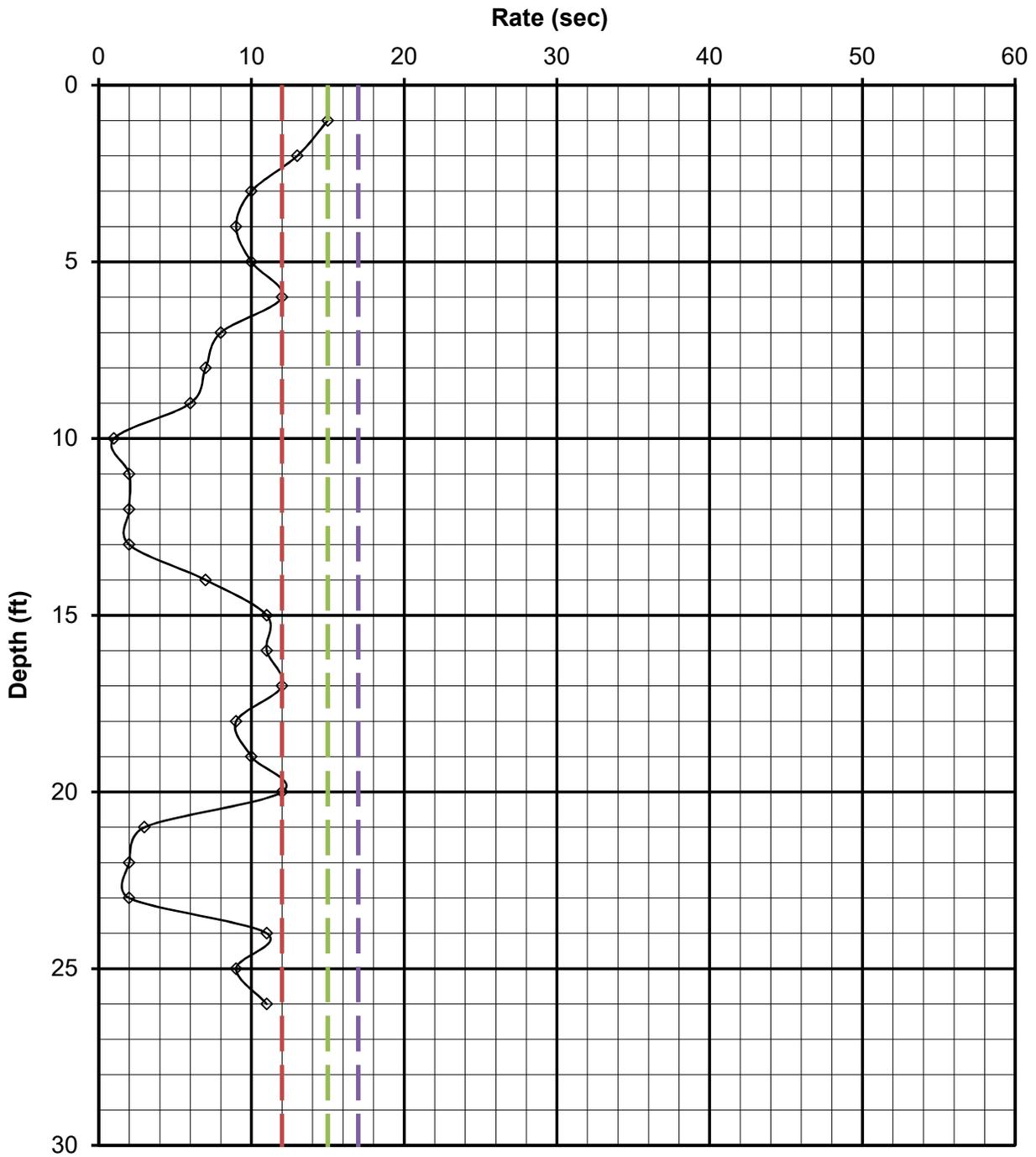


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PW 1507-05

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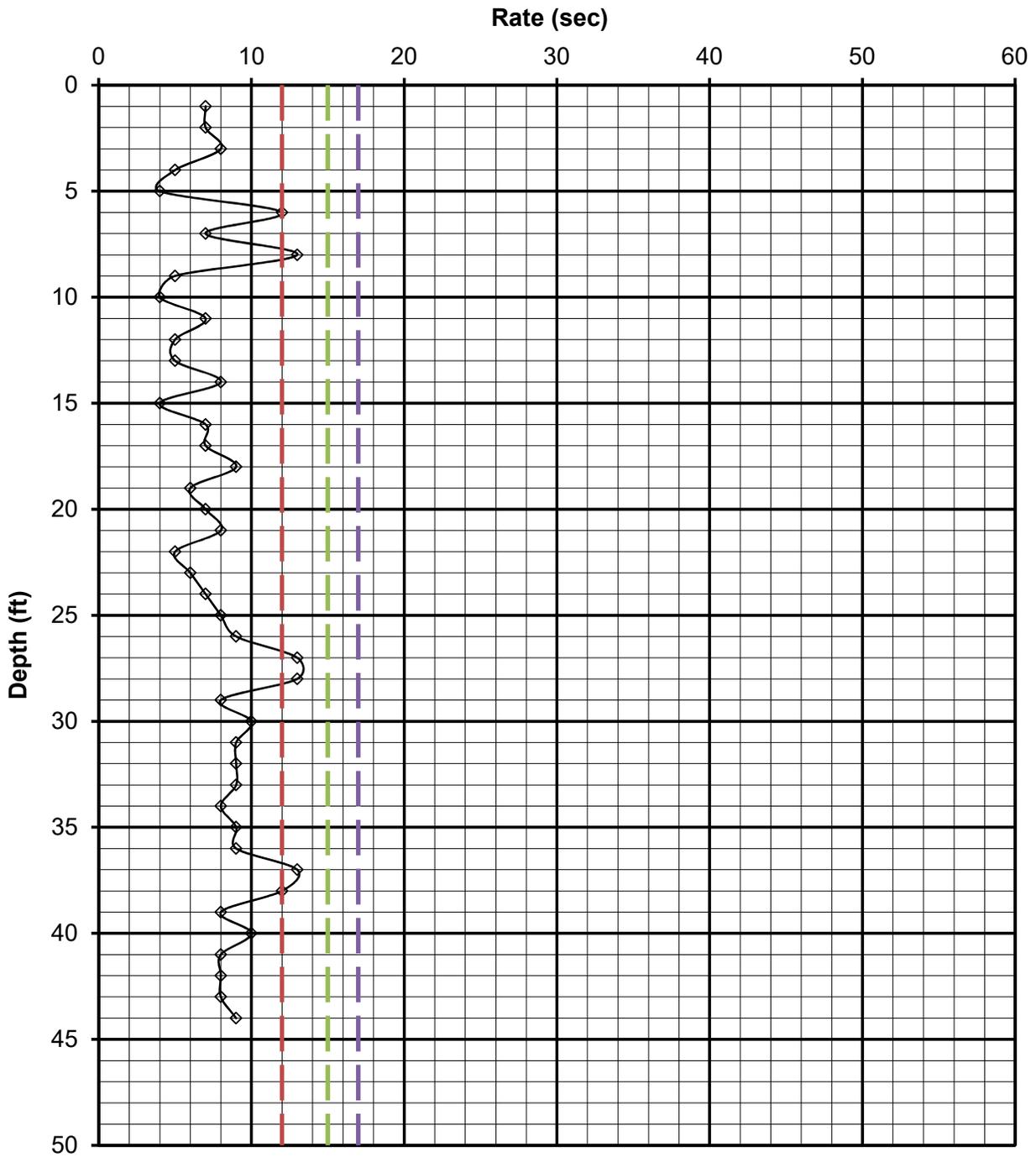


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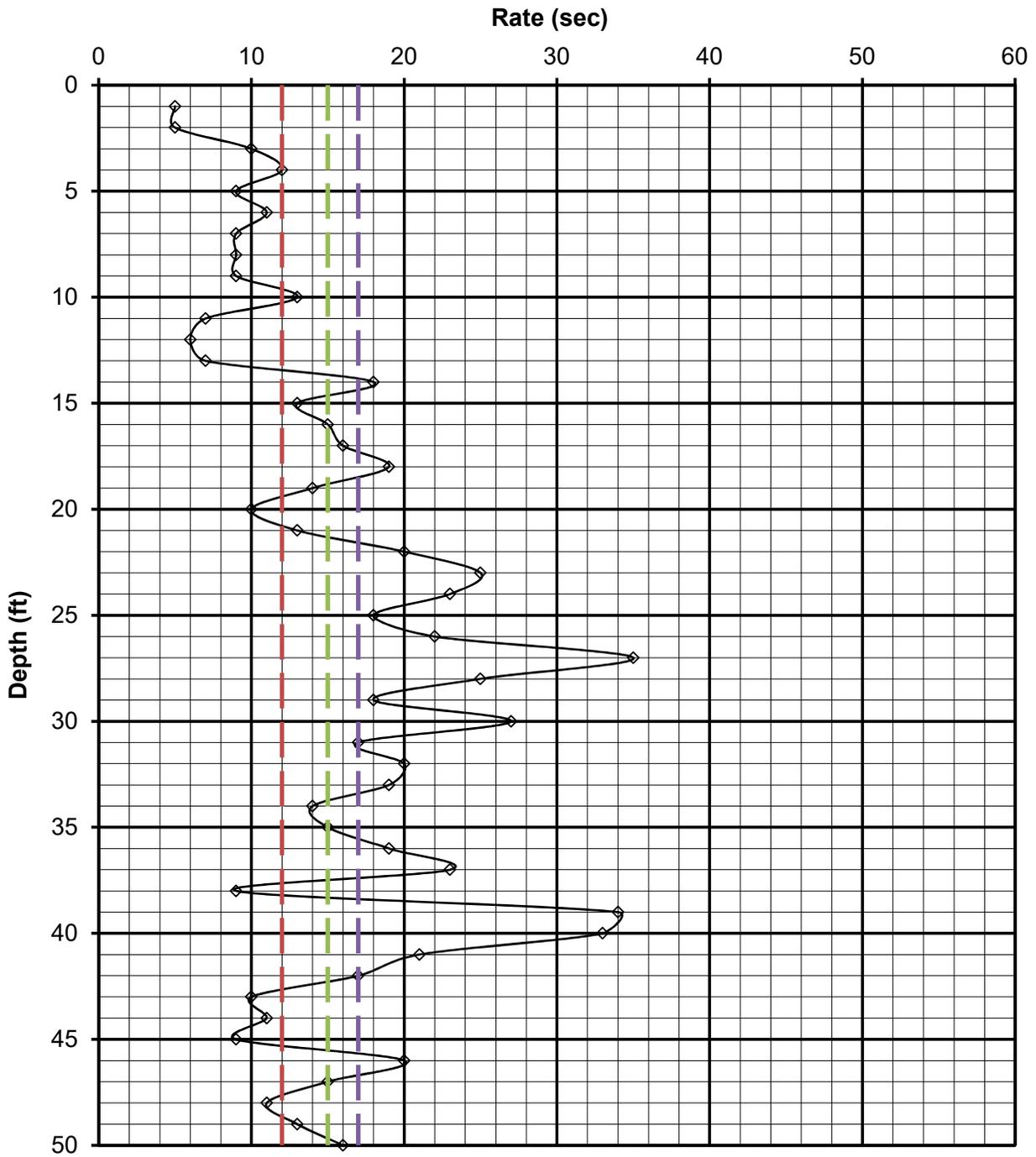


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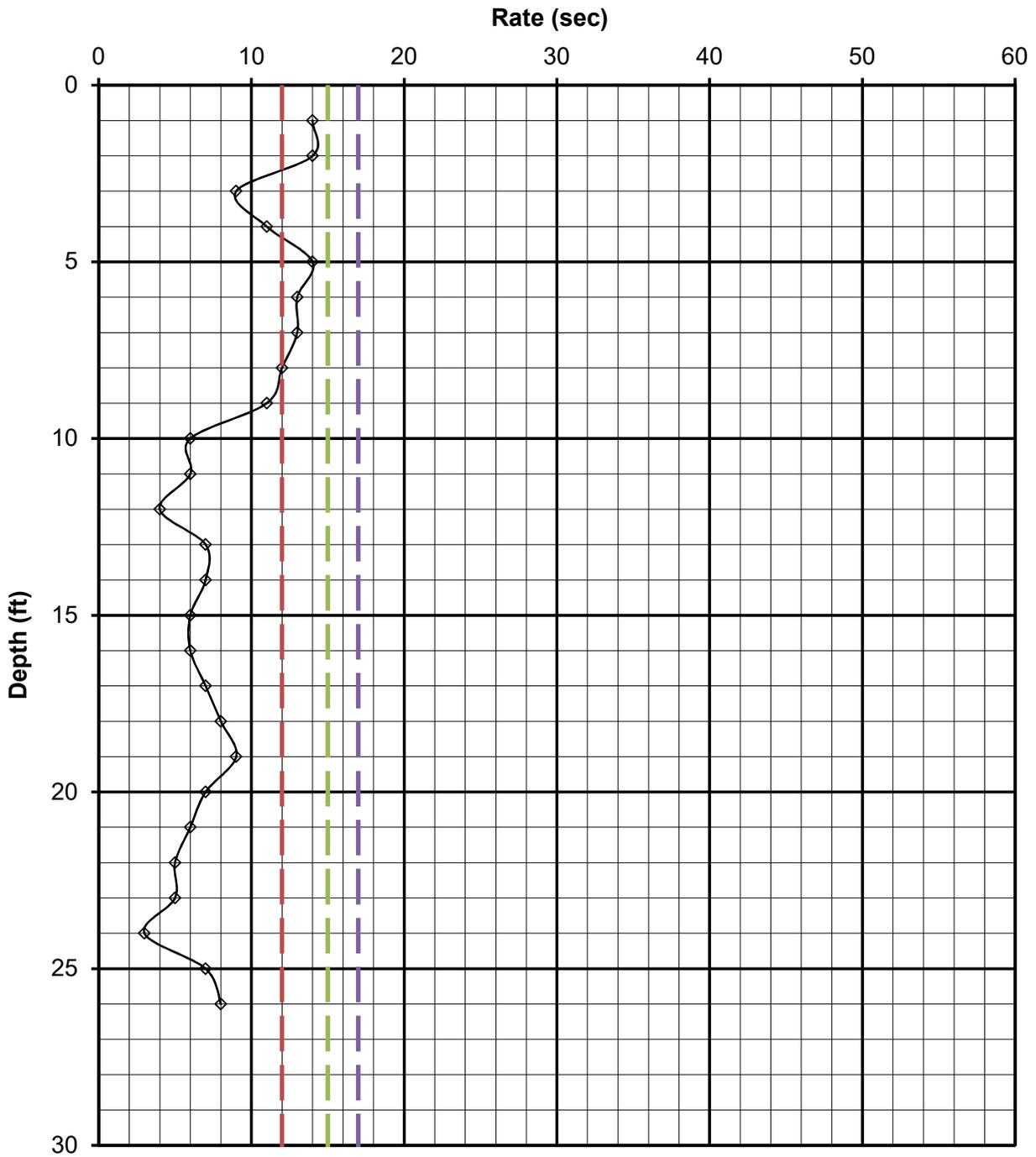


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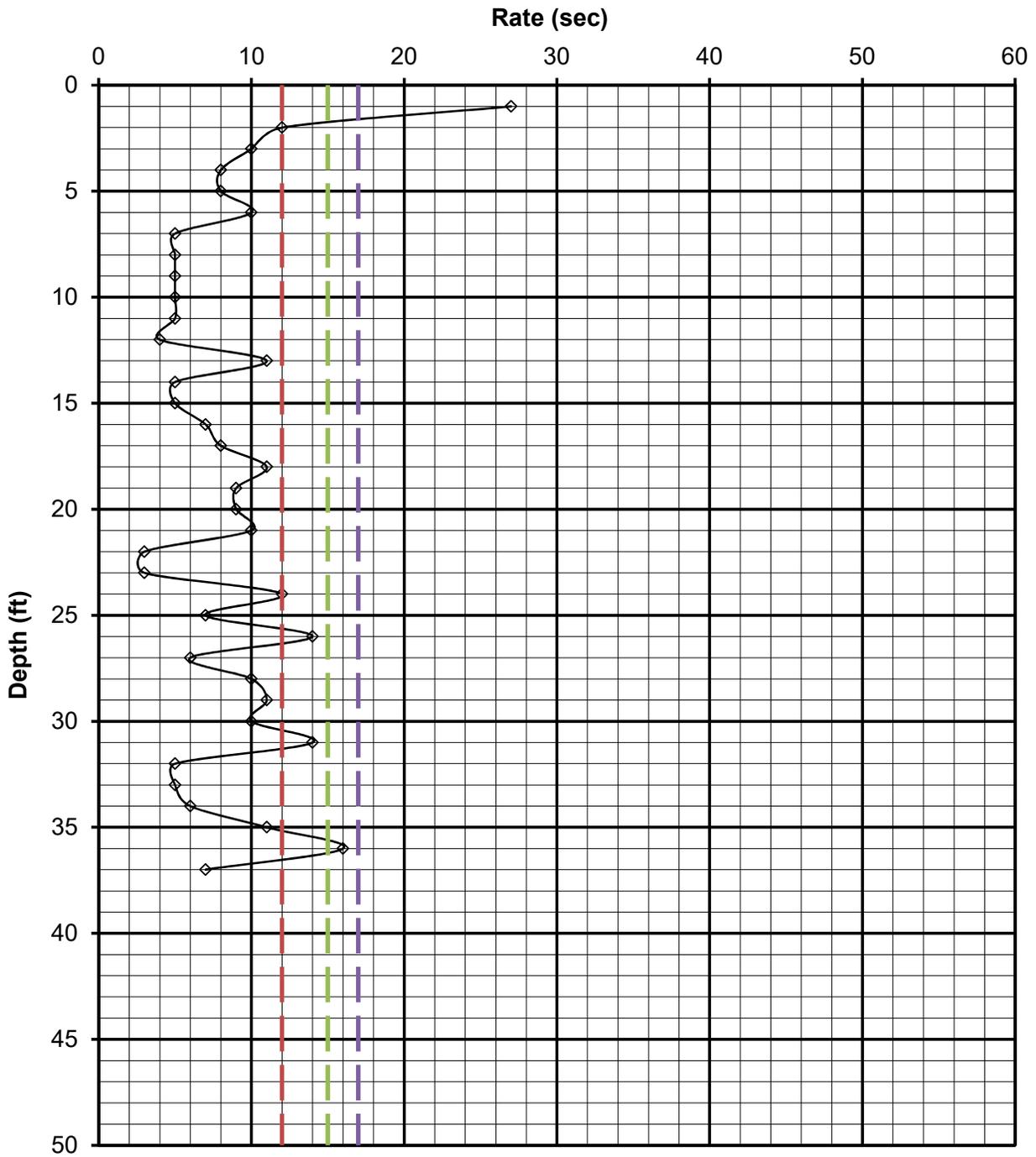


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PW 1507-05

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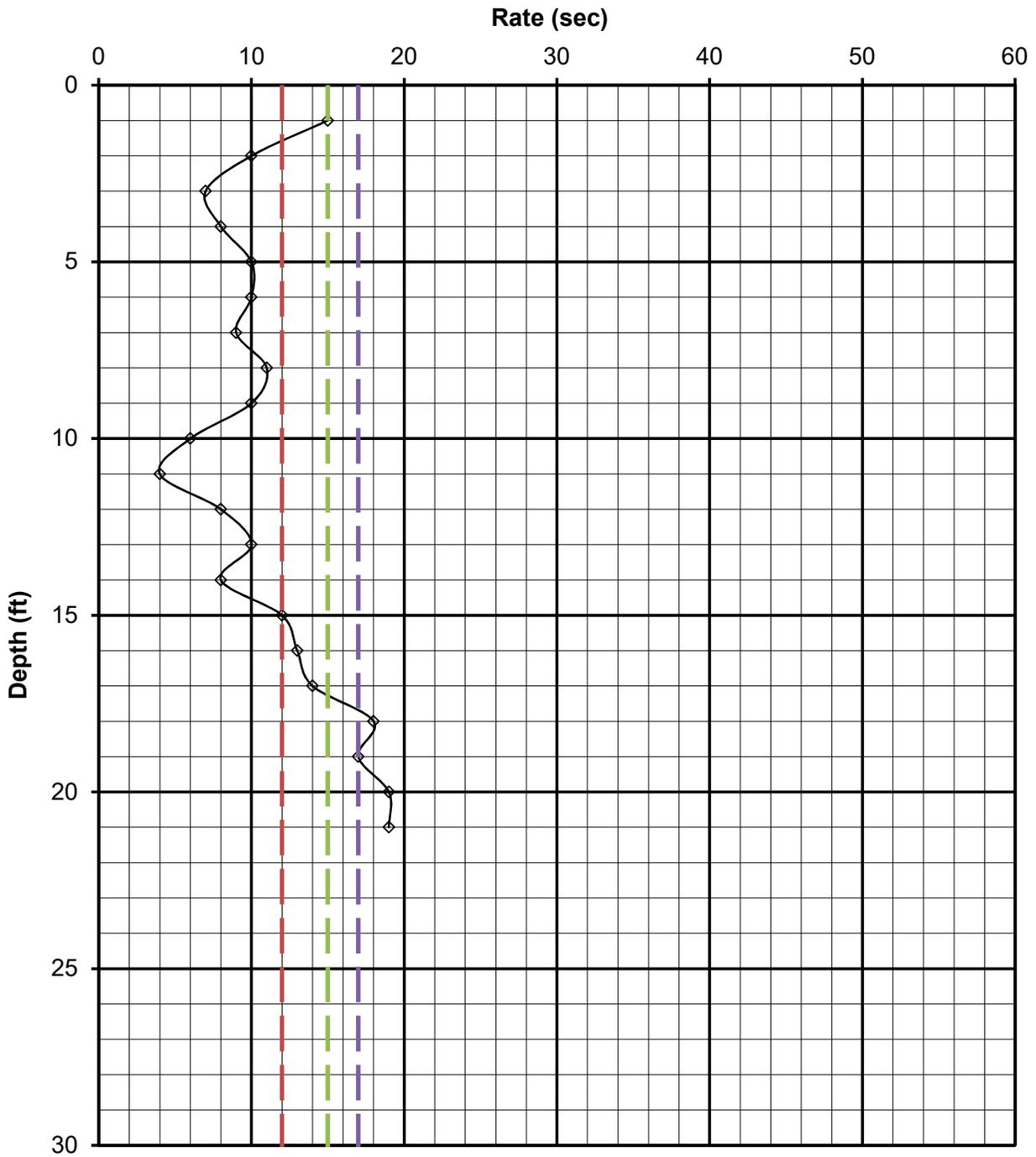


Equipment  
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Excavated April 18, 2018  
PW 1507-05

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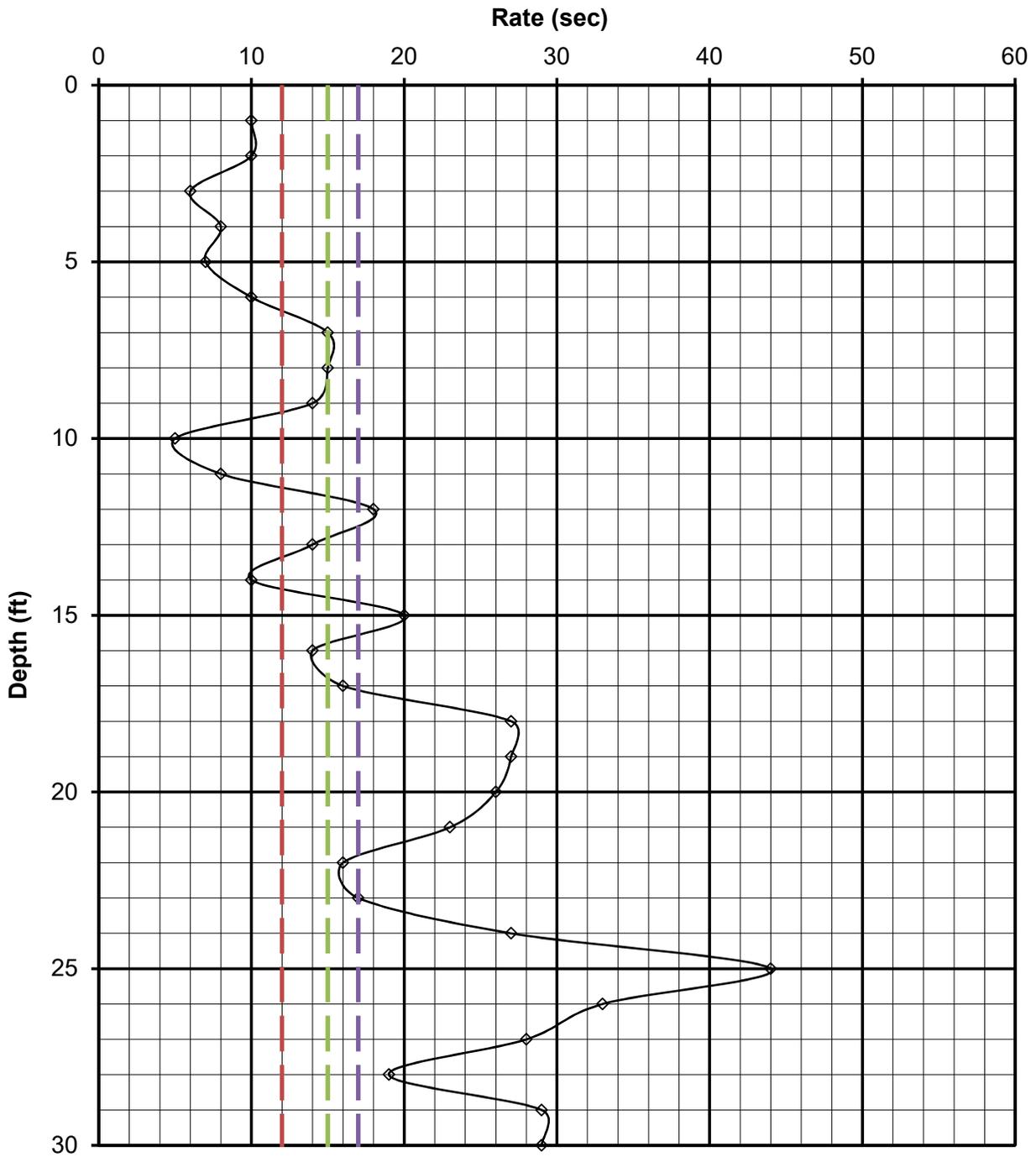


Equipment  
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Excavated April 18, 2018  
PW 1507-05

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# AP-14

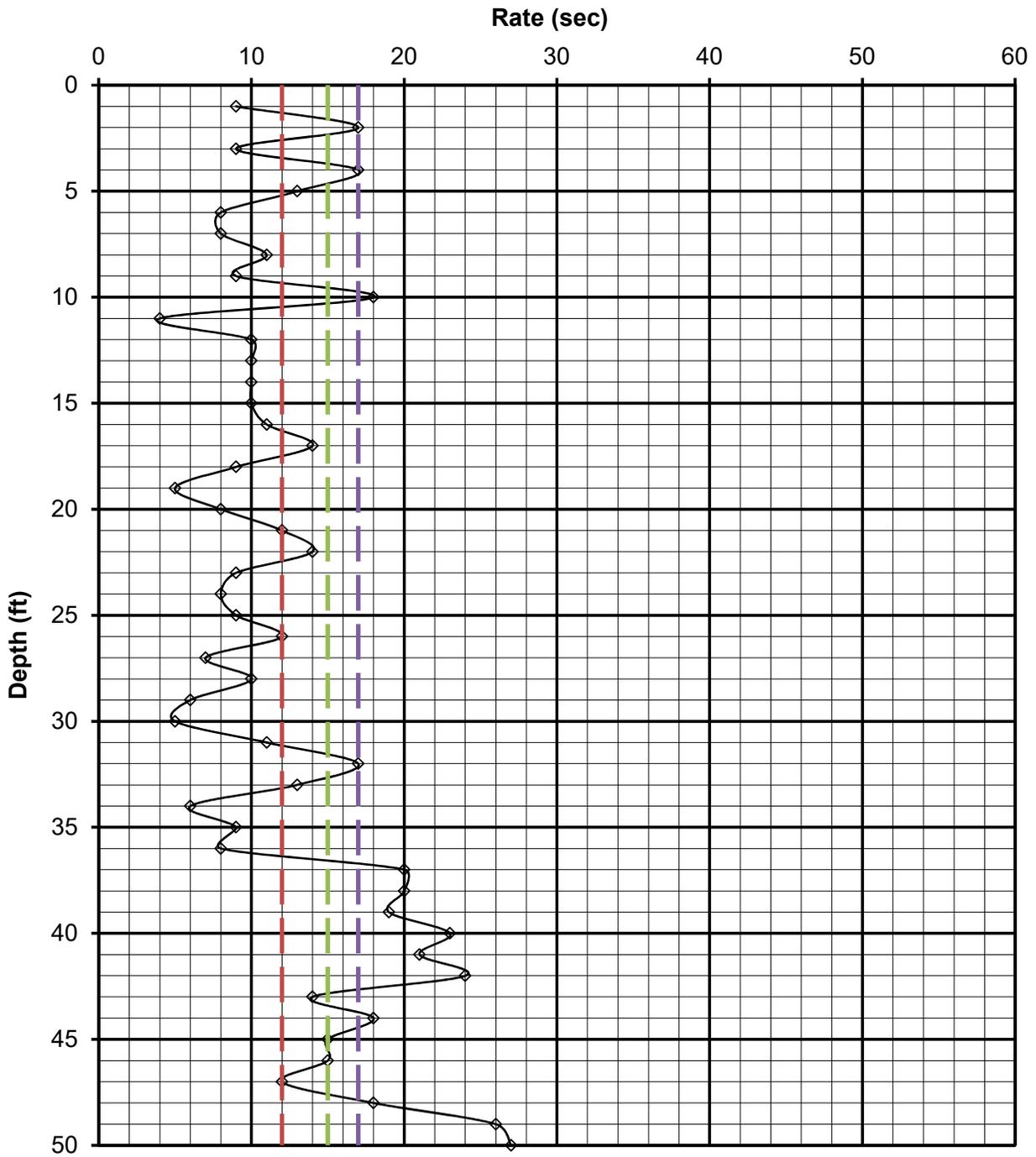


Equipment  
Ingersoll-Rand ECM-370  
Excavated April 18, 2018  
PW 1507-05

<12 Rippable  
12-15 Marginally Rippable  
15-17 Heavy Ripping  
>17 Drill & Shoot



# AP-15

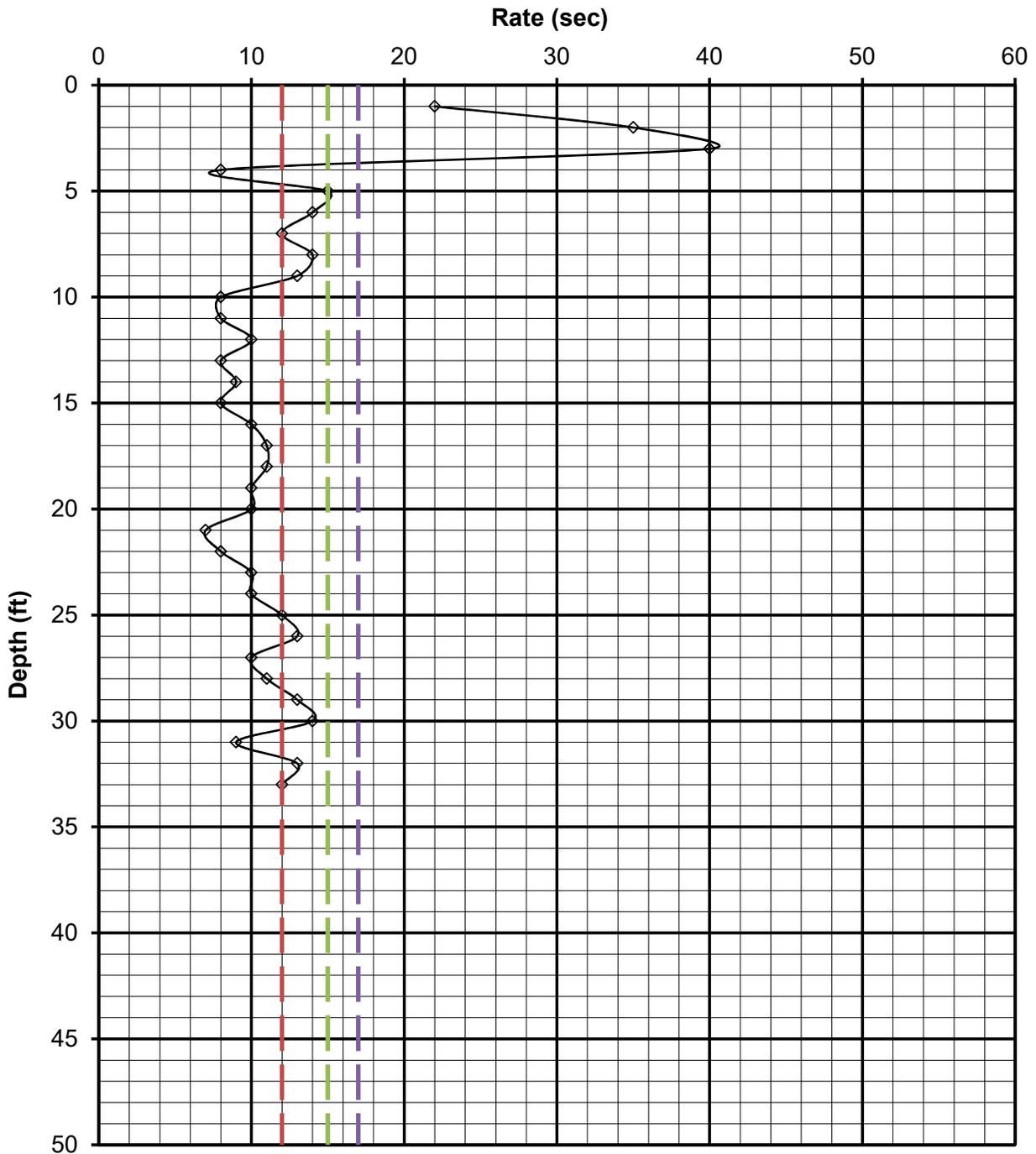


Equipment  
Ingersoll-Rand ECM-370  
Excavated April 18, 2018  
PW 1507-05

<12 Rippable  
12-15 Marginally Rippable  
15-17 Heavy Ripping  
>17 Drill & Shoot



# AP-16



Equipment  
Ingersoll-Rand ECM-370  
Excavated April 18, 2018  
PW 1507-05

<12 Rippable  
12-15 Marginally Rippable  
15-17 Heavy Ripping  
>17 Drill & Shoot



**SEISMIC REFRACTION SURVEY  
GREEN TREE RANCH  
RIVERSIDE, CALIFORNIA**

**PREPARED FOR:**

Advanced Geotechnical Solutions, Inc.  
485 Corporate Drive, Suite B  
Escondido, CA 92029

**PREPARED BY:**

Southwest Geophysics, Inc.  
8057 Raytheon Road, Suite 9  
San Diego, CA 92111

April 13, 2018  
Project No. 118142

April 13, 2018  
Project No. 118142

Mr. Daniel Linsley  
Advanced Geotechnical Solutions, Inc.  
485 Corporate Drive, Suite B  
Escondido, CA 92029

Subject: Seismic Refraction Survey  
Green Tree Ranch  
Riverside, California

Dear Mr. Linsley:

In accordance with your authorization, we have performed a seismic refraction survey pertaining to the Green Tree Ranch project located in Riverside, California. Specifically, our survey consisted of performing 10 seismic P-wave refraction traverses at the project site. The purpose of our study was to develop subsurface velocity profiles of the areas surveyed and to assess the apparent rippability of the subsurface materials. This data report presents our survey methodology, equipment used, analysis, and results.

We appreciate the opportunity to be of service on this project. Should you have any questions please contact the undersigned at your convenience.

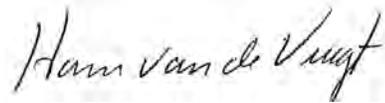
Sincerely,  
**SOUTHWEST GEOPHYSICS, INC.**



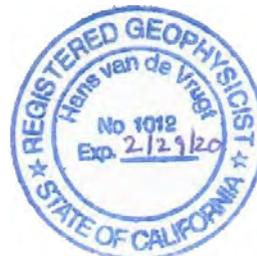
Aaron Puente  
Project Geologist/Geophysicist

AMB/ATP/hv

Distribution: Addressee (electronic)



Hans van de Vrugt, C.E.G., P.Gp.  
Principal Geologist/Geophysicist



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## **1. INTRODUCTION**

In accordance with your authorization, we have performed a seismic refraction survey pertaining to the Green Tree Ranch project located in Riverside, California (Figure 1). Specifically, our survey consisted of performing ten seismic P-wave refraction traverses at the project site. The purpose of our study was to develop subsurface velocity profiles of the areas surveyed and to assess the apparent rippability of the subsurface materials. This data report presents our survey methodology, equipment used, analysis, and results.

## **2. SCOPE OF SERVICES**

Our scope of services included:

- Performance of ten seismic P-wave refraction lines at the project site.
- Compilation and analysis of the data collected.
- Preparation of this data report presenting our results and conclusions.

## **3. SITE DESCRIPTION**

The project site is located approximately 1 mile north of Lake Mathews and 7 miles east of Interstate Highway 15 in Riverside, California (Figure 1). Access to the site is by way of dirt roads north of El Sobrante Road and west of Vista Del Lago Drive. The project area is an undeveloped lot with hills, ridges and associated drainages. The seismic lines were conducted along the slopes and ridges. Vegetation in the area consists of annual grass and brush. Several outcrops of granitic rock are also present in and near the site. Figures 2 and 3 depict the general site conditions in the areas of the seismic traverses.

## **4. SURVEY METHODOLOGY**

As previously indicated, the primary purpose of our services was to characterize the subsurface conditions at pre-selected locations through the collection of seismic data. The seismic refraction method uses first-arrival times of refracted seismic waves to estimate the thicknesses and seismic velocities of subsurface layers. Seismic P-waves (compression waves) generated at the surface are refracted at boundaries separating materials of contrasting velocities. These refracted seismic waves are then detected by a series of surface vertical component 14-Hz geophones and recorded

with a 24-channel Geometrics Geode seismograph. The travel times of the seismic P-waves are used in conjunction with the shot-to-geophone distances to obtain thickness and velocity information on the subsurface materials. In general, the effective depth of evaluation for a seismic refraction traverse is approximately one-third to one-fifth the length of the traverse.

Ten seismic profiles (SL-1 through SL-10) were conducted at the site and multiple shot points (signal generator locations) were conducted along the lines at the ends, midpoint, and intermediate points between the ends and the midpoint. The P-wave signal (shot) was generated using a 20-pound hammer and an aluminum plate. The locations of the profiles, which were selected by your office, are depicted on Figure 2.

The refraction method requires that subsurface velocities increase with depth. A layer having a velocity lower than that of the layer above will not generally be detectable by the seismic refraction method and, therefore, could lead to errors in the depth calculations of subsequent layers. In addition, lateral variations in velocity, such as those caused by buried boulders, fractures, dikes, etc. can result in the misinterpretation of the subsurface conditions.

In general, the seismic P-wave velocity of a material can be correlated to rippability (see Table 1 below), or to some degree “hardness.” Table 1 is based on published information from the Caterpillar Performance Handbook (Caterpillar, 2011) as well as our experience with similar materials, and assumes that a Caterpillar D-9 dozer ripping with a single shank is used. We emphasize the cutoffs in this classification scheme are approximate and rock characteristics, such as fracture spacing and orientation, play a significant role in determining rock quality or rippability. The rippability of a mass is also dependent on the excavation equipment used and the skill and experience of the equipment operator.

For trenching operations, the rippability values should be scaled downward. For example, velocities as low as 3,500 feet/second may indicate difficult ripping during trenching operations. In addition, the presence of boulders, which can be troublesome in narrow trenching operations, should be anticipated.

<b>Table 1 – Rippability Classification</b>	
<b>Seismic P-wave Velocity</b>	<b>Rippability</b>
0 to 2,000 feet/second	Easy
2,000 to 4,000 feet/second	Moderate
4,000 to 5,500 feet/second	Difficult, Possible Blasting
5,500 to 7,000 feet/second	Very Difficult, Probable Blasting
Greater than 7,000 feet/second	Blasting Generally Required

It should be noted that the rippability cutoffs presented in Table 1 are slightly more conservative than those published in the Caterpillar Performance Handbook. Accordingly, the above classification scheme should be used with discretion, and contractors should not be relieved of making their own independent evaluation of the rippability of the on-site materials prior to submitting their bids.

## 5. DATA ANALYSIS

The collected data were processed using SIPwin (Rimrock Geophysics, 2003), a seismic interpretation program, and analyzed using SeisOpt Pro (Optim, 2008). SeisOpt Pro uses first arrival picks and elevation data to produce subsurface velocity models through a nonlinear optimization technique called adaptive simulated annealing. The resulting velocity model provides a tomography image of the estimated geologic conditions. Both vertical and lateral velocity information is contained in the tomography model. Changes in layer velocity are revealed as gradients rather than discrete contacts, which typically are more representative of actual conditions.

## 6. RESULTS AND CONCLUSIONS

As previously indicated, 10 seismic traverses were conducted as part of our study. Figures 4a through 4j present the velocity models generated from our analysis. Based on the results it appears the study areas are underlain by low velocity materials (e.g., colluvium and topsoil) in the near surface and higher velocity bedrock material at depth. Distinct vertical and lateral velocity variations are evident in the models. Moreover, the degree of bedrock weathering and the depth to bedrock appears to be highly variable across the study area.

Based on the refraction results, variability in the excitability (including depth of rippability) of the subsurface materials should be expected across the project area. Furthermore, blasting may be required depending on the excavation depth, location, equipment used, and desired rate of production. In addition, oversized materials should be expected. A contractor with excavation experience in similar difficult conditions should be consulted for expert advice on excavation methodology, equipment and production rate.

## **7. LIMITATIONS**

The field evaluation and geophysical analyses presented in this report have been conducted in general accordance with current practice and the standard of care exercised by consultants performing similar tasks in the project area. No warranty, express or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be present. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface surveying will be performed upon request.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Southwest Geophysics, Inc. should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document. This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

## **8. SELECTED REFERENCES**

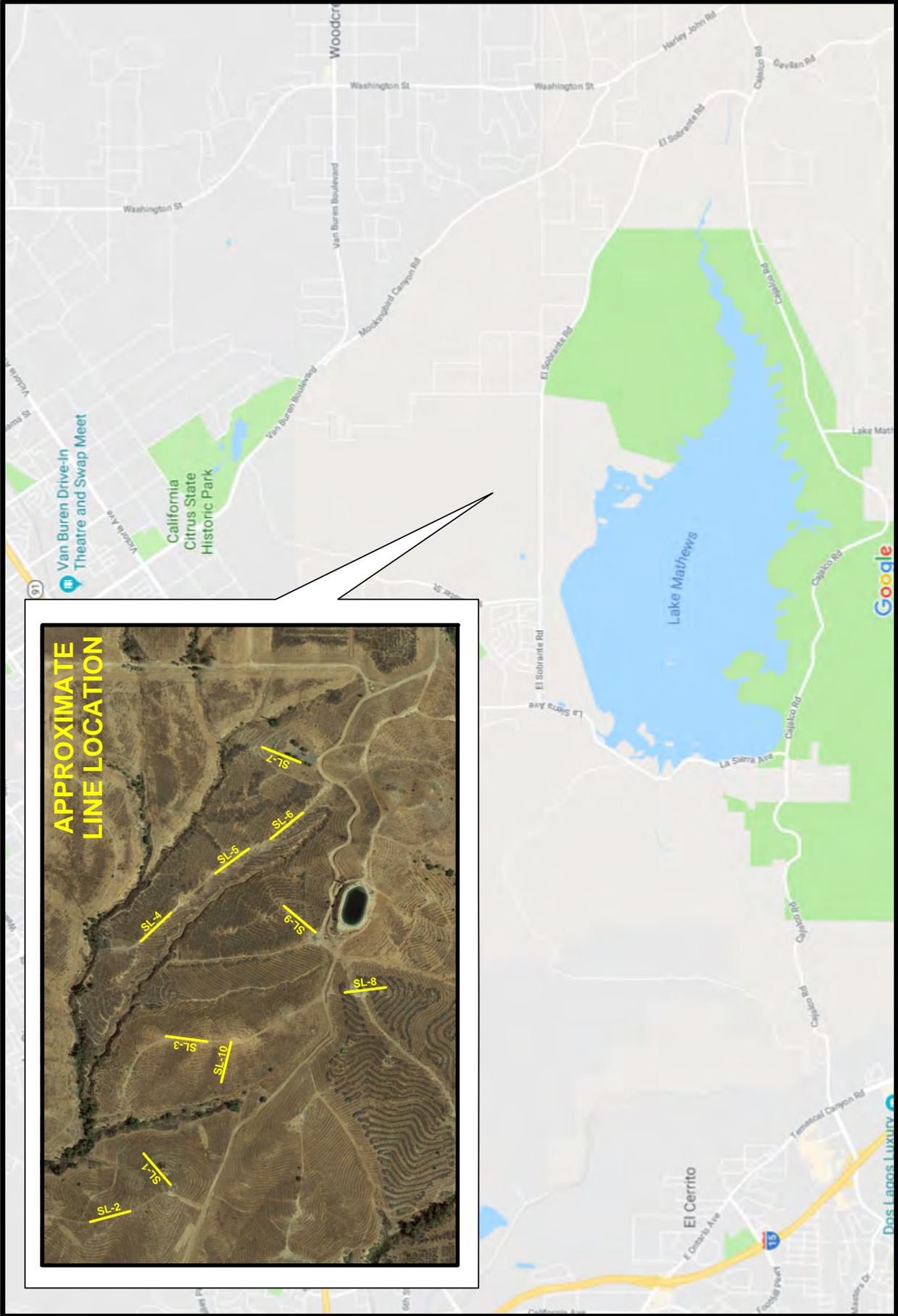
Caterpillar, Inc., 2011, Caterpillar Performance Handbook, Edition 41, Caterpillar, Inc., Peoria, Illinois.

Mooney, H.M., 1976, Handbook of Engineering Geophysics, dated February.

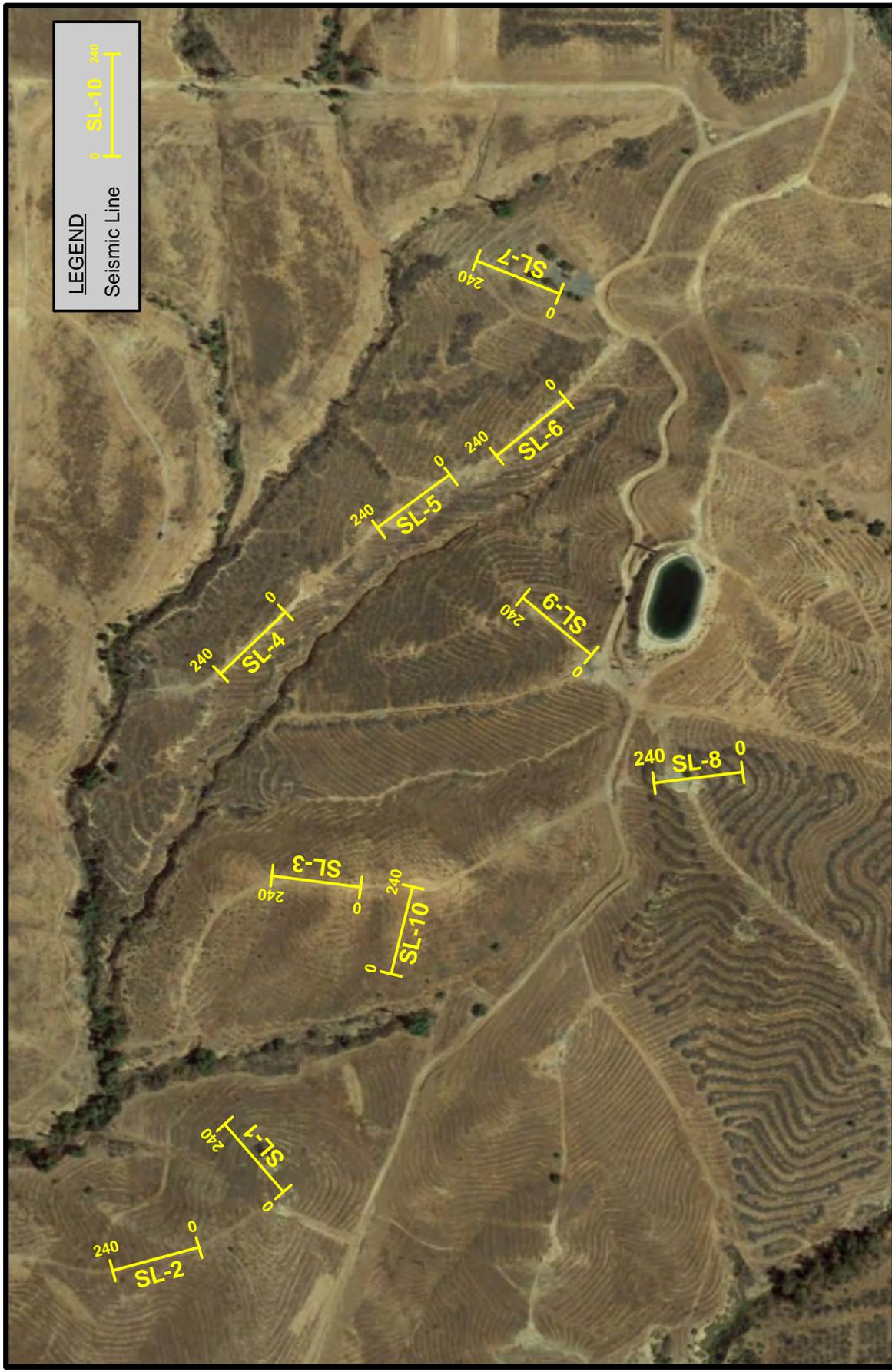
Optim, Inc., 2008, SeisOpt Pro, V-5.0.

Rimrock Geophysics, 2003, Seismic Refraction Interpretation Program (SIPwin), V-2.76.

Telford, W.M., Geldart, L.P., Sheriff, R.E., and Keys, D.A., 1976, Applied Geophysics, Cambridge University Press.



**SITE LOCATION MAP**



**LEGEND**  
Seismic Line

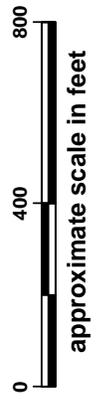


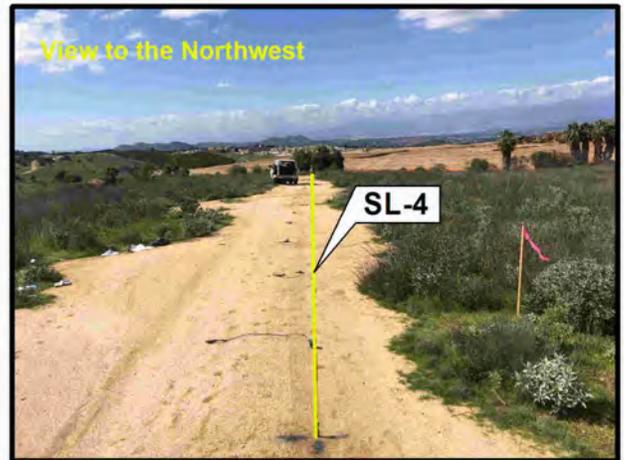
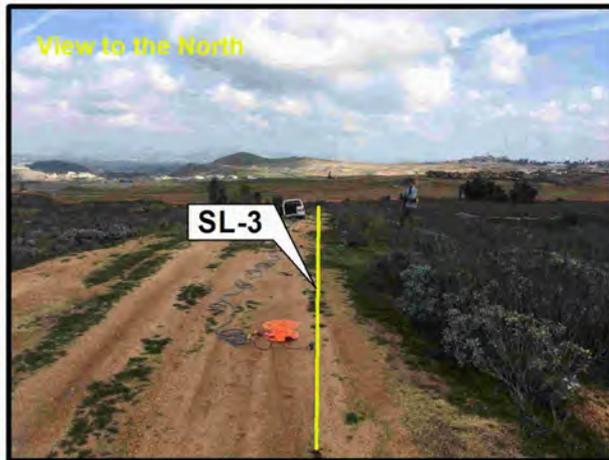
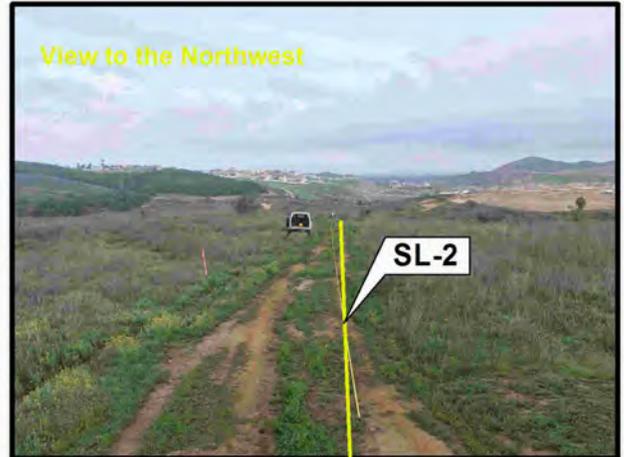
Figure 2

Green Tree Ranch  
Riverside, California

Project No.: 118142      Date: 04/18



**LINE LOCATION MAP**



# SITE PHOTOGRAPHS

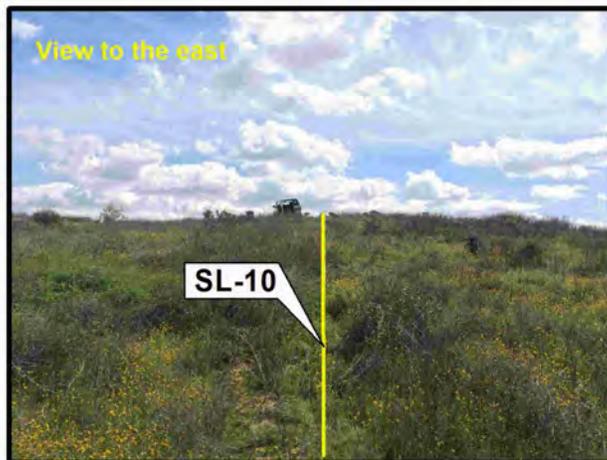
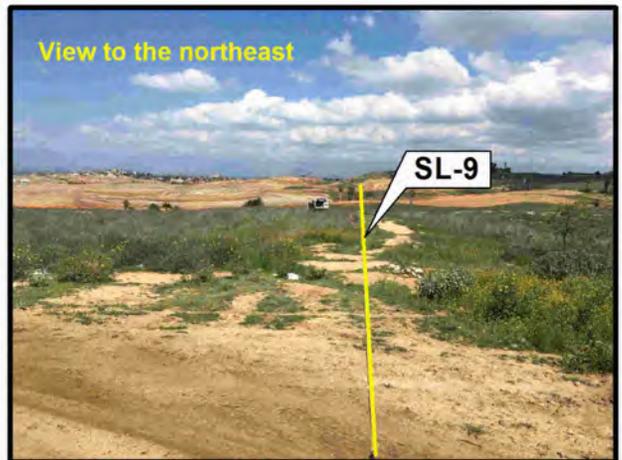
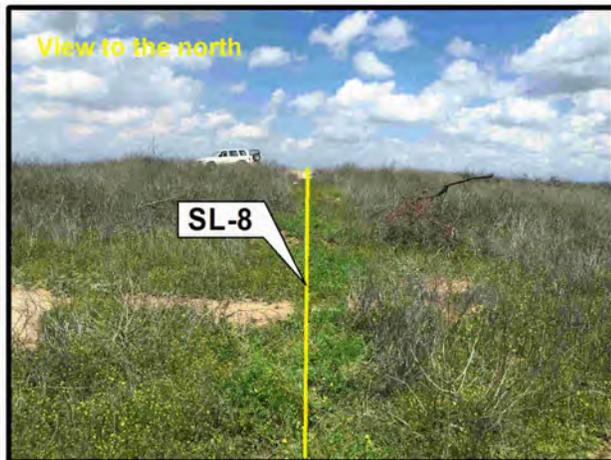
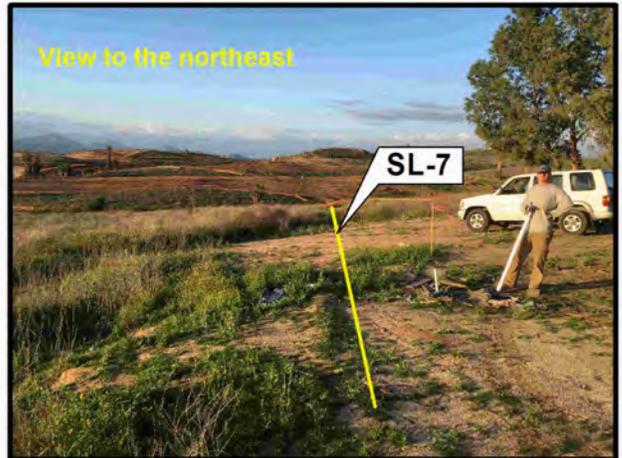
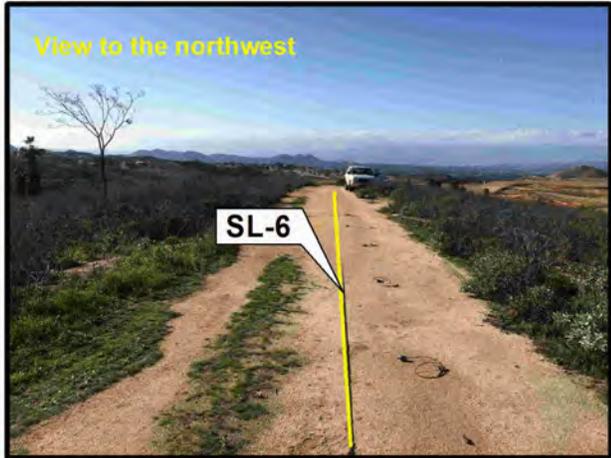
Green Tree Ranch  
Riverside, California

Project No.: 118142

Date: 4/18



Figure 3a



# SITE PHOTOGRAPHS

Green Tree Ranch  
Riverside, California

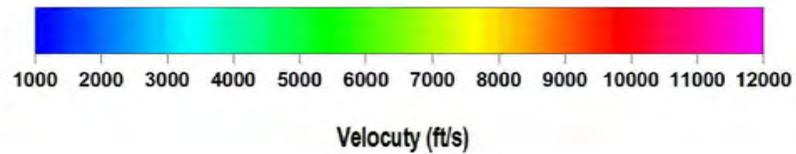
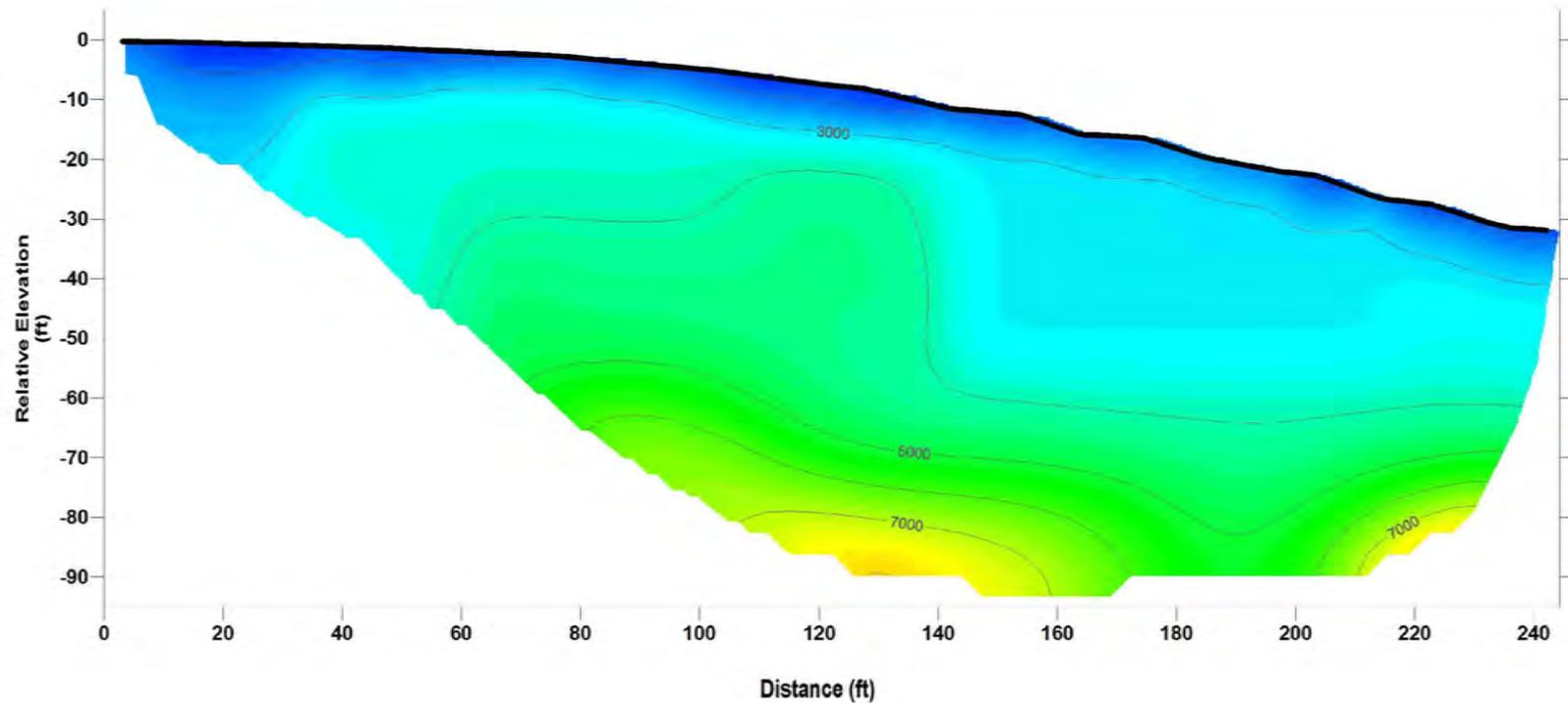


Project No.: 118142

Date: 4/18

Figure 3b

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-1**

Green Tree Ranch  
Riverside, California

Project No.: 118142

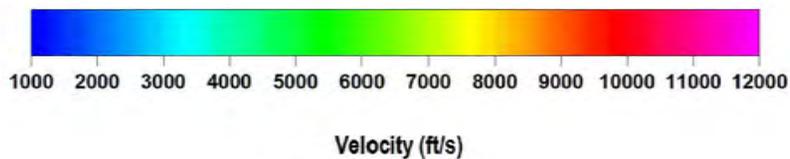
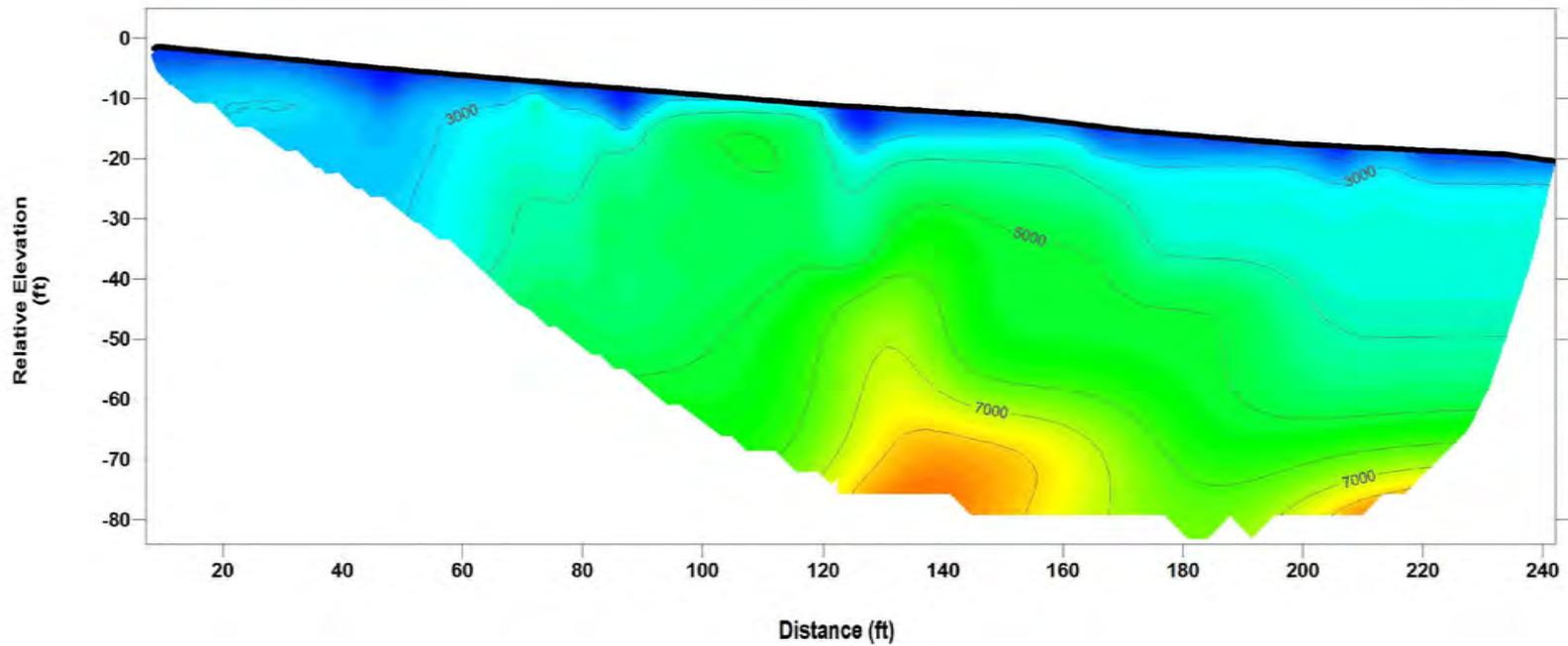
Date: 04/18



Figure 4a

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-2**

Green Tree Ranch  
Riverside, California

Project No.: 118142

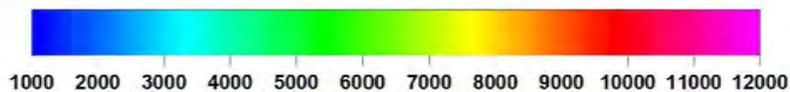
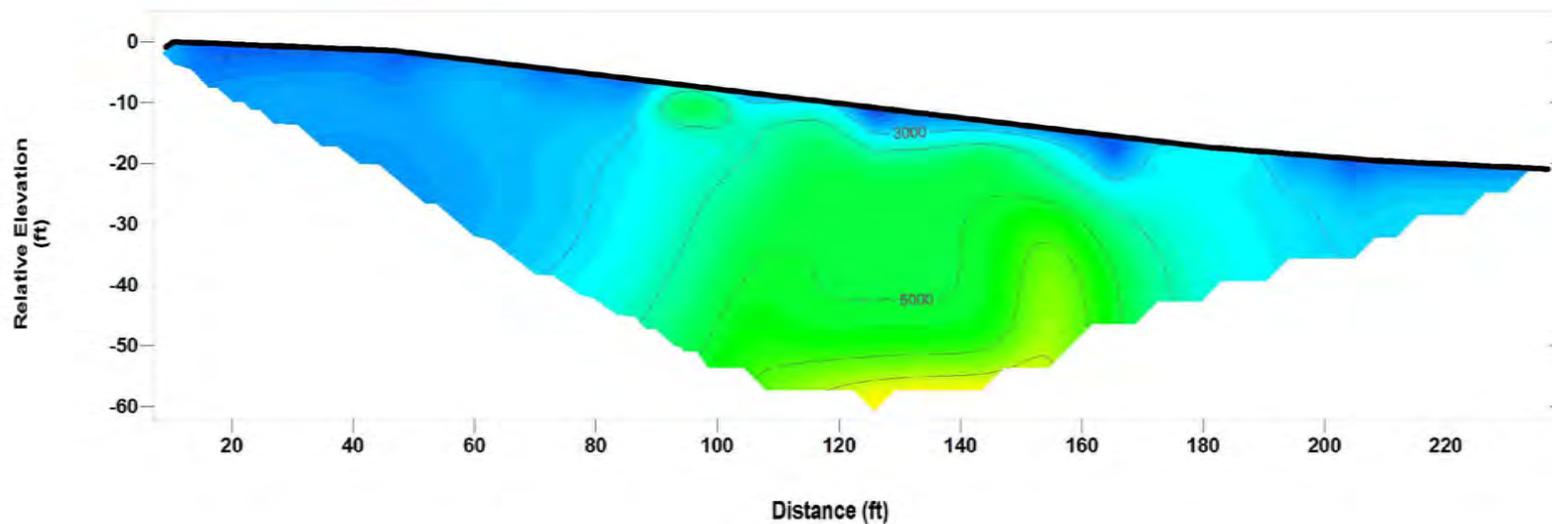
Date: 04/18



Figure 4b

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



Velocity (ft/s)

**P-WAVE PROFILE  
SL-3**

Green Tree Ranch  
Riverside, California

Project No.: 118142

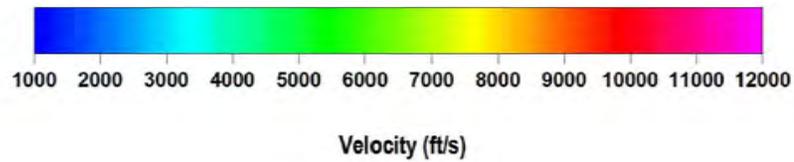
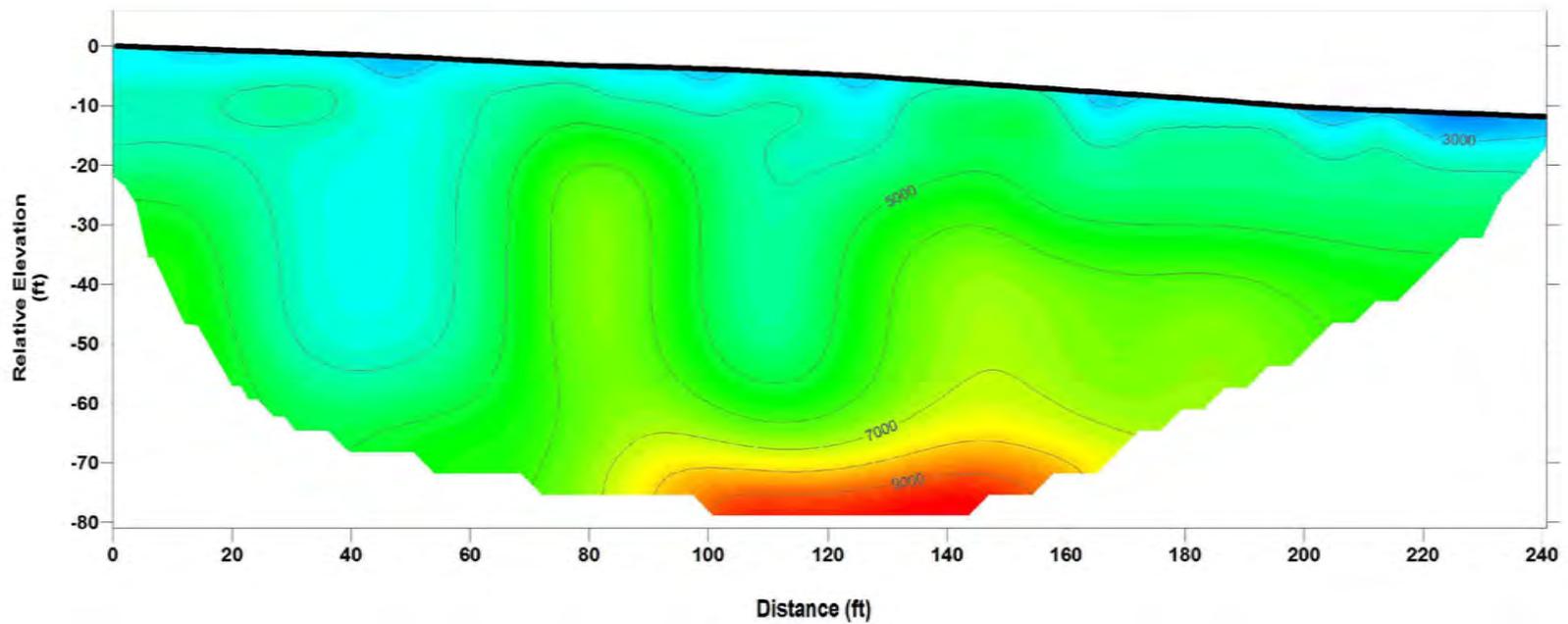
Date: 04/18



Figure 4c

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-4**

Green Tree Ranch  
Riverside, California

Project No.: 118142

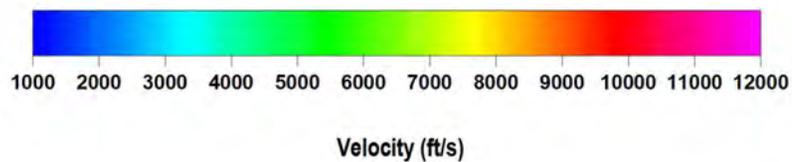
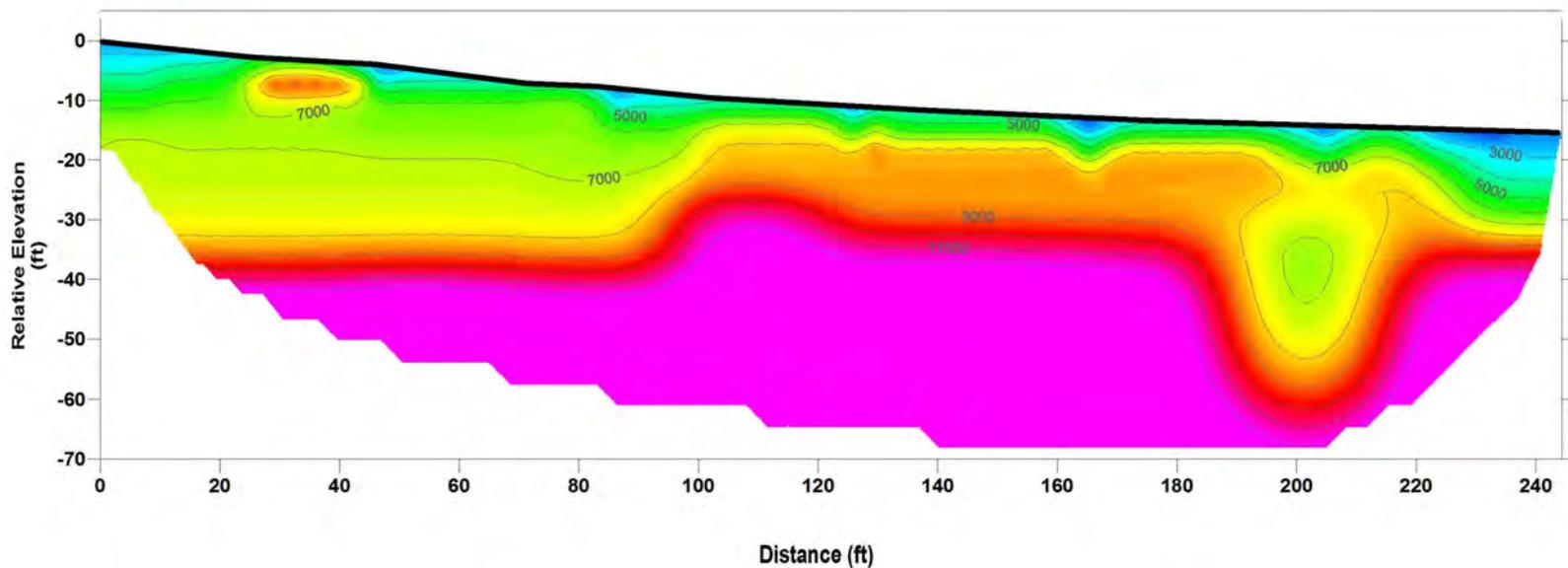
Date: 04/18



Figure 4d

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-5**

Green Tree Ranch  
Riverside, California

Project No.: 118142

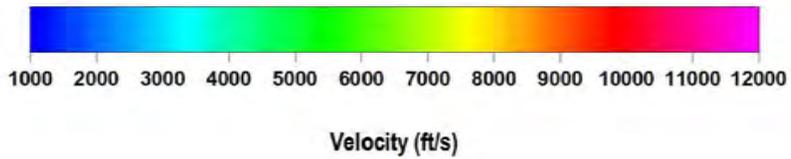
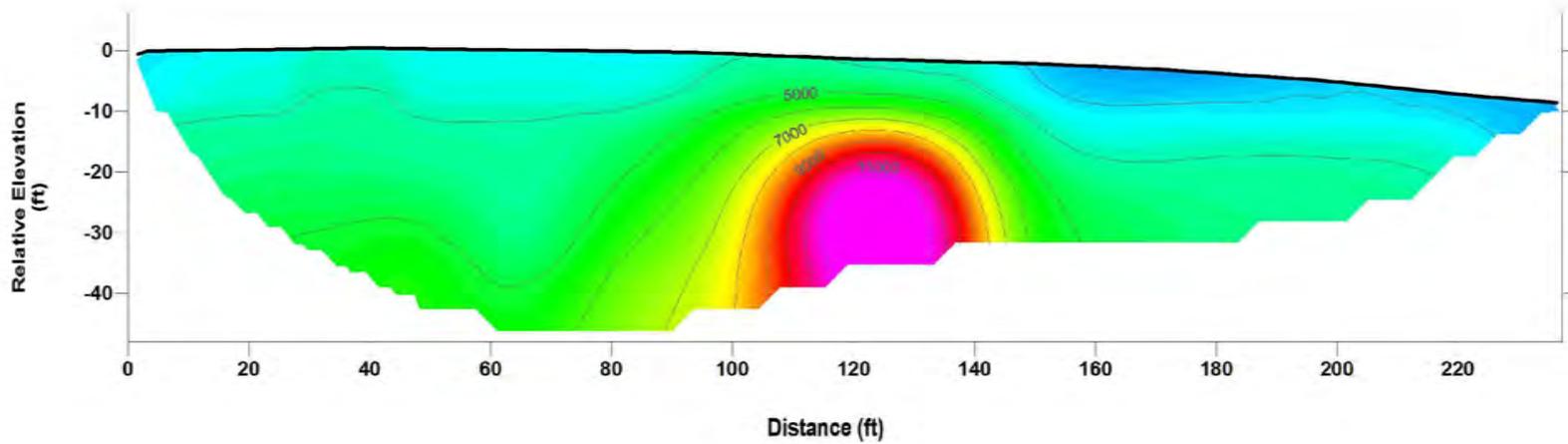
Date: 04/18



Figure 4e

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-6**

Green Tree Ranch  
Riverside, California

Project No.: 118142

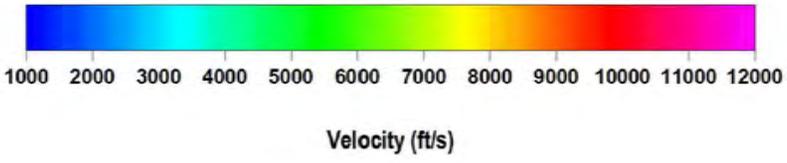
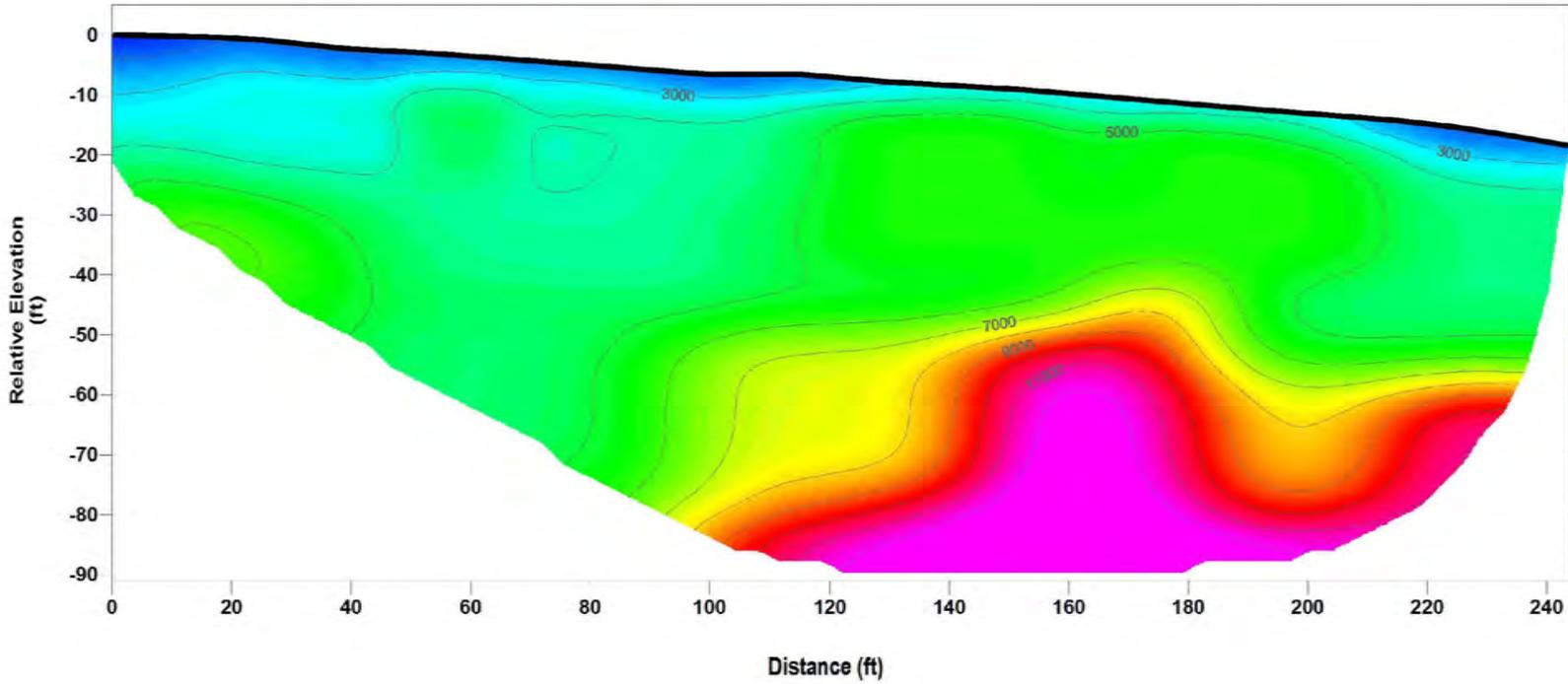
Date: 04/18



Figure 4f

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-7**

Green Tree Ranch  
Riverside, California

Project No.: 118142

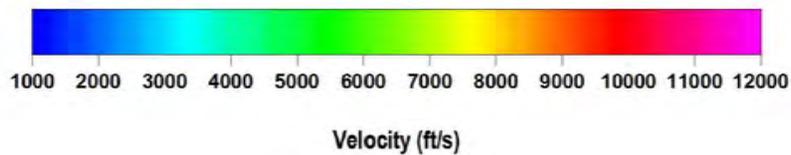
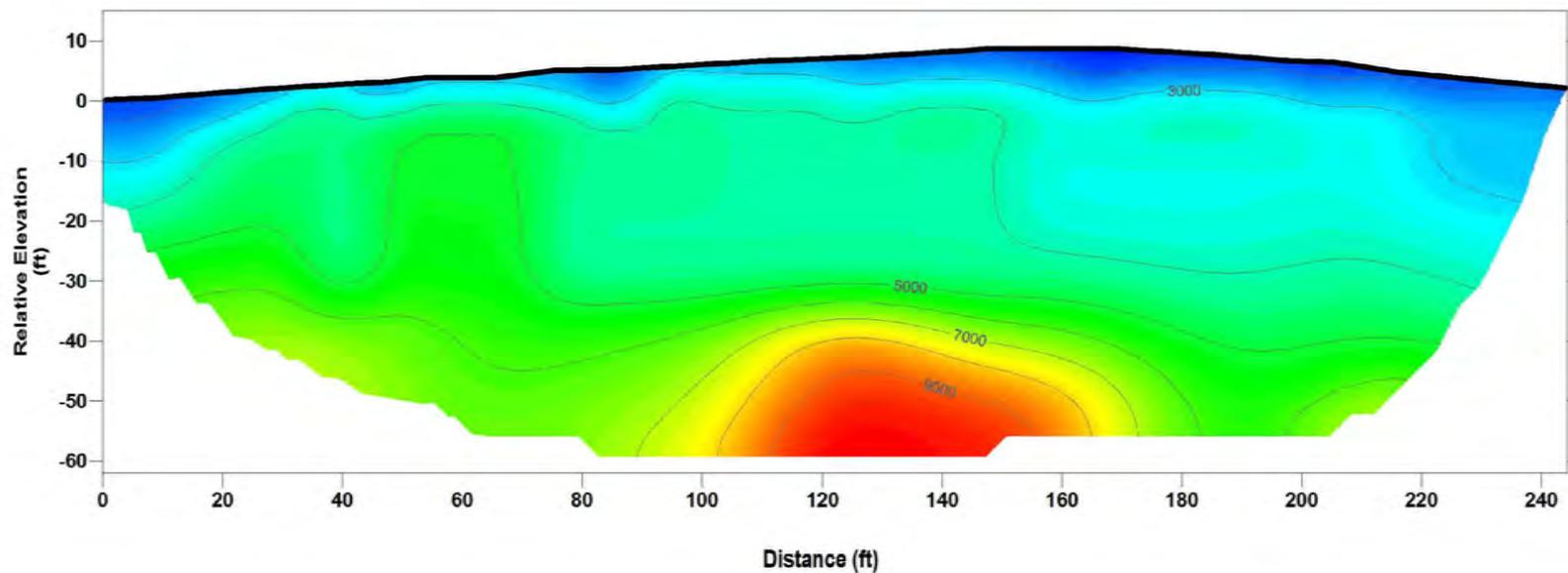
Date: 04/18



Figure 4g

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-8**

Green Tree Ranch  
Riverside, California

Project No.: 118142

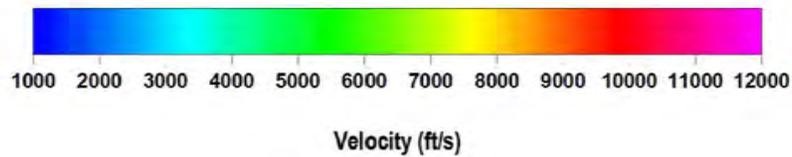
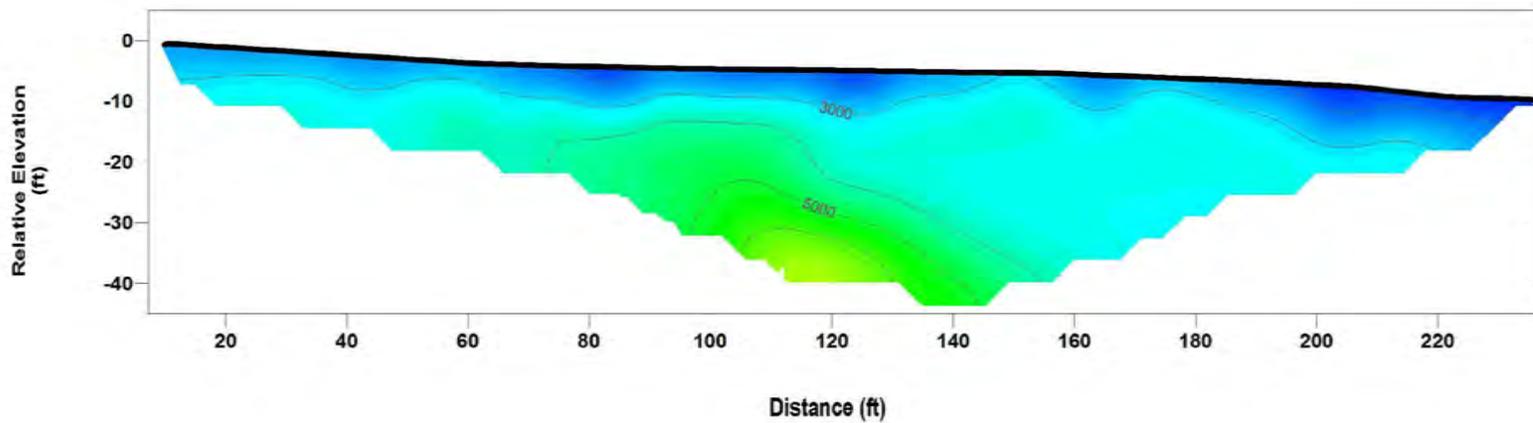
Date: 04/18



Figure 4h

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-9**

Green Tree Ranch  
Riverside, California

Project No.: 118142

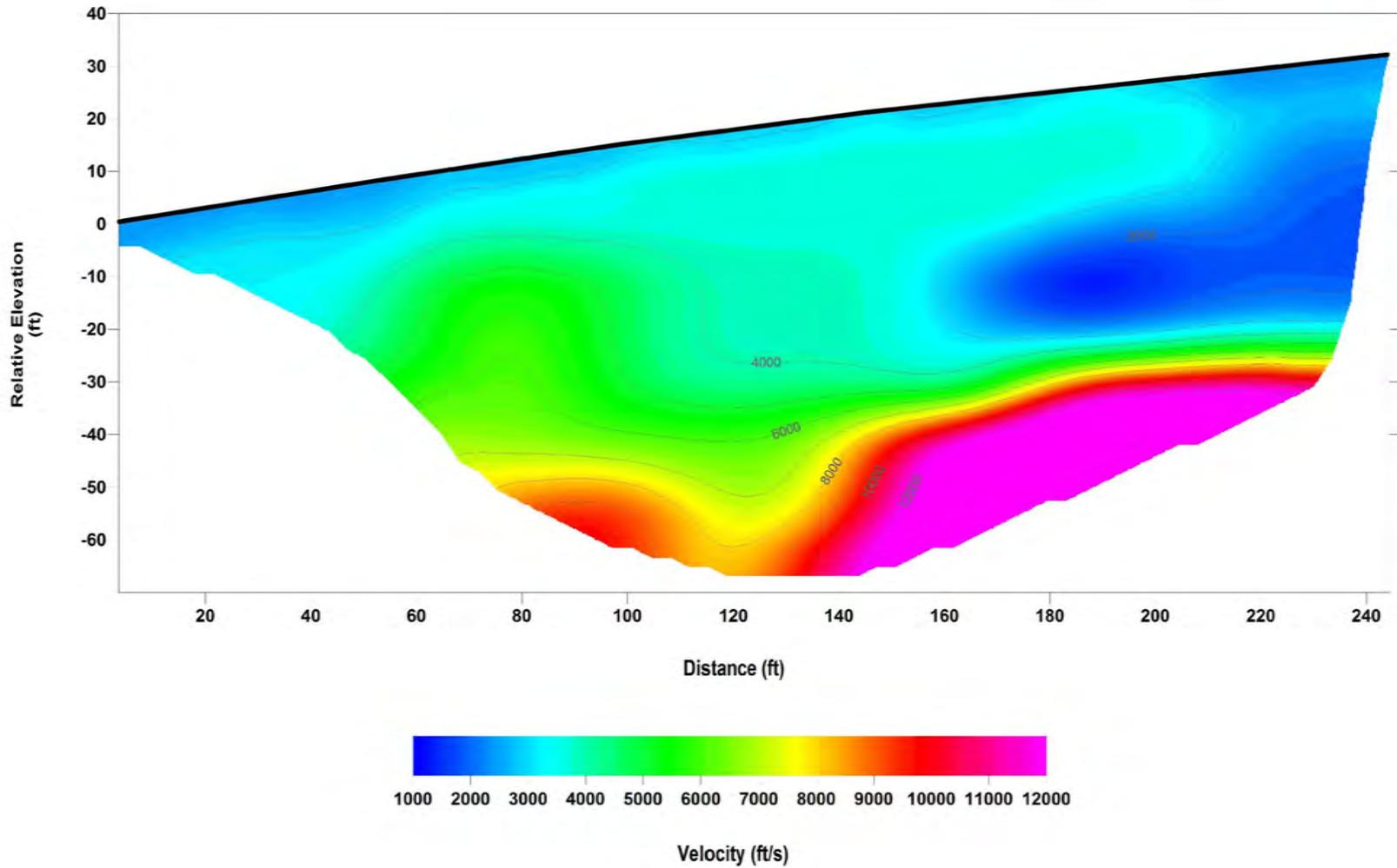
Date: 04/18



Figure 4i

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-10**

Green Tree Ranch  
Riverside, California

Project No.: 118142

Date: 04/18



Figure 4j

Note: Contour Interval = 1,000 feet per second

**APPENDIX B2**  
**SUBSURFACE LOGS**  
**(LEIGHTON AND ASSOCIATES 2005)**

# GEOTECHNICAL BORING LOG LB-1

Date 1-24-05 Sheet 1 of 1  
 Project Victoria Grove East Project No. 111446-001  
 Drilling Co. Layne Christiansen Type of Rig \_\_\_\_\_  
 Hole Diameter 8" Drive Weight 140 lbs Drop 30"  
 Elevation Top of Hole +/- 1221' Location See Map

Elevation Feet	Depth Feet	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
									Logged By <u>PC</u> Sampled By <u>PC</u>	
1220	0	N S							TOPSOIL QUATERNARY ALLUVIUM (Qal)	
		(s) (cl) (s)		R1	7	103.5	14.7	SM	@ 2.5': Dark brown, moist, loose, silty, fine SAND; pinhole pore common, rootlets common, vugs common	
1215	5			R2	26	113.0	9.3	SM	QUATERNARY ALLUVIUM OLDER (Qalo) @ 5': Red-brown, moist, medium dense, silty, fine SAND; pinhole pores common, blocky	
		(s) (cl) (s)		R3	89/11"	134.5	5.9		CRETACEOUS AGED GRANITIC BEDROCK (Kgr) @ 7.5': Medium brown, damp to moist, very dense, weathered BEDROCK; very friable	
1210	10								Total Depth 8.9' No Groundwater Encountered Backfilled with Spoils 1/24/05	
1205	15									
1200	20									
1195	25									
	30									

**SAMPLE TYPES:**  
 S SPT  
 R RING SAMPLE  
 B BULK SAMPLE  
 T TUBE SAMPLE

G GRAB SAMPLE  
 C CORE SAMPLE

**TYPE OF TESTS:**  
 SU SULFATE  
 DS DIRECT SHEAR  
 MD MAXIMUM DENSITY  
 CN CONSOLIDATION  
 CR CORROSION

HCO HYDROCOLLAPSE  
 HD HYDROMETER  
 SA SIEVE ANALYSIS  
 AL ATTERBERG LIMITS  
 EI EXPANSION INDEX  
 RV R-VALUE

CS CORROSION SUITE  
 MC MOISTURE CONTENT  
 SE SAND EQUIVALENT  
 -200 200 WASH  
 RDS Remolded DS



**LEIGHTON**

# GEOTECHNICAL BORING LOG LB-2

Date 1-24-05 Sheet 1 of 1  
 Project Victoria Grove East Project No. 111446-001  
 Drilling Co. Layne Christiansen Type of Rig \_\_\_\_\_  
 Hole Diameter 8" Drive Weight 140 lbs Drop 30"  
 Elevation Top of Hole +/- 1290' Location See Map

Elevation Feet	Depth Feet	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
1290	0	N S							Logged By <u>PC</u> Sampled By <u>PC</u>	
									TOPSOIL QUATERNARY ALLUVIUM OLDER (Qal <sub>o</sub> )	
				R1	73	111.2	14.9	ML	@ 2.5': Light to medium brown, moist, very stiff, sandy SILT; pinhole pores, rootlets common, blocky texture	RDS
1285	5			R2	46	111.4	4.4		@ 5': Medium brown, damp to moist, very stiff, sandy SILT; pinhole pores common, calcium carbonate stringers common, blocky texture	HCO, -200, EI
				R3	34			SM	@ 7.5': Light to medium brown, damp to moist, medium dense, silty, fine SAND; pinhole to 2mm diameter hole pores common, calcium carbonate stringers common, blocky texture	
1280	10			R4	63	117.1	8.0		@ 10': Medium to red-brown, damp to moist, dense, silty, fine SAND; pinhole pores common, calcium carbonate stringers very common, blocky texture	HCO, EI
				R5	81	132.9	7.8		@ 12.5': Dark red-brown, moist, dense, silty, fine to medium SAND; few rock fragments, micaceous	HCO, -200, EI
1275	15			R6	19				@ 15': Dark red-brown, moist, medium dense, silty, fine to medium SAND; few rock fragments, micaceous	
				R7	24	112.9	17.2		@ 17.5': Red-brown, damp to moist, medium dense, silty, fine to medium SAND; calcium carbonate stringers very common, micaceous	-200
1270	20			R8	20				@ 20': Red-brown, damp to moist, medium dense, silty, fine to medium SAND; pebbles common, very micaceous	
				R9	63	123.8	2.5		CRETACEOUS AGED GRANITIC BEDROCK (K <sub>gr</sub> ) @ 22.5': Red-brown, damp to moist, dense, weathered BEDROCK; friable, breaks into coarse sand and gravel, very micaceous	
1265	25			S10	50/5"				@ 25': Gray-brown, damp, very dense, weathered BEDROCK; friable, breaks into coarse sand and gravel	
1260	30								Total Depth 25.9' No Groundwater Encountered Backfilled with Spoils 1/24/05	

**SAMPLE TYPES:**  
 S SPT  
 R RING SAMPLE  
 B BULK SAMPLE  
 T TUBE SAMPLE

G GRAB SAMPLE  
 C CORE SAMPLE

**TYPE OF TESTS:**  
 SU SULFATE  
 DS DIRECT SHEAR  
 MD MAXIMUM DENSITY  
 CN CONSOLIDATION  
 CR CORROSION

HCO HYDROCOLLAPSE  
 HD HYDROMETER  
 SA SIEVE ANALYSIS  
 AL ATTERBERG LIMITS  
 EI EXPANSION INDEX  
 RV R-VALUE

CS CORROSION SUITE  
 MC MOISTURE CONTENT  
 SE SAND EQUIVALENT  
 -200 200 WASH  
 RDS Remolded DS



## LEIGHTON

# GEOTECHNICAL BORING LOG LB-3

Date 1-24-05 Sheet 1 of 1  
 Project Victoria Grove East Project No. 111446-001  
 Drilling Co. Layne Christiansen Type of Rig \_\_\_\_\_  
 Hole Diameter 8" Drive Weight 140 lbs Drop 30"  
 Elevation Top of Hole +/- 1182' Location See Map

Elevation Feet	Depth Feet	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
									Logged By <u>PC</u> Sampled By <u>PC</u>	
1180	0	N S							<u>TOPSOIL</u>	
1175	5	N S		R1	23	128.2	2.9		<u>CRETACEOUS AGED GRANITIC BEDROCK (Kgr)</u>  @ 5': Red-brown, damp, medium dense, weathered BEDROCK; friable, breaks into coarse sand and gravel	
1170	7.5	N S		R2	50/5"	120.7	2.8		@ 7.5': Red-brown, damp, very dense, weathered BEDROCK; friable, breaks into coarse sand and gravel	
1165	10								Total Depth 8.4' No Groundwater Encountered Backfilled with Spoils 1/24/05	
1160	15									
1155	20									
	25									

**SAMPLE TYPES:**  
 S SPT  
 R RING SAMPLE  
 B BULK SAMPLE  
 T TUBE SAMPLE

G GRAB SAMPLE  
 C CORE SAMPLE

**TYPE OF TESTS:**  
 SU SULFATE  
 DS DIRECT SHEAR  
 MD MAXIMUM DENSITY  
 CN CONSOLIDATION  
 CR CORROSION

HCO HYDROCOLLAPSE  
 HD HYDROMETER  
 SA SIEVE ANALYSIS  
 AL ATTERBERG LIMITS  
 EI EXPANSION INDEX  
 RV R-VALUE

CS CORROSION SUITE  
 MC MOISTURE CONTENT  
 SE SAND EQUIVALENT  
 -200 200 WASH  
 RDS Remolded DS



## LEIGHTON

# GEOTECHNICAL BORING LOG LB-4

Date 1-24-05 Sheet 1 of 1  
 Project Victoria Grove East Project No. 111446-001  
 Drilling Co. Layne Christiansen Type of Rig \_\_\_\_\_  
 Hole Diameter 8" Drive Weight 140 lbs Drop 30"  
 Elevation Top of Hole +/- 1228' Location See Map

Elevation Feet	Depth Feet	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
									Logged By <u>PC</u> Sampled By <u>PC</u>	
	0	N S							TOPSOIL QUATERNARY ALLUVIUM OLDER (Qalo)	
1225		•••••		R1	17	109.8	15.5	SM	@ 2.5': Dark red-brown, moist, medium dense, silty, fine SAND; calcium carbonate stringers common, pinhole pores common, rootlets common, semi-blocky texture	HCO, EI
	5	•••••		R2	11				@ 5': Dark red-brown, moist, loose to medium dense, silty, fine SAND; calcium carbonate stringers common, pinhole pores common, rootlets common	
1220		•••••		R3	19	114.0	11.2		@ 7.5': Dark red-brown, moist, medium dense, silty, fine to coarse SAND; pebbles common, micaceous	HCO, EI
	10	•••••		R4	35				@ 10': Dark red-brown, very moist, medium dense, silty, fine to coarse SAND; pebbles common, micaceous	
1215		•••••		R5	50/5"	122.3	8.8		@ 12.5': Dark red-brown, very moist, very dense, silty, fine to coarse SAND; micaceous, pebbles common CRETACEOUS AGED GRANITIC BEDROCK (Kgr)	
	15	X		R6	50/5"	112.1	6.4		@ 15': Red-brown, moist, very dense, weathered BEDROCK; friable, breaks into coarse sand and gravel	
1210									Total Depth 15.4' No Groundwater Encountered Backfilled with Spoils 1/24/05	
1205										
1200										
	30									

**SAMPLE TYPES:**  
 S SPT  
 R RING SAMPLE  
 B BULK SAMPLE  
 T TUBE SAMPLE

G GRAB SAMPLE  
 C CORE SAMPLE

**TYPE OF TESTS:**  
 SU SULFATE  
 DS DIRECT SHEAR  
 MD MAXIMUM DENSITY  
 CN CONSOLIDATION  
 CR CORROSION

HCO HYDROCOLLAPSE  
 HD HYDROMETER  
 SA SIEVE ANALYSIS  
 AL ATTERBERG LIMITS  
 EI EXPANSION INDEX  
 RV R-VALUE

CS CORROSION SUITE  
 MC MOISTURE CONTENT  
 SE SAND EQUIVALENT  
 -200 200 WASH  
 RDS Remolded DS



## LEIGHTON

# GEOTECHNICAL BORING LOG LB-5

Date 1-24-05

Sheet 1 of 1

Project Victoria Grove East

Project No. 111446-001

Drilling Co. Layne Christiansen

Type of Rig \_\_\_\_\_

Hole Diameter 8" Drive Weight 140 lbs

Elevation Top of Hole +/- 1240' Location See Map

Drop 30"

Elevation Feet	Depth Feet	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
1240	0	N S							Logged By <u>PC</u> Sampled By <u>PC</u>	
									TOPSOIL QUATERNARY ALLUVIUM OLDER (Q <sub>alo</sub> )	
				R1	20	104.4	19.3	SM	@ 2.5': Red-brown, moist, medium dense, silty, fine SAND; rootlets common, pinhole pores common, calcium carbonate stringers common, blocky textures	
1235	5			R2	28	110.8	15.1		@ 5': Medium brown, moist, medium dense, silty, fine to medium SAND; few rootlets, calcium carbonate stringers common, pinhole pores common, few pebbles	
				R3	35			SP-SM	@ 7.5': Gray-brown, moist, medium dense, silty, fine to coarse SAND; pebbles common, micaceous	
1230	10			R4	22	114.9	16.9	SC-SM	@ 10': Gray-brown, moist, medium dense, clayey, silty, fine SAND; few coarse grains	
				R5	92				CRETACEOUS AGED GRANITIC BEDROCK (K <sub>gr</sub> ) @ 12.5': Gray-brown, moist, medium dense, heavily weathered BEDROCK; friable, breaks into coarse sand	
1225	15			R6	72	125.3	11.6		@ 15': Medium gray, moist, dense, weathered BEDROCK; friable, breaks into medium to coarse sand, veined	
1220	20								Total Depth 16.5' No Groundwater Encountered Backfilled with Spoils 1/24/05	
1215	25									
1210	30									

**SAMPLE TYPES:**  
 S SPT  
 R RING SAMPLE  
 B BULK SAMPLE  
 T TUBE SAMPLE

G GRAB SAMPLE  
 C CORE SAMPLE

**TYPE OF TESTS:**  
 SU SULFATE  
 DS DIRECT SHEAR  
 MD MAXIMUM DENSITY  
 CN CONSOLIDATION  
 CR CORROSION

HCO HYDROCOLLAPSE  
 HD HYDROMETER  
 SA SIEVE ANALYSIS  
 AL ATTERBERG LIMITS  
 EI EXPANSION INDEX  
 RV R-VALUE

CS CORROSION SUITE  
 MC MOISTURE CONTENT  
 SE SAND EQUIVALENT  
 -200 200 WASH  
 RDS Remolded DS



## LEIGHTON

# GEOTECHNICAL BORING LOG LB-6

Date 1-24-05

Sheet 1 of 1

Project Victoria Grove East

Project No. 111446-001

Drilling Co. Layne Christiansen

Type of Rig \_\_\_\_\_

Hole Diameter 8" Drive Weight 140 lbs

Drop 30"

Elevation Top of Hole +/- 1255' Location See Map

Elevation Feet	Depth Feet	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
1255	0	N S							Logged By <u>PC</u> Sampled By <u>PC</u>	
				R1	50/5"	130.9	2.2		TOPSOIL CRETACEOUS AGED GRANITIC BEDROCK (Kgr)  @ 2.5': Red-brown, damp, very dense, weathered BEDROCK; friable, breaks into coarse sand and gravel	
1250	5									
1245	10								Total Depth 5' No Groundwater Encountered Backfilled with Spoils 1/24/05	
1240	15									
1235	20									
1230	25									
1225	30									

**SAMPLE TYPES:**

- S SPT
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

- G GRAB SAMPLE
- C CORE SAMPLE

**TYPE OF TESTS:**

- SU SULFATE
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- CR CORROSION

- HCO HYDROCOLLAPSE
- HD HYDROMETER
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

- CS CORROSION SUITE
- MC MOISTURE CONTENT
- SE SAND EQUIVALENT
- 200 200 WASH
- RDS Remolded DS



LEIGHTON

**LOG OF TEST PITS**

**Project No.** 111446-001  
**CLIENT:** Victoria Grove

**LOGGED BY:** PC  
**DATE:** 12/21/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-1	0-2				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, very moist, loose to medium dense, silty, fine to coarse SAND; rootlets throughout
	2-5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, moist, medium dense to very dense, weathered BEDROCK; iron oxide staining, silts between grains, very friable, breaks into silty, fine to coarse sand  Total Depth 5', No Groundwater, No Caving, Backfilled 12/21/04
T-2	0-2.5				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, very moist, loose to medium dense, silty, fine to medium SAND; rootlets extend throughout, medium micaceous flakes
	2.5-4					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Pale brown, damp, medium dense to dense, weathered BEDROCK; ivery friable, breaks into silty, fine to coarse sand  Total Depth 4', No Groundwater, No Caving, Backfilled 12/21/04
T-3	0-2				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, very moist, loose to medium dense, silty, fine to coarse SAND; rootlets throughout
	2-5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, moist, medium dense to very dense, weathered BEDROCK; iron oxide staining, silts between grains, very friable, breaks into silty, fine to coarse sand  Total Depth 5', No Groundwater, No Caving, Backfilled 12/21/04

**LOG OF TEST PITS**

**Project No.** 111446-001  
**CLIENT:** Victoria Grove

**LOGGED BY:** PC  
**DATE:** 12/21/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION																	
T-4	0-2.5				SM	<p><b>Quaternary Colluvium (Qcol)</b> – Red-brown, very moist, loose to medium dense, silty, fine to coarse SAND; rootlets throughout, large subangular cobbles &lt;8"</p> <p><b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, moist, medium dense to very dense, weathered BEDROCK; iron oxide staining, silts between grains, very friable, breaks into silty, fine to coarse sand</p> <p>Total Depth 4.5', No Groundwater, No Caving, Backfilled 12/21/04</p>																	
	2.5-4.5						T-5	0-2.5				SM	<p><b>Quaternary Colluvium (Qcol)</b> – Brown, very moist, loose to medium dense, silty, fine to medium SAND; rootlets throughout</p> <p><b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, moist, medium dense to dense, weathered BEDROCK; silts and clay between grains, very friable, breaks into silty, fine to very coarse sand</p> <p>Total Depth 4.5', No Groundwater, No Caving, Backfilled 12/21/04</p>	2.5-4.5				T-6	0-7	Chunk 1 @ 0-6.5 Bulk 2 @ 0-6.5	92.0	5.5	ML
T-5	0-2.5				SM	<p><b>Quaternary Colluvium (Qcol)</b> – Brown, very moist, loose to medium dense, silty, fine to medium SAND; rootlets throughout</p> <p><b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, moist, medium dense to dense, weathered BEDROCK; silts and clay between grains, very friable, breaks into silty, fine to very coarse sand</p> <p>Total Depth 4.5', No Groundwater, No Caving, Backfilled 12/21/04</p>																	
	2.5-4.5						T-6	0-7	Chunk 1 @ 0-6.5 Bulk 2 @ 0-6.5	92.0	5.5	ML	<p><b>Quaternary Colluvium (Qcol)</b> – Red-brown, very moist, soft to medium stiff, silty, fine to coarse SAND; rootlets throughout</p> <p><b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Gray-brown, damp, medium dense to dense, weathered BEDROCK</p> <p>Total Depth 7.5', No Groundwater, No Caving, Backfilled 12/21/04</p>	7-7.5									
T-6	0-7	Chunk 1 @ 0-6.5 Bulk 2 @ 0-6.5	92.0	5.5	ML	<p><b>Quaternary Colluvium (Qcol)</b> – Red-brown, very moist, soft to medium stiff, silty, fine to coarse SAND; rootlets throughout</p> <p><b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Gray-brown, damp, medium dense to dense, weathered BEDROCK</p> <p>Total Depth 7.5', No Groundwater, No Caving, Backfilled 12/21/04</p>																	
	7-7.5																						

**LOG OF TEST PITS**

**Project No.** 111446-001  
**CLIENT:** Victoria Grove

**LOGGED BY:** PC  
**DATE:** 12/21/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-7	0-2.5	Bulk 3 @ 3-8'			SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to moist, loose to medium dense, silty, fine to medium SAND; rootlets throughout
	2.5-3				SM	Red-brown, damp, very dense, silty, fine to medium SAND; hardpan layer, calcium carbonate stringers, pinhole pores throughout
	3-8.5				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Red-brown, damp, medium dense to dense, silty, fine to medium SAND; calcium carbonate stringers throughout, pinhole pores throughout
						Total Depth 8.5', No Groundwater, No Caving, Backfilled 12/21/04
T-8	0-3	Bulk 4 @ 6.5-8.5'			SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to moist, loose to medium dense, silty, fine to medium SAND; rootlets throughout, thicker root system upper 1.5 feet
	3-6.5				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Red-brown, damp, medium dense to dense, silty, fine to medium SAND; calcium carbonate stringers throughout, pinhole pores throughout
	6.5-8.5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Gray-brown, damp, dense to very dense, weathered BEDROCK; mafic, friable, breaks into medium to coarse sand
						Total Depth 8.5', No Groundwater, No Caving, Backfilled 12/21/04

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TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-9	0-8				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, moist to very moist, loose to medium dense, silty, fine SAND; few pebbles, pinhole pores throughout, rootlets to 3' in depth
	3-11				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Dark red-brown, moist to wet, medium dense, silty, fine to medium SAND; pinhole pores, calcium carbonate stringers
	11-12					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Green-gray, wet, loose, heavily weathered BEDROCK; very spongy  Total Depth 12', No Groundwater, No Caving, Backfilled 12/21/04
T-10	0-0.5				SM	<b>Quaternary Colluvium (Qcol)</b> – Dark red-brown, moist, loose to medium dense, silty, fine to medium SAND; rootlets throughout
	0.5-11				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Dark red-brown, moist, loose to medium dense, silty, fine to medium SAND; pinhole pores throughout, calcium carbonate stringers, few rootlets, infilled burrows
	11-12				SM	Dark red-brown, moist, dense, silty, fine to medium SAND; calcium carbonate stringers, calcium carbonate infilled burrows, few rootlets, pinhole pores  Total Depth 12', No Groundwater, No Caving, Backfilled 12/21/04
T-11	0-0.5				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, moist, loose to medium dense, silty, fine to medium SAND; rootlets throughout
	0.5-9					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense, severely weathered BEDROCK; well decomposed to silty, fine to coarse sand with weathered granitic cobbles up to 6 inches in diameter  Total Depth 9', No Groundwater, No Caving, Backfilled 12/21/04

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TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-12	0-0.5				SM	<b>Topsoil</b> – Red-brown, moist, loose, silty, fine SAND;; rootlet system throughout
	0.5-4.5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense, weathered BEDROCK; friable, breaks into medium to very coarse sand and gravel, some silts between grains  Total Depth 4.5', No Groundwater, No Caving, Backfilled 12/21/04
T-13	0-5.5				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Red-brown, moist, loose to medium dense, silty, fine SAND; rootlet system to 2½', calcium carbonate stringers
	5.5-9				SM	Light-brown, damp, medium dense, silty, fine to medium SAND; calcium carbonate rich, few pebbles, granitic cobbles surrounded by sand matrix, weathered
	9-12					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Olive-light brown, moist, loose to medium dense, severely weathered BEDROCK; well decomposed to silty fine to medium sand around heavily weathered granitic cobbles  Total Depth 12', No Groundwater, No Caving, Backfilled 12/21/04
T-14	0-4.5				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, moist, medium dense, silty, fine to coarse SAND and GRAVEL; pebbles < 4mm in diameter, rootlets
	4.5-6					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp to moist, dense, weathered BEDROCK; friable, breaks into medium to very coarse sand  Total Depth 6', No Groundwater, No Caving, Backfilled 12/21/04

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TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-15	0-5				SM/GW	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, moist, medium dense, silty, fine to coarse SAND and GRAVEL; pebbles < 4mm in diameter, rootlets
	5-6					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp to moist, dense, weathered BEDROCK; friable, breaks into medium to very coarse sand  Total Depth 6', No Groundwater, No Caving, Backfilled 12/21/04
T-16	0-3				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Red-brown, damp, medium dense, silty, fine to medium SAND and GRAVEL; pebbles range between 2mm and 2 inches in diameter
	3-5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense, weathered BEDROCK; friable, breaks into fine to coarse sand  Total Depth 5', No Groundwater, No Caving, Backfilled 12/21/04
T-17	0-7.5				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Red-brown, damp to slightly moist, loose, silty, fine to coarse SAND; few pebbles, few rootlets, same calcium carbonate stringers  Total Depth 7.5', No Groundwater, No Caving, Backfilled 12/21/04
T-18	0-4				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Dark red-brown, moist, loose to medium dense, silty, fine to medium SAND; rootlets throughout
	4-7					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Light brown, damp, dense to very dense, weathered BEDROCK; slope contact with unit above (possibly a large boulder) latite dike near vertical  Total Depth 7', No Groundwater, No Caving, Backfilled 12/21/04

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TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-19	0-9				SM	<p><b>Quaternary Alluvium Older (Qalo)</b> – Red-brown, damp to moist, medium dense to dense, silty, fine to coarse SAND; rootlets upper 2 feet, pinhole pores throughout, some calcium carbonate stringers</p> <p>Total Depth 9', No Groundwater, No Caving, Backfilled 12/21/04</p>
T-20	0-2.5 2.5-5.5				SM	<p><b>Quaternary Colluvium (Qcol)</b> – Red-brown, moist, medium dense, silty, fine to medium SAND; rootlets throughout, few burrows &lt;1/2 inch in diameter, few pinhole pores</p> <p><b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense, weathered BEDROCK; very friable, breaks into medium to coarse sand</p> <p>Total Depth 5.5', No Groundwater, No Caving, Backfilled 12/21/04</p>
T-21	0-4 4-7				SM	<p><b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to slightly moist, medium dense, silty, fine to medium SAND; root system upper 2 feet, few pinhole pores</p> <p><b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp to slightly moist, dense to very dense, weathered BEDROCK; friable, breaks into medium to very coarse sand</p> <p>Total Depth 7', No Groundwater, No Caving, Backfilled 12/21/04</p>
T-22	0-0.5 0.5-2.5				SM	<p><b>Topsoil</b> – Brown, moist, loose, silty, fine to coarse SAND; rootlet system throughout</p> <p><b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, moist, medium dense to dense, weathered BEDROCK; friable, breaks into medium to coarse sand</p> <p>Total Depth 2.5', No Groundwater, No Caving, Backfilled 12/21/04</p>

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TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-23	0-0.5				SM	<b>Topsoil</b> – Red-brown, moist, loose, silty, fine to medium SAND;; root system throughout
	0.5-4				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Red-brown, moist, medium dense, silty, fine to medium SAND; calcium carbonate stringers, pinhole pores, few angular cobbles towards lower 2 feet
	4-6					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, moist, medium dense to dense, weathered BEDROCK; friable, breaks into medium to coarse sand  Total Depth 6', No Groundwater, No Caving, Backfilled 12/21/04
T-24	0-0.5				SM	<b>Topsoil</b> – Red-brown, moist, loose, silty, fine to medium SAND;; root system throughout
	0.5-3				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Red-brown, moist, medium dense, silty, fine to medium SAND; calcium carbonate stringers, pinhole pores, few angular cobbles towards lower 2 feet
	3-5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, moist, medium dense to dense, weathered BEDROCK; friable, breaks into medium to coarse sand  Total Depth 5', No Groundwater, No Caving, Backfilled 12/22/04
T-25	0-7				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to slightly moist, loose to medium dense, silty, fine SAND; rootlets throughout, no gradation change in grain size  Total Depth 7', No Groundwater, No Caving, Backfilled 12/22/04

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TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-26	0-3.5	B-5 @ 1-3'			SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to slightly moist, loose to medium dense, silty, fine SAND; rootlets throughout, no gradation change in grain size
	3.5-5	B-6 @ 3.5-5'				<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, moist, medium dense to dense, weathered BEDROCK; friable, breaks into medium to coarse sand  Total Depth 5', No Groundwater, No Caving, Backfilled 12/22/04
T-27	0-10				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Red-brown, damp to moist, medium dense to dense, silty, fine to medium SAND;,, rootlets throughout, pinhole pores, calcium carbonate stringers throughout  Total Depth 10', No Groundwater, No Caving, Backfilled 12/22/04
T-28	0-0.5				SM	<b>Topsoil</b> – Red-brown, moist, loose, silty, fine SAND;,, root system
	0.5-3				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Dark brown, moist, medium dense, silty, fine SAND; active root system throughout, pinhole pores throughout, blocky
	3-7				SM	Red-brown, damp to moist, medium dense, silty, fine to medium SAND; few rootlets, pinhole pores throughout, some calcium carbonate stringers, blocky
	7-7.5					Calcium Carbonate Layer – Pale brown, damp, loose, calcium carbonate stringers, porous, flaky
	7.5-9				SM	Red-brown, damp to slightly moist, medium dense, silty, fine SAND
	9-9.5					Boulder – Gray, damp, very dense BOULDER; diorite boulder, fresh
	9.5-10				SM	Red-brown, damp, medium dense, silty, fine SAND; pinhole pores  Total Depth 10', No Groundwater, No Caving, Backfilled 12/22/04

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T-29	0-7				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Red-brown, damp to moist, medium dense, silty, fine to medium SAND; pinhole pores throughout, rootlets throughout, blocky  Total Depth 7', No Groundwater, No Caving, Backfilled 12/22/04
T-30	0-5				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Red-brown, damp to moist, loose to medium dense, silty, fine SAND; pinhole pores, throughout, rootlets in upper 2 feet, calcium carbonate stringers
	5-5.5					Calcium carbonate layer – Pale brown, damp to moist, loose to medium dense, calcium carbonate layer, porous
	5.5-6.5				SM	Dark brown, damp to moist, medium dense to dense, silty, fine SAND; pinhole pores throughout, calcium carbonate stringers, blocky  Total Depth 6.5', No Groundwater, No Caving, Backfilled 12/22/04
T-31	0-8				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Red-brown, moist, loose to medium dense, silty, medium to coarse SAND; grains comprised of displaced Kgr, sand and gravel
	3.5-5					Calcium carbonate layer; 2-3' thick
	8-9	B-7 @ 8-9'				<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Dark gray, damp to moist, dense to very dense, weathered BEDROCK; friable, breaks into medium to coarse sand  Total Depth 9', No Groundwater, No Caving, Backfilled 12/22/04

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T-32	0-2				SM	<b>Topsoil</b> – Brown, damp, loose to medium dense, silty, fine SAND; rootlets throughout, few pinhole pores
	2-9				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Dark red-brown, damp to slightly moist, medium dense to dense, silty, fine SAND; few rootlets, pinhole pores, calcium carbonate stringers, blocky, few pebbles <6 mm in diameter  Total Depth 9', No Groundwater, No Caving, Backfilled 12/22/04
T-33	0-8				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Red-brown, damp, dense to very dense, silty SAND; very well cemented, subangular pebbles <8 mm in diameter, calcium carbonate stringers, blocky  Total Depth 8', No Groundwater, No Caving, Backfilled 12/22/04
T-34	0-4				SM	<b>Artificial Fill Undocumented (Afu)</b> – Red-brown, damp to moist, medium dense, silty, fine to coarse SAND; asphalt blocks, rootlets throughout
	4-6				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Red-brown, damp to moist, medium dense, silty, fine SAND with gravels; pebbles <4 mm in diameter, pinhole pores, calcium carbonate stringers
	6-7					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense to very dense, weathered BEDROCK; friable, breaks down to medium to coarse sand  Total Depth 7', No Groundwater, No Caving, Backfilled 12/22/04

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T-35	0-2				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to moist, loose to medium dense, silty, fine SAND; active root system throughout, porous, some pebbles <10 mm in diameter
	2-4.5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, medium dense, weathered BEDROCK; very friable, breaks into medium to coarse sand  Total Depth 4.5', No Groundwater, No Caving, Backfilled 12/22/04
T-36	0-2				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, moist, loose, silty, fine SAND; few pebbles <4 mm in diameter, rootlets throughout
	2-4.5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp to moist, medium dense to dense, weathered BEDROCK; very friable, breaks into medium to coarse sand, few pockets of silty sand  Total Depth 4.5', No Groundwater, No Caving, Backfilled 12/22/04
T-37	0-7	B-8 @ 0-5'			ML	<b>Quaternary Alluvium Older (Qalo)</b> – Light brown, damp, medium stiff, clayey, sandy SILT; rootlets, calcium carbonate stringers throughout, pinhole pores  Total Depth 7', No Groundwater, No Caving, Backfilled 12/22/04
T-38	0-5				SM	<b>Artificial Fill Undocumented (Afu)</b> – Red-brown, damp to moist, medium dense, silty, fine SAND; scattered pebbles <5 mm in diameter, rootlets throughout
	5-8.5				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Light brown, damp, medium dense, silty, fine SAND; scattered pebbles <5 mm in diameter
	8.5-9.5				SM	Dark gray, damp, medium dense to dense, silty, fine SAND and GRAVEL; pebbles <8 mm in diameter, heavily weathered, calcium carbonate stringers  Total Depth 9.5', No Groundwater, No Caving, Backfilled 12/22/04

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T-39	0-1				SM	<b>Topsoil</b> – Red-brown, damp, loose to medium dense, silty, fine SAND; active root system
	1-7				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Dark red-brown, damp, medium dense to dense, silty, fine SAND and GRAVEL; pebbles <5 mm in diameter, cobbles @ 5' <8 inches
	7					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense to very dense, weathered BEDROCK; friable, breaks into medium to coarse sand  Total Depth 7', No Groundwater, No Caving, Backfilled 12/22/04
T-40	0-3				SM	<b>Topsoil</b> – Red-brown, damp, loose to medium dense, silty, fine SAND; active root system throughout, some calcium carbonate stringers
	3-6.5				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Dark red-brown, damp, medium dense to dense, silty, fine SAND and GRAVEL; calcium carbonate stringers throughout, rounded to angular pebbles <3 mm in diameter throughout, rootlets
	6.5-7					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Gray, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand  Total Depth 7', No Groundwater, No Caving, Backfilled 12/22/04
T-41	0-5				SM	<b>Topsoil/Quaternary Colluvium (Qcol)</b> – Red-brown, damp to slightly moist, loose to medium dense, silty, fine SAND; pinhole pores throughout, active root system throughout
	5-6					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand  Total Depth 6', No Groundwater, No Caving, Backfilled 12/22/04

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T-42	0-2				SM	<b>Topsoil</b> – Red-brown, moist, loose to medium dense, silty, fine SAND; trace roots throughout
	2-4				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to moist, medium dense, silty, fine SAND and GRAVEL; rounded to angular pebbles <3 mm in diameter, rootlets throughout
	4-6					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense to very dense, weathered BEDROCK; friable, rips to medium to coarse sand  Total Depth 6', No Groundwater, No Caving, Backfilled 12/22/04
T-43	0-0.5				SM	<b>Topsoil</b> – Red-brown, moist, medium dense, silty, fine SAND and GRAVEL; scattered pebbles <3 mm in diameter, rootlets throughout, porous
	0.5-3					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense to very dense, weathered BEDROCK; friable, breaks to medium to coarse sand  Total Depth 3', No Groundwater, No Caving, Backfilled 12/22/04
T-44	0-5				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, moist, medium dense, silty, fine SAND and GRAVEL; scattered pebbles <3 mm in diameter, rootlets throughout, porous
	5-6					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense to very dense, weathered BEDROCK; friable, breaks to medium to coarse sand  Total Depth 6', No Groundwater, No Caving, Backfilled 12/22/04
T-45	0-3.5				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, moist, medium dense, silty, fine SAND and GRAVEL; scattered pebbles <3 mm in diameter, rootlets throughout, porous
	3.5-5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense to very dense, weathered BEDROCK; friable, breaks to medium to coarse sand  Total Depth 5', No Groundwater, No Caving, Backfilled 12/22/04

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T-46	0-5				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, moist, medium dense, silty, fine SAND and GRAVEL; scattered pebbles <3 mm in diameter, rootlets, porous
	5-6				SM	Red-brown, damp, medium dense to dense, silty, fine SAND; scattered pebbles <3 mm in diameter, micaceous
	6-7					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense to very dense, weathered BEDROCK; friable, breaks to medium to coarse sand  Total Depth 7', No Groundwater, No Caving, Backfilled 12/22/04
T-65	0-2				SM	<b>Topsoil-</b> Red-brown, damp to moist, loose, silty, fine SAND; scattered pebbles <3mm in diameter, dense root system throughout, pinhole pores very common
	2-6				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to moist, medium dense, silty, fine SAND and GRAVEL; subrounded pebbles between 2mm and 20 mm in diameter, rootlets throughout, pinhole pores very common
	6-7					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense, weathered BEDROCK; friable, breaks into medium to coarse sand  Total Depth 7', No Groundwater, No Caving, Backfilled 12/27/04
T-66	0-4				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to moist, loose to medium dense, silty, fine SAND; scattered pebbles <3mm in diameter, rootlets
	4-7.5				SM	Red-brown, damp to moist, medium dense, silty, fine SAND and GRAVEL; subrounded pebbles between 2mm and 20 mm in diameter, rootlets throughout, pinhole pores very common
	7.5-8					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense, weathered BEDROCK; friable, breaks into medium to coarse sand  Total Depth 8', No Groundwater, No Caving, Backfilled 12/27/04

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T-67	0-1				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to moist, loose to medium dense, silty, fine SAND; scattered pebbles <3mm in diameter, rootlets throughout
	1-2.5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp to moist, dense, weathered BEDROCK; friable, breaks into medium to coarse sand, mafic 80%, felsic 20%
						Total Depth 2.5', No Groundwater, No Caving, Backfilled 12/27/04
T-68	0-3				SM	<b>Undocumented Artificial Fill (Afu)</b> – Red-brown, damp to moist, loose to medium dense, silty, fine SAND; scattered rootlets, few large roots
	2-3				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to moist, medium dense, silty, fine SAND and GRAVEL; subrounded pebbles between 2mm and 20 mm in diameter, rootlets throughout, pinhole pores very common
	3-3.5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense to very dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 3.5', No Groundwater, No Caving, Backfilled 12/27/04
T-69	0-5				SM	<b>Undocumented Artificial Fill (Afu)</b> – Yellow-red-brown, damp to moist, loose to medium dense, silty, fine to coarse SAND and GRAVEL; scattered pebbles <3mm in diameter
	5-6.5				SM	<b>Quaternary Colluvium (Qcol)</b> – Dark red-brown, damp to slightly moist, medium dense to dense, silty, fine SAND and GRAVEL; subrounded to subangular pebbles between <20 mm in diameter
	6.5-7.5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Dark red-brown, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 7.5', No Groundwater, No Caving, Backfilled 12/27/04

**LOG OF TEST PITS**

**Project No.** 111446-001  
**CLIENT:** Victoria Grove

**LOGGED BY:** PC  
**DATE:** 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-70	0-3				SM	<b>Topsoil</b> – Red-brown, moist, loose to medium dense, silty, fine SAND; few low-laying boulders, rootlets throughout, pinhole pores very common
	3-5				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, moist, medium dense, silty, fine SAND; scattered pebbles and granitic boulders, pinhole pores common
	5-5.5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Dark red-brown, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand  Total Depth 5.5', No Groundwater, No Caving, Backfilled 12/27/04
T-71	0-3				SM	<b>Topsoil</b> – Red-brown, damp to moist, loose, silty, fine SAND; scattered pebbles <20mm in diameter, rootlets throughout, slightly clayey at bottom
	3-4					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Blue-gray, damp to moist, dense, weathered BEDROCK; friable, breaks into medium to coarse sand and gravel  Total Depth 4', No Groundwater, No Caving, Backfilled 12/27/04
T-72	0-2.5				SM	<b>Topsoil</b> – Red-brown, damp, loose to medium dense, silty, fine SAND; scattered pebbles <5mm in diameter, rootlets throughout, pinhole pores common
	2.5-4.5				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Dark red-brown, damp, dense to very dense, silty, fine SAND; Manganese deposits very common, pinhole pores common, rootlets throughout
	4.5-7.5				SM	Red-brown, damp, dense, silty, fine to coarse SAND; manganese deposits common, calcium carbonate stringers common, pinhole pores common, blocky texture  Total Depth 7.5', No Groundwater, No Caving, Backfilled 12/27/04

**LOG OF TEST PITS**

**Project No.** 111446-001  
**CLIENT:** Victoria Grove

**LOGGED BY:** PC  
**DATE:** 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-73	0-0.5				SM	<b>Topsoil</b> – Red-brown, moist, loose to medium dense, silty, fine SAND; scattered pebbles <3mm in diameter, rootlets throughout, pinhole pores common
	0.5-1.5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense, weathered BEDROCK; friable, breaks into medium to coarse sand
	1.5-2.5					Blue-gray, damp, dense, weathered BEDROCK; friable, breaks into medium to coarse sand and gravel
						Total Depth 2.5', No Groundwater, No Caving, Backfilled 12/27/04
T-74	0-2.5				SM	<b>Topsoil</b> – Red-brown, moist, loose, silty, fine SAND; rootlets throughout, pinhole pores common
	2.5-3.5				SP	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to moist, medium dense to dense, silty, fine SAND and GRAVEL; cobble sized gravel
	3.5-4				SP	<b>Quaternary Alluvium Older (Qalo)</b> – Red-brown, damp to moist, dense, silty, sandy, GRAVEL; calcium carbonate stringers common, blocky texture
						Total Depth 4', No Groundwater, No Caving, Backfilled 12/27/04
T-75	0-1.5				SM	<b>Topsoil</b> – Red-brown, moist, loose, clayey, silty, fine SAND; scattered pebbles <3mm in diameter, rootlets throughout, pinhole pores common
	1.5-2					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp to moist, dense, heavily weathered BEDROCK; friable, breaks into medium to coarse sand
	2-4					Blue-gray, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 4', No Groundwater, No Caving, Backfilled 12/27/04

**LOG OF TEST PITS**

**Project No.** 111446-001  
**CLIENT:** Victoria Grove

**LOGGED BY:** PC  
**DATE:** 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-76	0-1.5				SM	<b>Topsoil</b> – Red-brown, moist, medium dense, clayey, fine SAND; scattered pebbles, rootlets throughout, pinhole pores common
	1.5-5.5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense, weathered BEDROCK; friable, breaks into medium to coarse sand  Total Depth 5.5', No Groundwater, No Caving, Backfilled 12/27/04
T-77	0-3				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to moist, medium dense, silty, fine SAND; scattered pebbles <3mm in diameter, pinhole pores common, rootlets throughout, cobbles at 2.5' and pinch out towards the SE
	3-6				SM/ SP	<b>Quaternary Alluvium Older (Qalo)</b> – Dark red-brown, damp, dense, silty, fine SAND; scattered pebbles <3mm in diameter, pinhole pores common, calcium carbonate stringers common, blocky texture  Total Depth 6', No Groundwater, No Caving, Backfilled 12/27/04
T-78	0-2.5				SM	<b>Topsoil</b> – Red-brown, damp, loose to medium dense, silty, fine SAND; scattered pebbles <5mm in diameter, pinhole pores common, rootlets throughout
	2.5-4				SM/ SP	<b>Quaternary Colluvium (Qcol)</b> – Blue-gray, damp to moist, dense, silty GRAVEL; silts tightly packed between granitic pebbles
	4					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Blue-gray, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand and gravel  Total Depth 4', No Groundwater, No Caving, Backfilled 12/27/04

**LOG OF TEST PITS**

**Project No.** 111446-001  
**CLIENT:** Victoria Grove

**LOGGED BY:** PC  
**DATE:** 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-79	0-10				SM	<b>Quaternary Colluvium (Qcol)</b> – Light brown, damp, medium dense, silty, fine SAND; scattered pebbles <3mm in diameter, rootlets throughout, pinhole pores very common, calcium carbonate stringers common, sand fines upwards  Total Depth 10', No Groundwater, No Caving, Backfilled 12/27/04
T-80	0-4.5				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to moist, medium dense, silty, fine to coarse SAND; scattered pebbles <4mm in diameter, very porous, rootlets throughout
	4.5-6					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Blue-brown, damp, very dense, weathered BEDROCK; slightly friable, breaks into medium to coarse sand and gravel  Total Depth 6', No Groundwater, No Caving, Backfilled 12/27/04
T-81	0-3				SM	<b>Topsoil</b> – Red-brown, moist, loose, silty, fine SAND; scattered pebbles, porous, rootlets common
	3-8				SM	<b>Quaternary Alluvium Older (Qalo)</b> – Dark red-brown, damp, dense, silty, fine SAND; scattered pebbles, porous, calcium carbonate stringers common  Total Depth 8', No Groundwater, No Caving, Backfilled 12/27/04
T-82	0-3.5				SM	<b>Topsoil</b> – Red-brown, damp to moist, medium dense, silty, fine SAND; scattered pebbles <3mm in diameter, porous, rootlets common
	3.5-4					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand  Total Depth 4', No Groundwater, No Caving, Backfilled 12/27/04

**LOG OF TEST PITS**

**Project No.** 111446-001  
**CLIENT:** Victoria Grove

**LOGGED BY:** PC  
**DATE:** 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-83	0-1				SM	<b>Undocumented Artificial Fill (Afu)</b> — Red-brown, damp, loose, silty, fine to coarse SAND and GRAVEL
	1-3				SM	<b>Quaternary Alluvium Older (Qalo)</b> — Dark red-brown, damp, medium dense, silty, fine SAND; scattered pebbles <5mm in diameter, porous, calcium carbonate stringers common, rootlets common
	3-7				SM/ SP	Dark red-brown, damp, dense, silty, fine to coarse SAND; cobbles at 6'
	7-8					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> — Dark green-gray, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 8', No Groundwater, No Caving, Backfilled 12/27/04

**APPENDIX C1**  
**LABORATORY TESTING**  
**(AGS)**

# ANAHEIM TEST LAB, INC

3008 ORANGE AVENUE  
SANTA ANA, CALIFORNIA 92707  
PHONE (714) 549-7267

Advanced Geotechnical Solutions  
2842 Walnut Avenue, Suite C-1  
Tustin, CA 92780

DATE: 09/30/15

P.O. NO.: Chain of Custody

LAB NO.: B-8710-2

SPECIFICATION: CA 301

MATERIAL: Brown, D.G.

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Project #: 1507-05  
Victoria Heights  
Date sampled: 09/15/15

## ANALYTICAL REPORT

### "R" VALUE

BY EXUDATION

BY EXPANSION

EX-14 @ 6'

72

75

RESPECTFULLY SUBMITTED



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WES BRIDGER CHEMIST

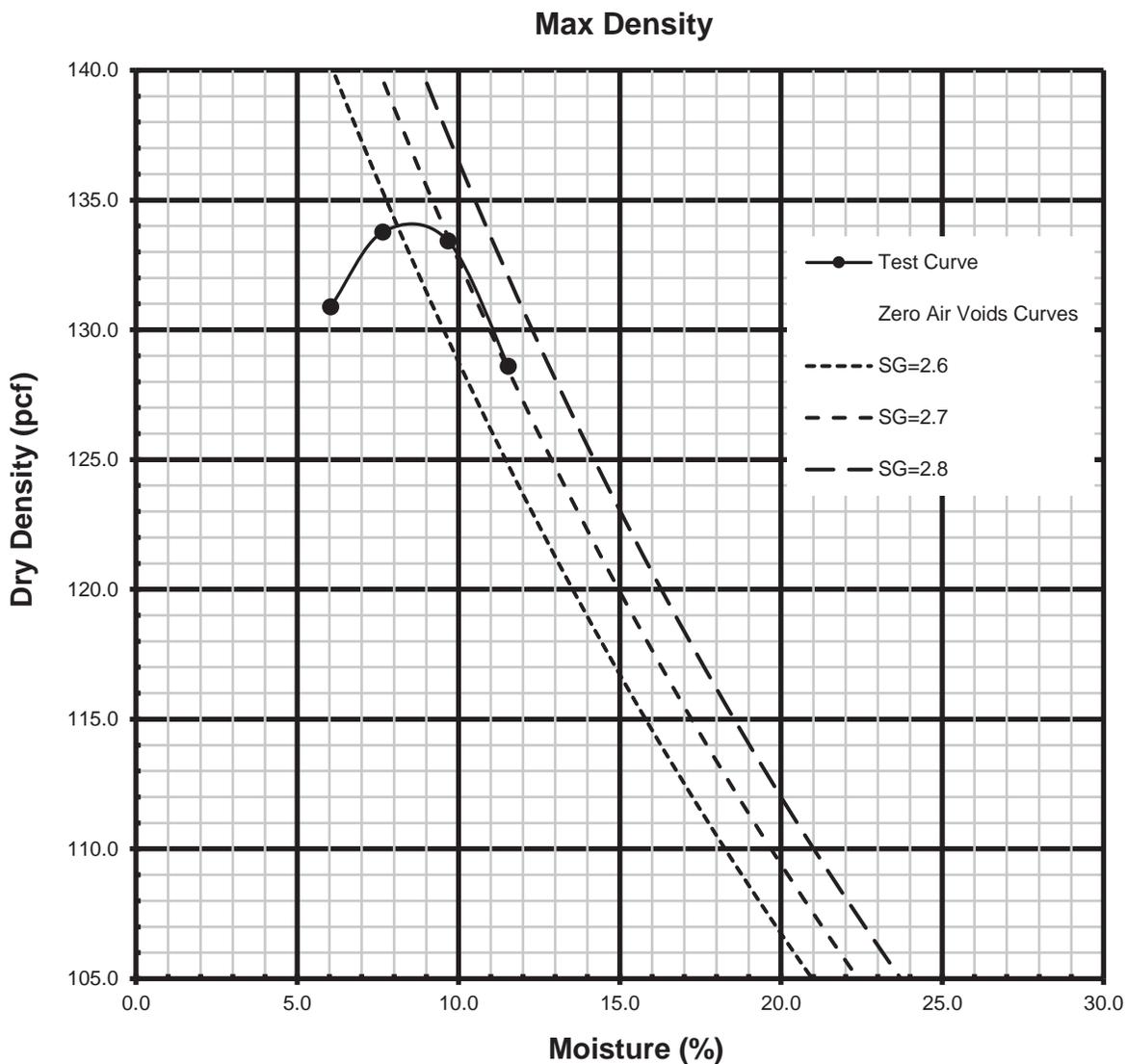
**ADVANCED GEOTECHNICAL SOLUTIONS, INC.**

**MAXIMUM DENSITY - ASTM D1557**

Project Name: Greentree Ranch  
 Location: \_\_\_\_\_  
 Project No.: 1507-05  
 Date: 9/23/2015

Excavation: EX-19  
 Depth: 1'  
 Description: \_\_\_\_\_  
 By: H-M

	Method A			
Test Number	1	2	3	4
Dry Density (pcf)	130.9	133.8	133.4	128.6
Moisture Content (%)	6.0	7.7	9.7	11.5



Maximum Density 134.0 pcf

Optimum Moisture 8.5 %

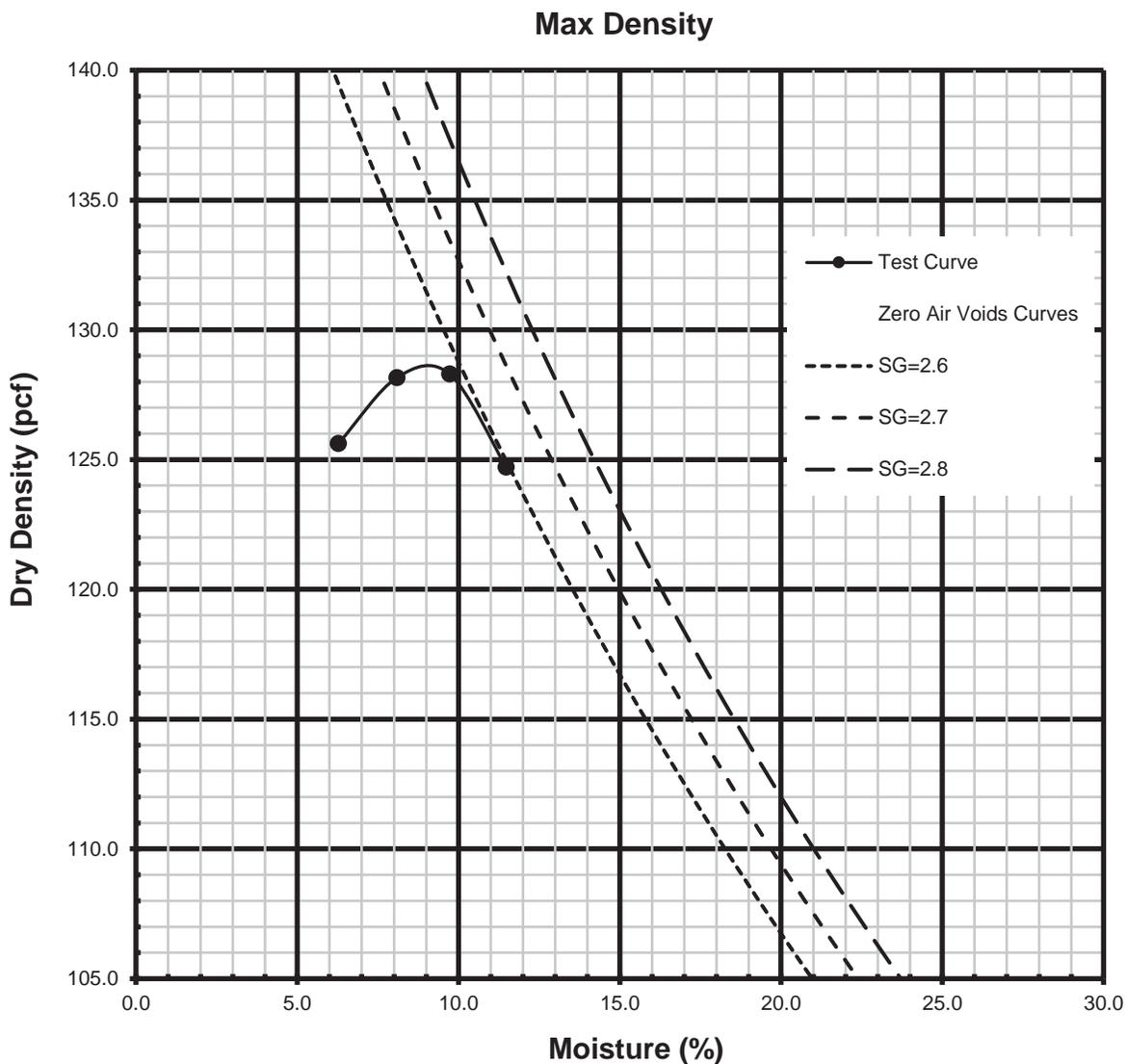
**ADVANCED GEOTECHNICAL SOLUTIONS, INC.**

**MAXIMUM DENSITY - ASTM D1557**

Project Name: Greentree Ranch  
 Location: \_\_\_\_\_  
 Project No.: 1507-05  
 Date: 9/23/2015

Excavation: EX-9  
 Depth: 12'  
 Description: \_\_\_\_\_  
 By: H-M

	Method A			
Test Number	1	2	3	4
Dry Density (pcf)	125.6	128.2	128.3	124.7
Moisture Content (%)	6.3	8.1	9.7	11.5



Maximum Density 128.5 pcf

Optimum Moisture 9.0 %

**ADVANCED GEOTECHNICAL SOLUTIONS, INC.**

**EXPANSION INDEX - ASTM D4829**

Project Name: Greentree Ranch  
Location: \_\_\_\_\_  
File No: 1507-05  
Date: 9/24/15

Excavation: EX-19  
Depth: 1'  
Description: Silty Sand  
By: \_\_\_\_\_

<b>Expansion Index - ASTM D4829</b>	
Initial Dry Density (pcf):	120.1
Initial Moisture Content (%):	7.5
Initial Saturation (%):	50.3
Final Dry Density (pcf):	113.5
Final Moisture Content (%):	14.8
Final Saturation (%):	99.1
Expansion Index:	8
Potential Expansion:	Very Low

ASTM D4829 - Table 5.3	
Expansion Index	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High

# ADVANCED GEOTECHNICAL SOLUTIONS, INC.

## DIRECT SHEAR - ASTM D3080

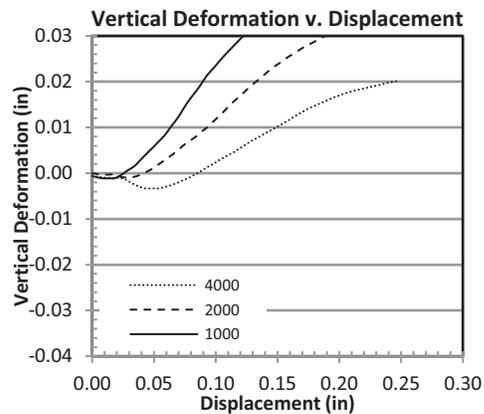
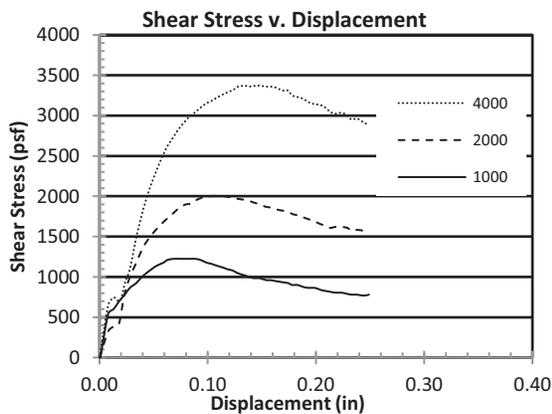
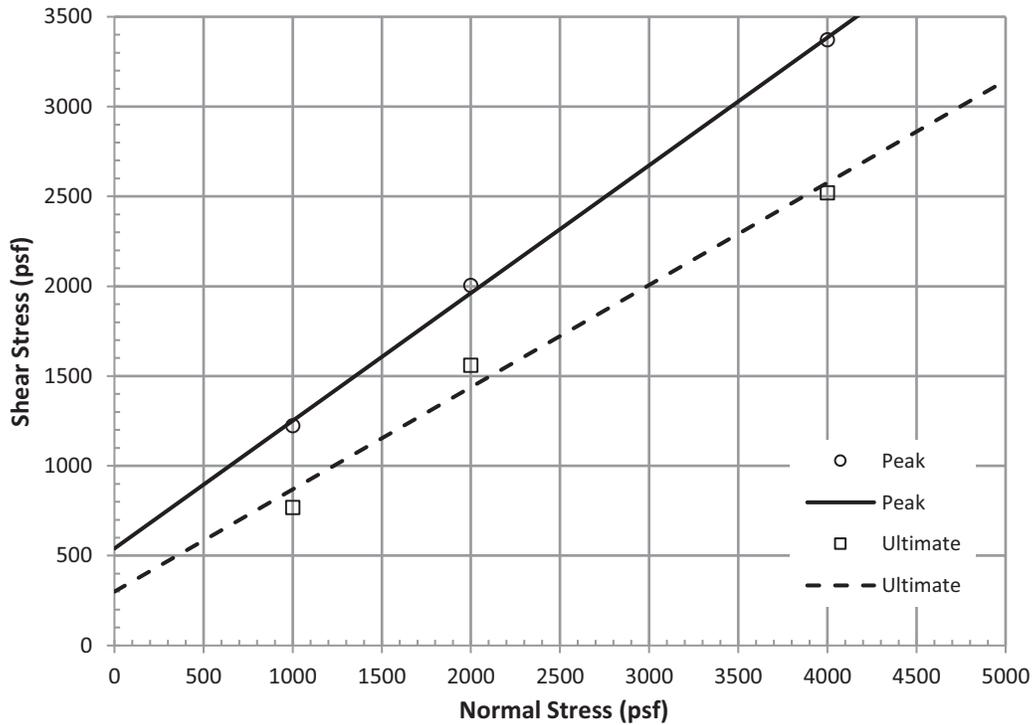
Project Name: Greentree Ranch  
 Location: \_\_\_\_\_  
 Project No.: 1507-05  
 Date: 9/25/15

Excavation: EX-9  
 Depth: 12  
 Sample Type: Remold 90%  
 By: 0

Samples Tested	1	2	3
Normal Stress (psf)	1000	2000	4000
Maximum Shear Stress (psf)	1224	2004	3372
Ultimate Shear Stress (psf)	768	1560	2520
Initial Moisture Content (%)	9.0	9.0	9.0
Initial Dry Density (pcf)	115.7	115.7	115.7

Method: Drained  
 Consolidation: Yes  
 Saturation: Yes  
 Shearing Rate (in/min): 0.04

	Peak	Ultimate
Friction Angle, phi (deg)	35	30
Cohesion (psf)	540	300



# ADVANCED GEOTECHNICAL SOLUTIONS, INC.

## DIRECT SHEAR - ASTM D3080

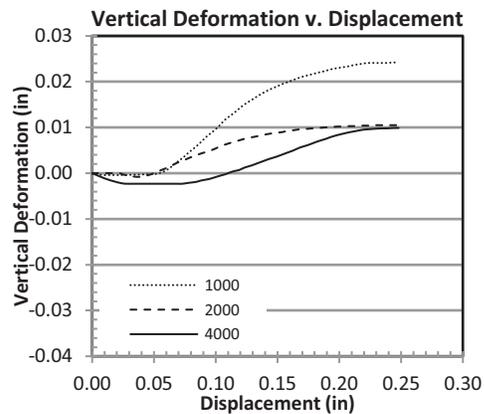
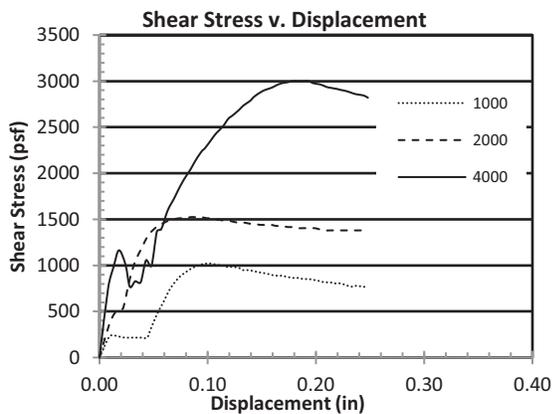
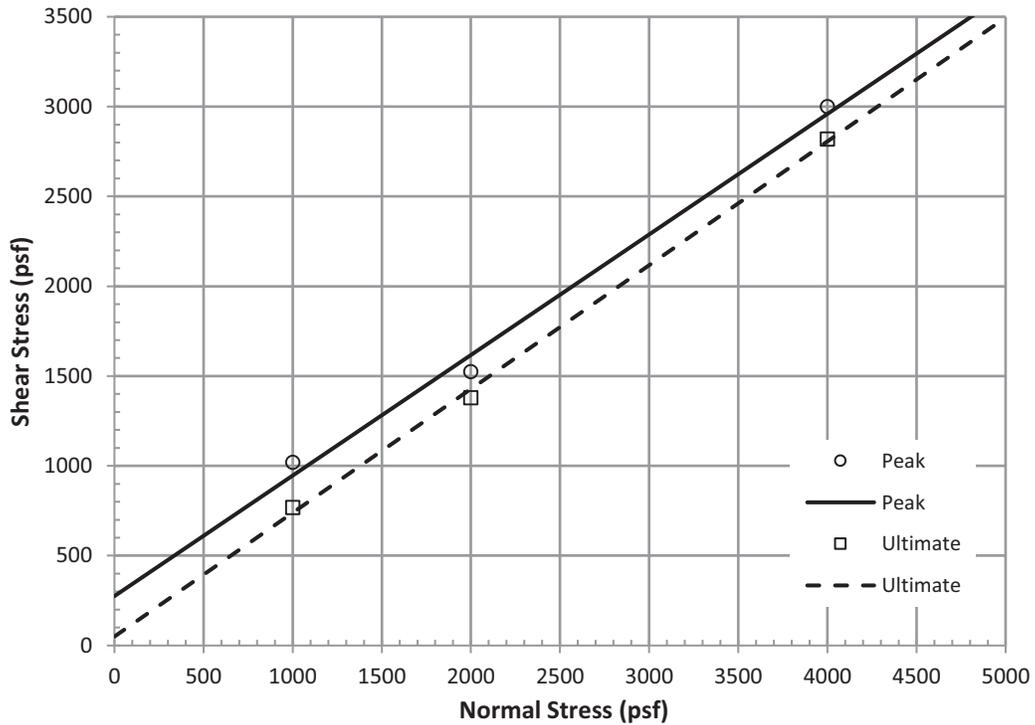
Project Name: Greentree  
 Location: \_\_\_\_\_  
 Project No.: 1507-05  
 Date: 9/26/15

Excavation: EX-19  
 Depth: 1  
 Sample Type: Remold 90%  
 By: 0

Samples Tested	1	2	3
Normal Stress (psf)	4000	2000	1000
Maximum Shear Stress (psf)	3000	1524	1020
Ultimate Shear Stress (psf)	2820	1380	768
Initial Moisture Content (%)	120.6	120.6	120.6
Initial Dry Density (pcf)	8.5	8.5	8.5

Method: Drained  
 Consolidation: Yes  
 Saturation: Yes  
 Shearing Rate (in/min): 0.04

	Peak	Ultimate
Friction Angle, phi (deg)	34	35
Cohesion (psf)	275	50



# ADVANCED GEOTECHNICAL SOLUTIONS, INC.

## DIRECT SHEAR - ASTM D3080

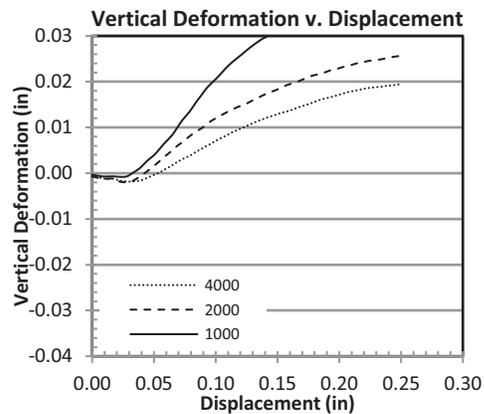
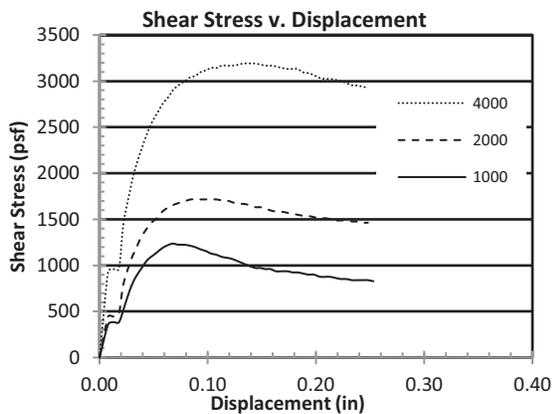
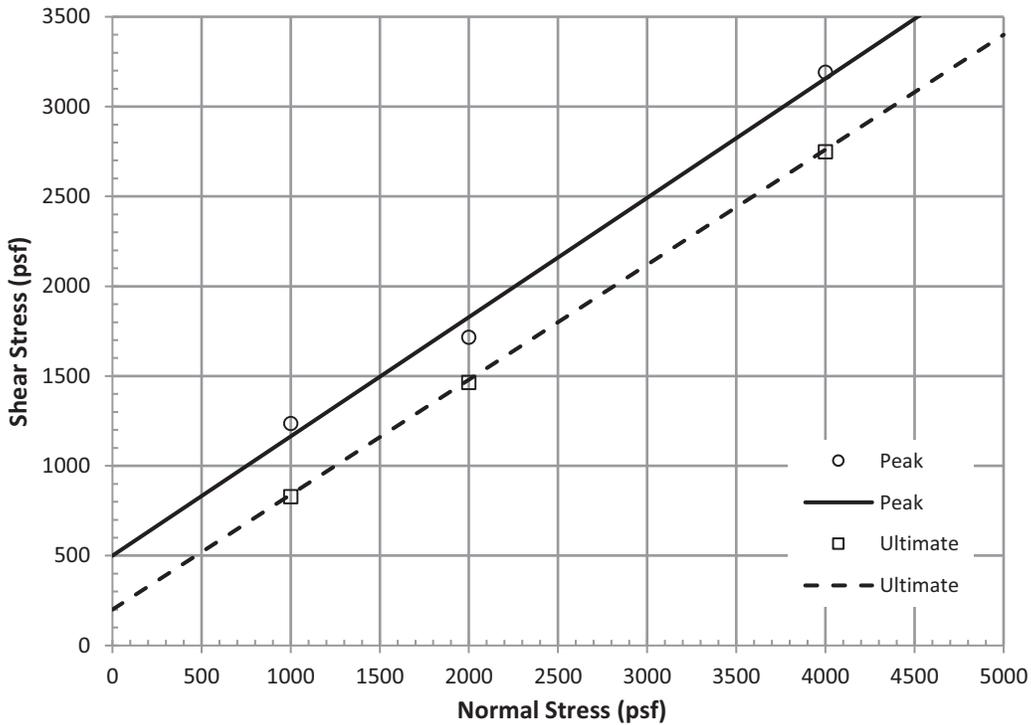
Project Name: Greentree Ranch  
 Location: \_\_\_\_\_  
 Project No.: 1507-05  
 Date: 9/5/15

Excavation: T-2  
 Depth: 4-5  
 Sample Type: Remold 90%  
 By: 0

Samples Tested	1	2	3
Normal Stress (psf)	1000	2000	4000
Maximum Shear Stress (psf)	1236	1716	3192
Ultimate Shear Stress (psf)	828	1464	2748
Initial Moisture Content (%)	8.5	8.5	8.5
Initial Dry Density (pcf)	118.8	118.8	118.8

Method: Drained  
 Consolidation: Yes  
 Saturation: Yes  
 Shearing Rate (in/min): 0.04

	Peak	Ultimate
Friction Angle, phi (deg)	34	33
Cohesion (psf)	500	200



# ADVANCED GEOTECHNICAL SOLUTIONS, INC.

## DIRECT SHEAR - ASTM D3080

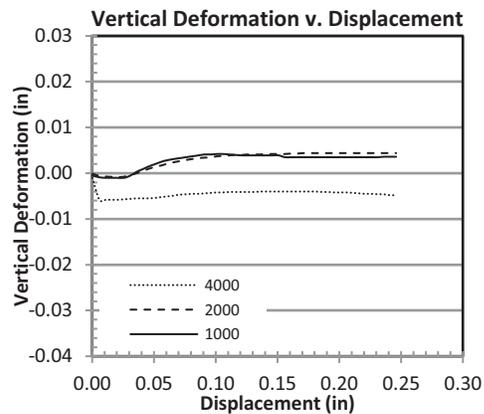
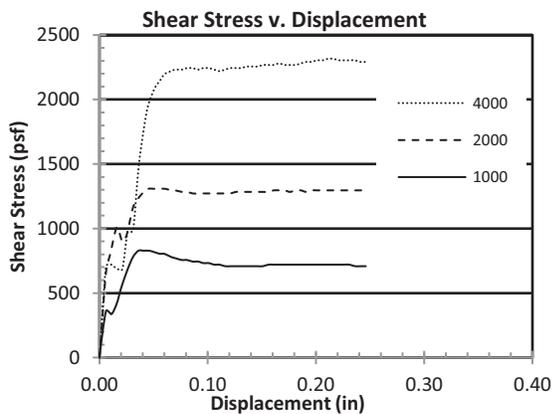
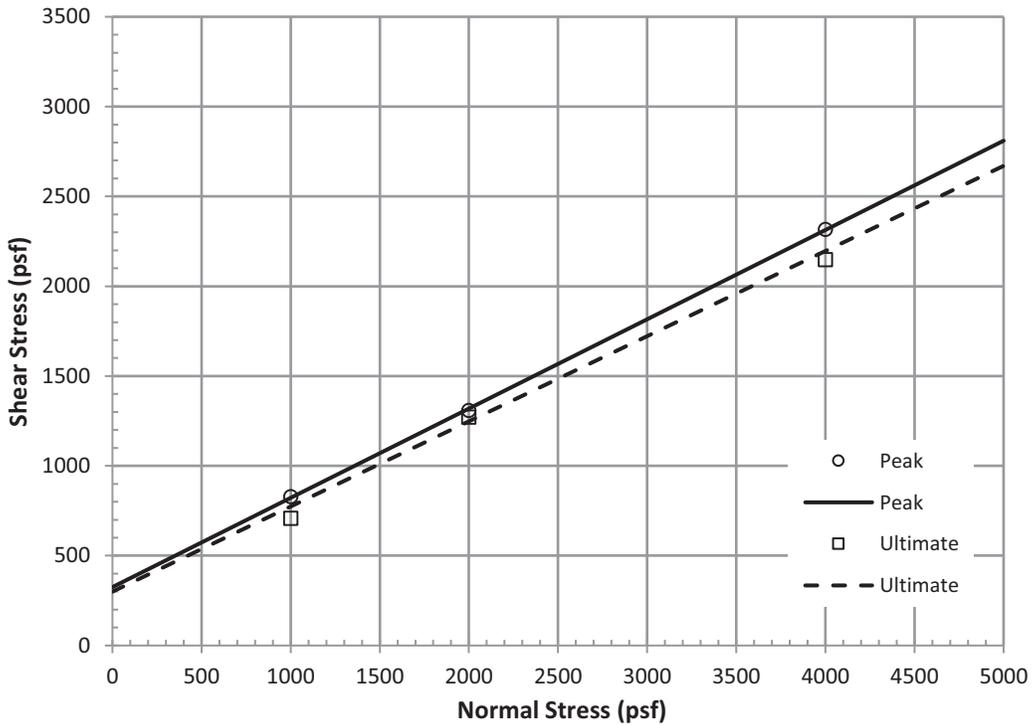
Project Name: Greentree Ranch  
 Location: \_\_\_\_\_  
 Project No.: 1507-05  
 Date: 9/6/15

Excavation: T-1  
 Depth: 2-3  
 Sample Type: Remold 90%  
 By: 0

Samples Tested	1	2	3
Normal Stress (psf)	1000	2000	4000
Maximum Shear Stress (psf)	828	1308	2316
Ultimate Shear Stress (psf)	708	1272	2148
Initial Moisture Content (%)	11.0	11.0	11.0
Initial Dry Density (pcf)	113.4	113.4	113.4

Method: Drained  
 Consolidation: Yes  
 Saturation: Yes  
 Shearing Rate (in/min): 0.04

	Peak	Ultimate
Friction Angle, phi (deg)	26	25
Cohesion (psf)	325	300



# ANAHEIM TEST LAB, INC

3008 ORANGE AVENUE  
SANTA ANA, CALIFORNIA 92707  
PHONE (714) 549-7267

Advanced Geotechnical Solutions, Inc  
2842 Walnut Avenue, Suite C-1  
Tustin, CA 92780

Attn: Sean Donovan

DATE: 09/25/15

P.O. NO.: Chain of Custody

LAB NO.: B-8710-1

SPECIFICATION: CA-417/422/643

MATERIAL: Soil

J.N.: 1507-05  
Date sampled: 09/15/15  
Project: Victoria Heights  
Sample ID: EX-7 @ 2'-3'

## ANALYTICAL REPORT

### CORROSION SERIES SUMMARY OF DATA

PH	SOLUBLE SULFATES per CA. 417 ppm	SOLUBLE CHLORIDES per CA. 422 ppm	MIN. RESISTIVITY per CA. 643 ohm-cm
7.2	1,074	507	980

RESPECTFULLY SUBMITTED



WES BRIDGER CHEMIST

**APPENDIX C2**  
**LABORATORY TESTING**  
**(LEIGHTON AND ASSOCIATES 2005)**

Boring No.	LB-1	LB-1	LB-1	LB-2	LB-2	LB-2	LB-2	LB-2
Sample No.	R-1	R-2	R-3	R-1	R-2	R-4	R-5	R-7
Depth (ft.)	2.5	5	7.5	2.5	5	10	12.5	17.5
Sample Type	RING	RING	RING	RING	RING	RING	RING	RING
Visual Soil Classification	SM	SM	SM	SM	SM	SM	SM	SM
Pocket Penetrometer								
Weight Soil + Rings / Tube (gm.)	1124.0	965.7	1079.5	991.1	922.4	1180.1	1301.8	1222.6
Weight of Rings / Tube (gm.)	267.0	222.5	222.5	222.5	222.5	267.0	267.0	267.0
Average Length (in.)	6.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0
Average Diameter (in.)	2.416	2.416	2.416	2.416	2.416	2.416	2.416	2.416
Wet. Wt. of Soil + Cont. (gm.)	183.8	190.0	201.7	184.7	165.4	156.4	226.3	194.5
Dry Wt. of Soil + Cont. (gm.)	166.7	178.1	193.3	167.4	160.5	148.5	213.6	179.3
Weight of Container (gm)	50.0	50.4	50.7	51.1	50.2	50.2	50.3	49.9
Container No.:	I	9	H	3	T	A	2	M
Wet Density	118.7	123.5	142.4	127.7	116.3	126.5	143.3	132.3
Moisture Content (%)	14.7	9.3	5.9	14.9	4.4	8.0	7.8	17.2
Dry Density (pcf)	103.5	113.0	134.5	111.2	111.4	117.1	132.9	112.9
Degree of Saturation (%)	63	51	63	78	23	49	79	94

**MOISTURE & DENSITY of SOILS  
ASTM D 2937**



Leighton and Associates, Inc.

Project Name: VICTORIA GROVE

Project No.: 111446-001

Client Name: \_\_\_\_\_

Tested By: AJP

Date: 01/26/05

Rev. 08-04

Boring No.	LB-2	LB-3	LB-3	LB-6	LB-4	LB-4	LB-4	LB-4
Sample No.	R-9	R-1	R-2	R-1	R-1	R-3	R-5	R-6
Depth (ft.)	22.5	5	7.5	2.5	2.5	7.5	12.5	15
Sample Type	RING	RING	RING	RING	RING	RING	RING	RING
Visual Soil Classification	SM	SM/SW	SM	SM	ML	SM	SM	SM/ML
Pocket Penetrometer								0.75
Weight Soil + Rings / Tube (gm.)	985.7	609.8	387.7	821.7	788.3	1182.5	818.5	752.4
Weight of Rings / Tube (gm.)	222.5	133.5	89.0	178.0	178.0	267.0	178.0	178.0
Average Length (in.)	5.0	3.0	2.0	4.0	4.0	6.0	4.9	4.0
Average Diameter (in.)	2.416	2.416	2.416	2.416	2.416	2.416	2.416	2.416
Wet. Wt. of Soil + Cont. (gm.)	184.0	175.2	161.2	186.4	227.5	207.1	194.9	164.5
Dry Wt. of Soil + Cont. (gm.)	180.8	171.7	158.2	183.5	203.7	191.3	183.2	157.6
Weight of Container (gm)	50.2	50.3	51.0	49.6	50.2	50.0	50.3	50.3
Container No.:	P	L	R	V	K	X	O	5
Wet Density	126.8	131.9	124.1	133.7	126.8	126.8	133.1	119.3
Moisture Content (%)	2.5	2.9	2.8	2.2	15.5	11.2	8.8	6.4
Dry Density (pcf)	123.8	128.2	120.7	130.9	109.8	114.0	122.3	112.1
Degree of Saturation (%)	18	25	19	20	78	63	63	34

**MOISTURE & DENSITY of SOILS  
ASTM D 2937**



**Leighton and Associates, Inc.**

Rev. 08-04

Project Name: VICTORIA GROVE  
Project No.: 111446-001  
Client Name: \_\_\_\_\_  
Tested By: AJP Date: 01/26/05

Boring No.	LB-5	LB-5	LB-5	LB-5				
Sample No.	R-1	R-2	R-4	R-6				
Depth (ft.)	2.5	5	10	15				
Sample Type	RING	RING	RING	RING				
Visual Soil Classification	ML	SM	ML	SM				
Pocket Penetrometer			4.50					
Weight Soil + Rings / Tube (gm.)	971.6	791.7	1236.7	1276.9				
Weight of Rings / Tube (gm.)	222.5	178.0	267.0	267.0				
Average Length (in.)	5.0	4.0	6.0	6.0				
Average Diameter (in.)	2.416	2.416	2.416	2.416				
Wet. Wt. of Soil + Cont. (gm.)	168.7	182.8	208.9	213.9				
Dry Wt. of Soil + Cont. (gm.)	149.6	165.3	185.9	196.9				
Weight of Container (gm)	50.4	49.5	49.6	50.4				
Container No.:	7	8	Y	Z				
Wet Density	124.5	127.5	134.3	139.9				
Moisture Content (%)	19.3	15.1	16.9	11.6				
Dry Density (pcf)	104.4	110.8	114.9	125.3				
Degree of Saturation (%)	85	78	98	91				

**MOISTURE & DENSITY of SOILS  
ASTM D 2937**



**Leighton and Associates, Inc.**

Rev. 08-04

Project Name: VICTORIA GROVE

Project No.: 111446-001

Client Name: \_\_\_\_\_

Tested By: AJP

Date: 01/26/05

Boring No.	T-6						
Sample No.	B-1						
Depth (ft.)	0-6.5						
Sample Type	CHUNK						
Visual Soil Classification	SM						
Pocket Penetrometer							
Weight Soil + Rings / Tube (gm.)	161.3						
Weight of Rings / Tube (gm.)	44.5						
Average Length (in.)	1.0						
Average Diameter (in.)	2.416						
Wet. Wt. of Soil + Cont. (gm.)	195.6						
Dry Wt. of Soil + Cont. (gm.)	188.0						
Weight of Container (gm)	50.3						
Container No.:	6						
Wet Density	97.1						
Moisture Content (%)	5.5						
Dry Density (pcf)	92.0						
Degree of Saturation (%)	18						

**MOISTURE & DENSITY of SOILS  
ASTM D 2937**



**Leighton and Associates, Inc.**

Rev. 08-04

Project Name: VICTORIA GROVE

Project No.: 111446-001

Client Name: \_\_\_\_\_

Tested By: JMD

Date: 01/03/05



Project Name: VICTORIA GROVE EAST Tested By: RGO Date: 01/21/05  
 Project No.: 111446-001 Checked By: PRC Date: 01/21/05  
 Boring No.: \_\_\_\_\_ Depth (ft.): \_\_\_\_\_  
 Sample No.: SA-1

Visual Sample Description: SM, DARK BROWN SILTY SAND

		Moisture Content of Total Air - Dry Soil	
Container No.:	A	Wt. of Air-Dry Soil + Cont. (gm.)	299.8
Wt. of Air Dry Soil+Cont.(gm.)	299.8	Wt. of Dry Soil + Cont. (gm.)	273.9
Wt. of Container (gm.)	0.0	Wt. of Container No. <u>A</u> (gm.)	84.6
Dry Wt. of Soil (gm.)	263.7	Moisture Content (%)	13.7

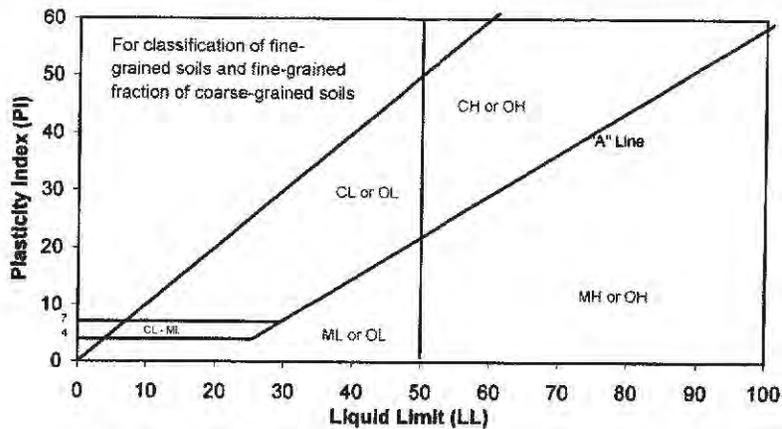
After Wet Sieve	Container No.	A
	Wt. of Dry Soil + Container (gm.)	126.5
	Wt. of Container (gm.)	84.6
	Dry Wt. of Soil Retained on # 200 Sieve (gm.)	41.9

U. S. Sieve Size		Cumulative Weight Dry Soil Retained (gm.)	Percent Passing (%)
(in.)	(mm.)		
6"	152.400		
3"	75.000		
1 1/2"	37.500		
3/4"	19.000		
3/8"	9.500	0.0	100.0
#4	4.750	6.0	97.7
#8	2.360	39.0	85.2
#16	1.180	84.0	68.1
#30	0.600	129.1	51.0
#50	0.300	157.0	40.5
#100	0.150	172.4	34.6
#200	0.075	177.4	32.7
PAN			

GRAVEL: 2 %  
 SAND: 65 %  
 FINES: 33 %  
 GRP. SYMBOL: SM

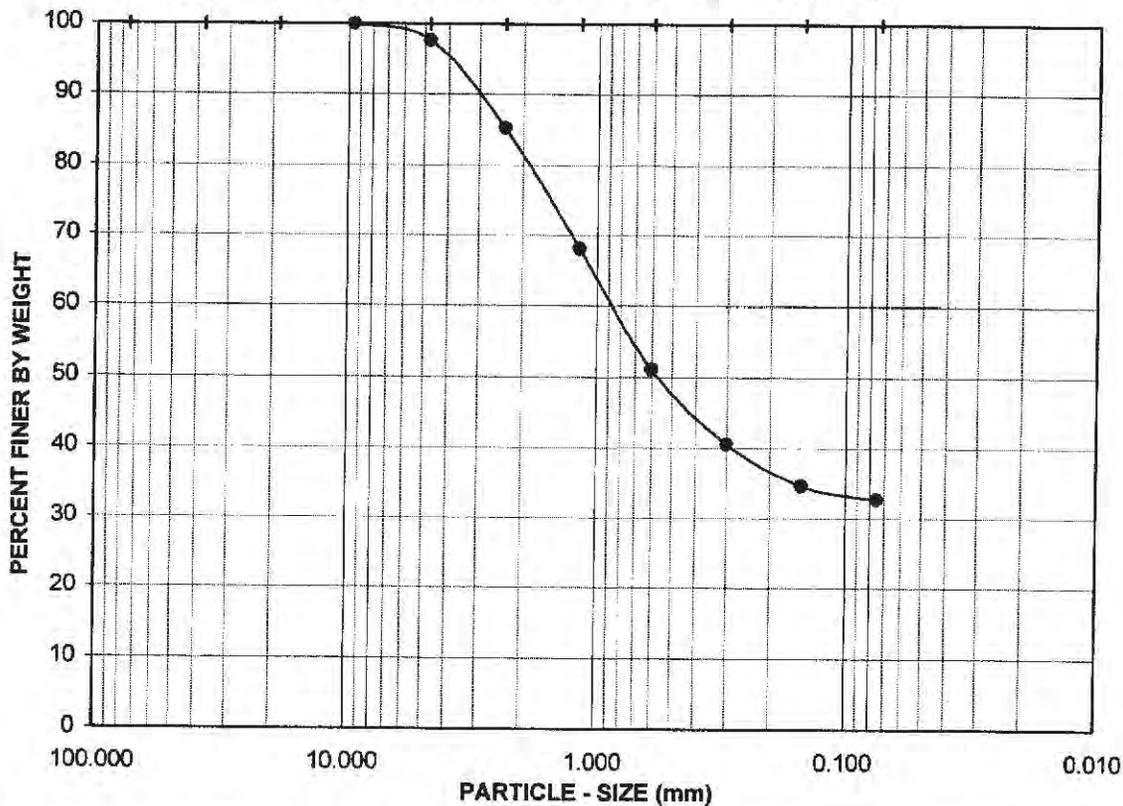
Liquid Limit:   
 Plastic Limit:   
 Plasticity Index: N/A  
 Cu = D60/D10 =  
 Cc = (D30)<sup>2</sup>/(D60\*D10) =

Remarks: \_\_\_\_\_



GRAVEL		SAND			FINES
COARSE	FINE	COARSE	MEDIUM	FINE	SILT / CLAY

U.S. STANDARD SIEVE OPENING      U.S. STANDARD SIEVE NUMBER  
 3.0"    1 1/2"    3/4"    3/8"    #4    #8    #16    #30    #50    #100    #200



Boring No.:	Sample No.:	Depth (ft.):	Soil Type	GR:SA:FI	LL,PL,PI
	SA-1		SM	2 : 65 : 33	N/A

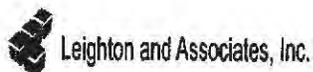
Visual Sample Description:  
 SM, DARK BROWN SILTY SAND

Project No.: 111446-001

VICTORIA GROVE EAST

ATTERBERG LIMITS, PARTICLE - SIZE CURVE

ASTM D 4318, D 422





Project Name: VICTORIA GROVE

Tested By : AJP/RGO

Date: 01/07/05

Project No. : 111446-001

Data Input By: JMD

Date: 01/10/05

Boring No.: T-37

Checked By: PRC

Date: 01/10/05

Sample No.: B-8

Depth (ft.) : 0-5

Visual Sample Description: ML, GREY SANDY SILT

Liquid Limit:		LL, PL, PI:	N/A	Moisture Content of Total Air-Dry Soils	Moisture Content of Air-Dry Soils Passing # 10	After Hydrometer & wet sieve ret. on #200 sieve
Plastic Limit:		GR:SA:FI:	0/21/79			
Plasticity Index:	N/A	Grp. Symbol:	ML			
Specific Gravity (Assumed)	2.70	Wt. of Air-Dry Soil + Cont. (gm.)		132.1	132.2	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (gm.)			128.6	93.4
Wt. of Air-Dry Soil + Cont. (gm.)	102.7	Wt. of Container No. ___ (gm.)		83.5	83.5	83.5
Wt. of Container	0.0	Moisture Content (%)			8.0	
Dry Wt. of Soil (gm.)	102.70	Wt. of Dry Soil (gm.)				9.9

**Coarse Sieve**

U.S. Sieve Size	Cumulative Wt. of Dry Soil Retained (gm)	% Passing
3"		
1½"		
¾"		
3/8"		
No. 4	0.0	100.0
No. 10	0.5	100.6
Pan		

**Sieve after Hydrometer & Wet Sieve**

U.S. Sieve Size	Cumulative Wt. of Dry Soil Retained (gm)	% Passing	% Total Sample
No. 10	0.0	100.0	100.6
No. 20	1.1	97.6	98.2
No. 40	2.4	94.7	95.3
No. 60	4.1	90.9	91.4
No. 100	6.1	86.5	87.0
No. 200	8.9	78.0	78.5
Pan			

**Hydrometer**

Wt. of Air-Dry Soil (gm)

48.7

Wt. of Dry Soil (gm)

45.1

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152 H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
1/7/05	7:32	0	20	5.0			
	7:34	2	20	5.0	26.0	46.4	0.033
	7:37	5	20	5.0	21.0	35.3	0.022
	7:47	15	20	5.0	17.5	27.6	0.013
	8:02	30	20	5.0	16.0	24.3	0.009
	8:32	60	20	5.0	15.0	22.1	0.006
	9:32	120	18	5.0	14.0	19.9	0.005
	11:42	250	18	5.0	13.0	17.7	0.003
1/8/05	7:32	1440	20	5.0	9.0	8.8	0.001





Leighton and Associates, Inc.

**PARTICLE-SIZE ANALYSIS of SOILS**  
ASTM D 422

Project Name: VICTORIA GROVE Tested By: JMD Date: 01/03/05  
 Project No.: 111446-001 Checked By: PRC Date: 01/05/05  
 Boring No.: T-6 Depth (ft.): 0-6.5  
 Sample No.: B-2  
 Visual Sample Description: ML, BROWN SANDY SILT

		Moisture Content of Total Air - Dry Soil	
Container No.:	A	Wt. of Air-Dry Soil + Cont. (gm.)	282.5
Wt. of Air Dry Soil+Cont.(gm.)	17266.4	Wt. of Dry Soil + Cont. (gm.)	270.7
Wt. of Container (gm.)	0.0	Wt. of Container No. A (gm.)	83.2
Dry Wt. of Soil (gm.)	17266.4	Moisture Content (%)	6.3

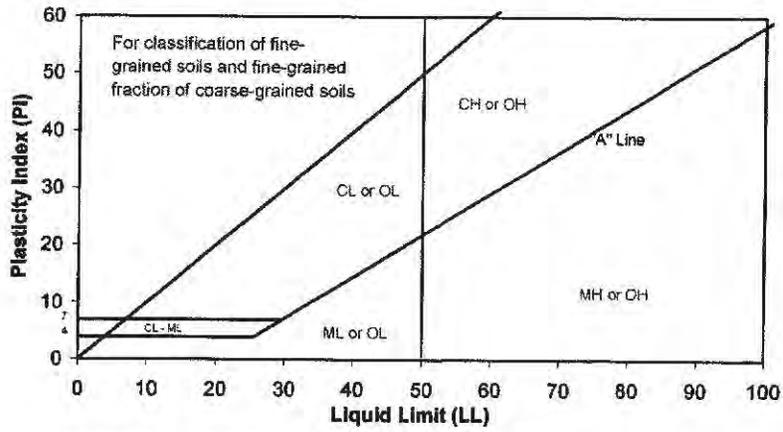
After Wet Sieve	Container No.	A
	Wt. of Dry Soil + Container (gm.)	145.5
	Wt. of Container (gm.)	83.2
	Dry Wt. of Soil Retained on # 200 Sieve (gm.)	62.3

U. S. Sieve Size		Cumulative Weight Dry Soil Retained (gm.)	Percent Passing (%)
(in.)	(mm.)		
6"	152.400		
3"	75.000		
1 1/2"	37.500		
3/4"	19.000		
3/8"	9.500		
#4	4.750	0.0	100.0
#8	2.360	0.5	99.7
#16	1.180	3.2	98.3
#30	0.600	11.3	94.0
#50	0.300	23.1	87.7
#100	0.150	39.3	79.0
#200	0.075	61.0	67.5
PAN			

GRAVEL: 0 %  
 SAND: 32 %  
 FINES: 68 %  
 GRP. SYMBOL: ML

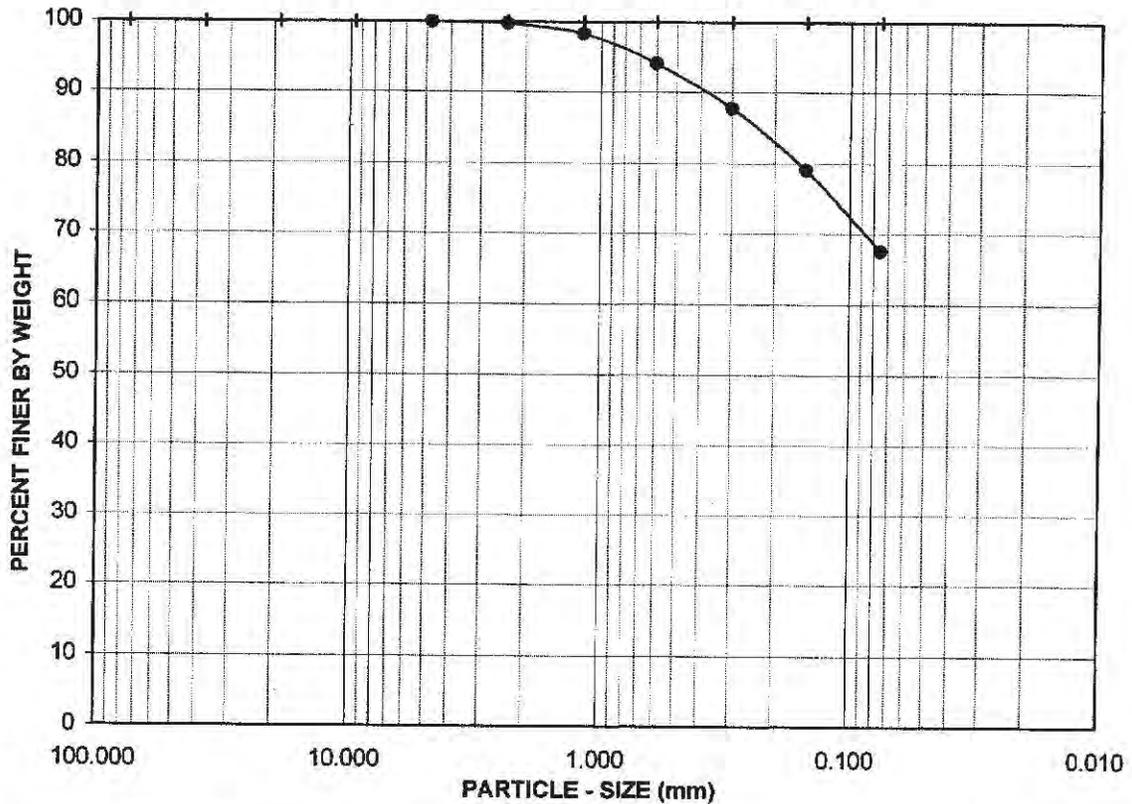
Liquid Limit:   
 Plastic Limit:   
 Plasticity Index: **N/A**  
 Cu = D60/D10 =  
 Cc = (D30)<sup>2</sup>/(D60\*D10) =

Remarks: \_\_\_\_\_



GRAVEL		SAND			FINES
COARSE	FINE	CRSE	MEDIUM	FINE	SILT / CLAY

U.S. STANDARD SIEVE OPENING      U.S. STANDARD SIEVE NUMBER  
 3.0"   1 1/2"   3/4"   3/8"   #4   #8   #16   #30   #50   #100   #200



Boring No.:	Sample No.:	Depth (ft.):	Soil Type	GR:SA:FI	LL,PL,PI
T-6	B-2	0-6.5	ML	0 : 32 : 68	N/A

Visual Sample Description:  
ML, BROWN SANDY SILT

Project No.: 111446-001

VICTORIA GROVE

ATTERBERG LIMITS, PARTICLE - SIZE CURVE

ASTM D 4318, D 422

Leighton and Associates, Inc.



Leighton and Associates, Inc.

**COMPACTION TEST**

ASTM D 1557

Project Name: VICTORIA GROVE Tested By: AJP Date: 1/3/05  
 Project No.: 111446-001 Calculated By: PRC Date: 1/5/05  
 Boring No.: T-6 Depth (ft.): 0-6.5  
 Sample No.: B-2  
 Sample Description ML, BROWN SANDY SILT

Preparation Method:  Moist  Dry  Mechanical Ram  Manual Ram  
 Mold Volume (ft<sup>3</sup>) 0.03344 Ram Weight 10 LBS Drop 18 inches

Moisture Added	100	50	150	0		
<b>TEST NO.</b>	1	2	3	4		
Wt. Comp. Soil + Mold (gm.)	5782	5695	5754	5584		
Wt. of Mold (gm.)	3639	3639	3639	3639		AS
Net Wt. of Soil (gm.)	2143	2056	2115	1945		REC'D
Wet Wt. of Soil + Cont. (gm.)	139.0	127.1	138.8	138.1		138.1
Dry Wt. of Soil + Cont. (gm.)	128.2	119.3	126.1	131.9		131.9
Wt. of Container (gm.)	12.6	12.6	12.6	12.6		12.6
Moisture Content (%)	9.3	7.3	11.2	5.2		5.2
Wet Density (pcf)	141.3	135.5	139.4	128.2		
Dry Density (pcf)	129.2	126.3	125.4	121.9		

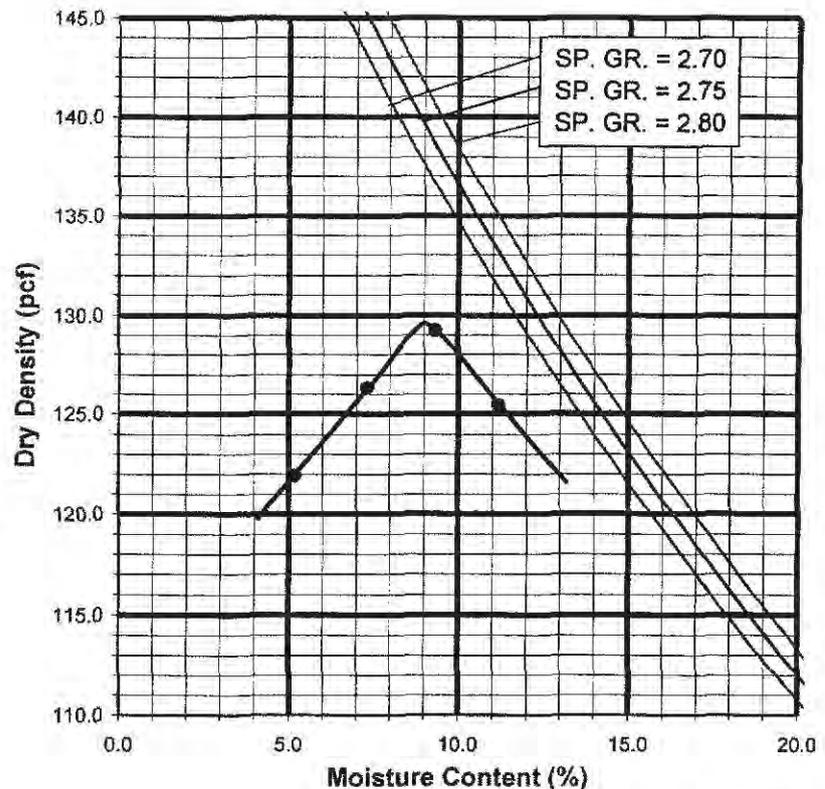
Maximum Dry Density (pcf) 129.5 Optimum Moisture Content (%) 9.0

**PROCEDURE USED**

- Procedure A**  
 Soil Passing No. 4 (4.75 mm) Siev  
 Mold: 4 in. (101.6 mm) diamete  
 Layers: 5 (Five)  
 Blows per layer: 25 (twenty-five)  
 May be used if No. 4 retained <20%
- Procedure B**  
 Soil Passing 3/8 in. (9.5 mm) Siev  
 Mold: 4 in. (101.6 mm) diamete  
 Layers: 5 (Five)  
 Blows per layer: 25 (twenty-five)  
 Use if + No. 4 >20% and +3/8 in. <20%
- Procedure C**  
 Soil Passing 3/4 in. (19.0 mm) Siev  
 Mold: 6 in. (152.4 mm) diamete  
 Layers: 5 (Five)  
 Blows per layer: 56 (fifty-six)  
 Use if +3/8 in. >20% and +3/4 in. <30%

**Particle-Size Distribution:**

GR:SA:FI  
**Atterberg Limits:**  
 LL,PL,PI



Rev. 08-04



Project Name: VICTORIA GROVE Tested By: AJP Date: 1/3/05  
 Project No.: 111446-001 Calculated By: PRC Date: 1/5/05  
 Boring No.: T-8 Depth (ft.): 6.5-8.5  
 Sample No.: B-4  
 Sample Description SM, BROWN SILTY SAND

Preparation Method:  Moist  Dry  Mechanical Ram  Manual Ram  
 Mold Volume (ft<sup>3</sup>) 0.0324 Ram Weight 10 LBS Drop 18 inches

Moisture Added	50	0	100	150		
TEST NO.	1	2	3	4		
Wt. Comp. Soil + Mold (gm.)	5607	5525	5695	5705		
Wt. of Mold (gm.)	3639	3639	3639	3639		AS
Net Wt. of Soil (gm.)	1968	1886	2056	2066		REC'D
Wet Wt. of Soil + Cont. (gm.)	141.3	151.5	121.7	140.4		151.5
Dry Wt. of Soil + Cont. (gm.)	128.7	140.2	109.4	124.0		141.4
Wt. of Container (gm.)	12.6	12.6	12.6	12.6		12.6
Moisture Content (%)	10.9	8.9	12.7	14.7		7.8
Wet Density (pcf)	129.7	124.3	135.5	136.2		
Dry Density (pcf)	117.0	114.2	120.3	118.7		

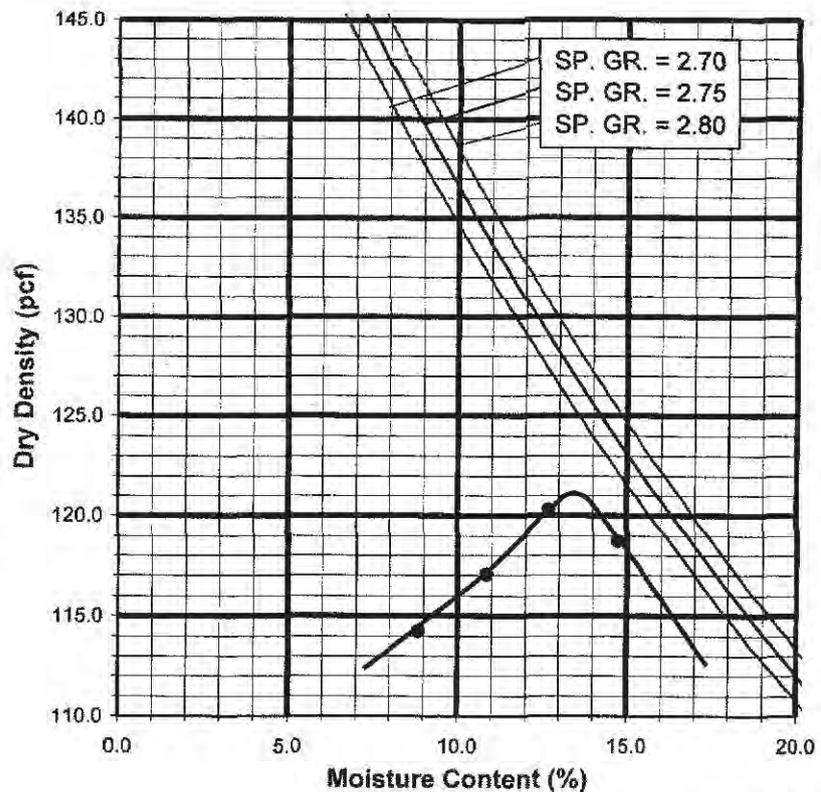
Maximum Dry Density (pcf) 121.0 Optimum Moisture Content (%) 13.5

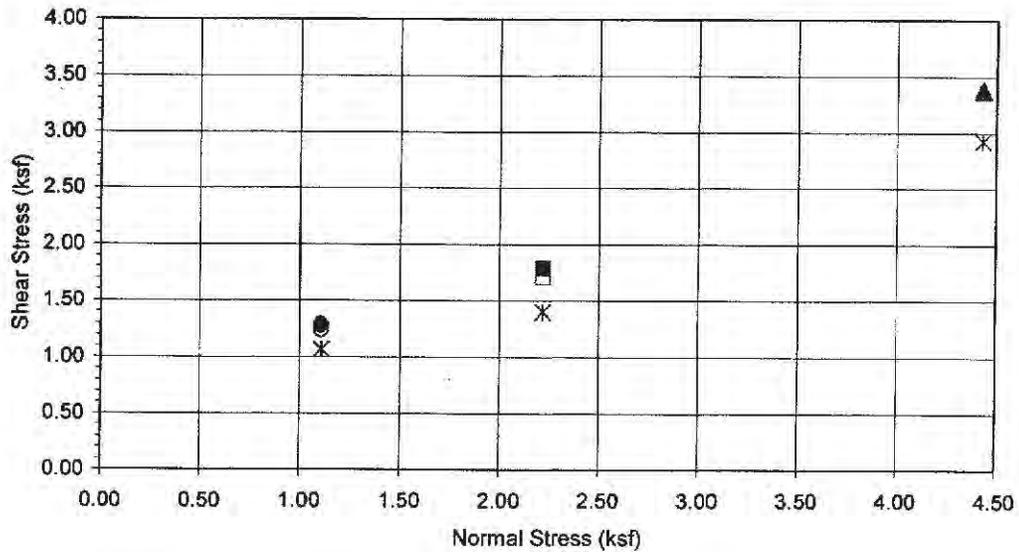
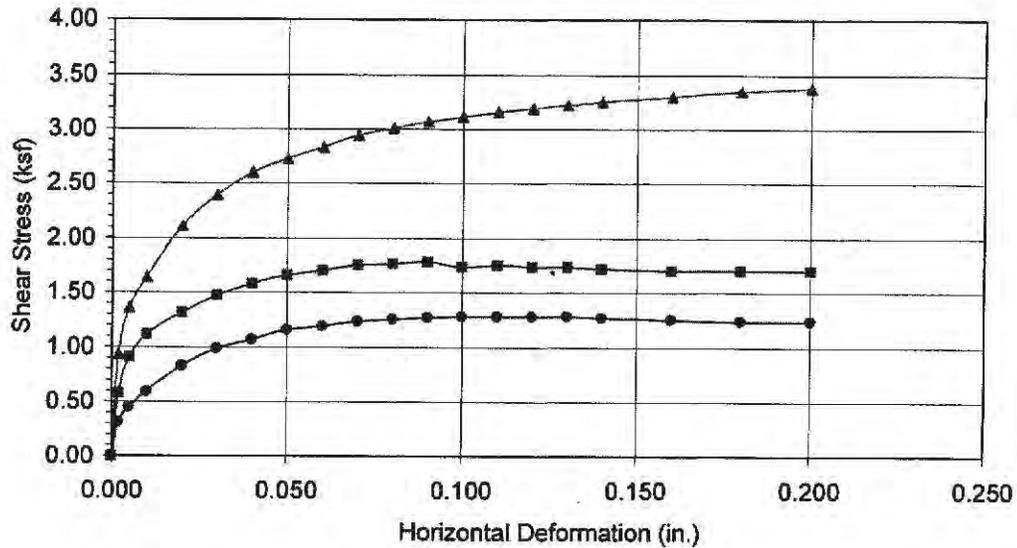
PROCEDURE USED

- Procedure A  
 Soil Passing No. 4 (4.75 mm) Siev  
 Mold: 4 in. (101.6 mm) diamete  
 Layers: 5 (Five)  
 Blows per layer: 25 (twenty-five)  
 May be used if No. 4 retained <20%
- Procedure B  
 Soil Passing 3/8 in. (9.5 mm) Siev  
 Mold: 4 in. (101.6 mm) diamete  
 Layers: 5 (Five)  
 Blows per layer: 25 (twenty-five)  
 Use if + No. 4 >20% and +3/8 in. <20%
- Procedure C  
 Soil Passing 3/4 in. (19.0 mm) Siev  
 Mold: 6 in. (152.4 mm) diamete  
 Layers: 5 (Five)  
 Blows per layer: 56 (fifty-six)  
 Use if +3/8 in. >20% and +3/4 in. <30%

Particle-Size Distribution:

GR:SA:FI  
 Atterberg Limits:  
 LL,PL,PI





Normal Stress (kip/ft <sup>2</sup> )	1.108	2.216	4.432
Peak Shear Stress (kip/ft <sup>2</sup> )	● 1.283	■ 1.784	▲ 3.380
Shear Stress @ End of Test (ksf)	○ 1.236	□ 1.706	△ 3.380
Relaxed Value (ksf)	X 1.064	X 1.393	X 2.927
Deformation Rate (in./min.)	0.010	0.010	0.010
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.416	2.416	2.416
Initial Moisture Content (%)	9.0	9.0	9.0
Dry Density (pcf)	119.1	119.1	119.1
Saturation (%)	58.5	58.5	58.5
Soil Height Before Shearing (in.)	N/A	N/A	N/A
Final Moisture Content (%)	21.6	19.7	20.8

**DIRECT SHEAR TEST RESULTS**

Consolidated Drained - ASTM D 3080  
Sample Remolded to 92% Relative Compaction



Leighton and Associates, Inc.

Boring No.: LB-2  
Sample No.: R-1  
Depth (ft): 2.5  
Soil Description: ML, BROWN SANDY SILT

Project No.: 111446-001

VICTORIA GROVE



Leighton and Associates, Inc.

**EXPANSION INDEX of SOILS**  
ASTM D 4829

Project Name: VICTORIA GROVE Tested By: AJP Date: 1/3/05  
 Project No.: 111446-001 Checked By: PRC Date: 1/5/05  
 Boring No.: T-26 Depth (ft.): 3.5-5  
 Sample No.: B-6 Location: \_\_\_\_\_  
 Sample Description: SM, BROWN SILTY SAND

Dry Wt. of Soil + Cont. (gm.)	2000.0
Wt. of Container No. (gm.)	0.0
Dry Wt. of Soil (gm.)	2000.0
Weight Soil Retained on #4 Sieve	0.0
Percent Passing # 4	100.0

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0142
Wt. Comp. Soil + Mold (gm.)	588.1	622.7
Wt. of Mold (gm.)	199.6	199.6
Specific Gravity (Assumed)	2.70	2.70
Container No.	E-7	E-7
Wet Wt. of Soil + Cont. (gm.)	312.6	622.7
Dry Wt. of Soil + Cont. (gm.)	287.8	356.4
Wt. of Container (gm.)	12.6	199.6
Moisture Content (%)	9.0	18.7
Wet Density (pcf)	117.2	127.5
Dry Density (pcf)	107.5	107.4
Void Ratio	0.568	0.590
Total Porosity	0.362	0.371
Pore Volume (cc)	75.0	77.9
Degree of Saturation (%) [ S meas]	42.8	85.6

**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.)
1/3/05	14:20	1.0	0	0.5000
1/3/05	14:30	1.0	10	0.4995
Add Distilled Water to the Specimen				
1/4/05	7:20	1.0	1010	0.5142
1/4/05	8:20	1.0	1070	0.5142

Expansion Index (EI meas) = ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	14.7
Expansion Index (EI) <sub>60</sub> = EI meas - (50 - S meas)x((65+EI meas) / (220-S meas))	11



**EXPANSION INDEX of SOILS**  
ASTM D 4829

Project Name: VICTORIA GROVE Tested By: AJP Date: 1/3/05  
 Project No. : 111446-001 Checked By: PRC Date: 1/5/05  
 Boring No.: T-7 Depth (ft.) 3-8  
 Sample No. : B-3 Location: \_\_\_\_\_  
 Sample Description: SM, BROWN SILTY SAND

Dry Wt. of Soil + Cont. (gm.)	2000.0
Wt. of Container No. (gm.)	0.0
Dry Wt. of Soil (gm.)	2000.0
Weight Soil Retained on #4 Sieve	0.0
Percent Passing # 4	100.0

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0063
Wt. Comp. Soil + Mold (gm.)	639.7	659.2
Wt. of Mold (gm.)	209.7	209.7
Specific Gravity (Assumed)	2.70	2.70
Container No.	E-5	E-5
Wet Wt. of Soil + Cont. (gm.)	312.6	659.2
Dry Wt. of Soil + Cont. (gm.)	289.1	396.3
Wt. of Container (gm.)	12.6	209.7
Moisture Content (%)	8.5	13.4
Wet Density (pcf)	129.7	135.4
Dry Density (pcf)	119.5	119.4
Void Ratio	0.410	0.419
Total Porosity	0.291	0.295
Pore Volume (cc)	60.2	61.5
Degree of Saturation (%) [ S meas]	55.9	86.5

**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.)
1/3/05	13:50	1.0	0	0.5000
1/3/05	14:00	1.0	10	0.4991
Add Distilled Water to the Specimen				
1/4/05	7:20	1.0	1040	0.5063
1/4/05	8:20	1.0	1100	0.5063

Expansion Index (EI meas) = ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	<b>7.2</b>
Expansion Index (EI) <sub>50</sub> = EI meas - (50 - S meas)x((65+EI meas) / (220-S meas))	<b>10</b>



**EXPANSION INDEX of SOILS**  
ASTM D 4829

Project Name: VICTORIA GROVE Tested By: AJP Date: 1/3/05  
 Project No. : 111446-001 Checked By: PRC Date: 1/5/05  
 Boring No.: T-26 Depth (ft.) 1-3  
 Sample No. : B-5 Location: \_\_\_\_\_  
 Sample Description: SM, BROWN SILTY SAND

Dry Wt. of Soil + Cont. (gm.)	2000.0
Wt. of Container No. (gm.)	0.0
Dry Wt. of Soil (gm.)	2000.0
Weight Soil Retained on #4 Sieve	0.0
Percent Passing # 4	100.0

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0186
Wt. Comp. Soil + Mold (gm.)	588.9	631.4
Wt. of Mold (gm.)	202.0	202.0
Specific Gravity (Assumed)	2.70	2.70
Container No.	E-6	E-6
Wet Wt. of Soil + Cont. (gm.)	312.6	631.4
Dry Wt. of Soil + Cont. (gm.)	289.1	356.6
Wt. of Container (gm.)	12.6	202.0
Moisture Content (%)	8.5	20.4
Wet Density (pcf)	116.7	129.4
Dry Density (pcf)	107.6	107.4
Void Ratio	0.567	0.596
Total Porosity	0.362	0.374
Pore Volume (cc)	74.9	78.8
Degree of Saturation (%) [ S meas]	40.5	92.4

**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.)
1/3/05	14:00	1.0	0	0.5000
1/3/05	14:10	1.0	10	0.4978
Add Distilled Water to the Specimen				
1/4/05	7:20	1.0	1030	0.5186
1/4/05	8:20	1.0	1090	0.5186

Expansion Index (EI meas) = ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	<b>20.8</b>
Expansion Index (EI) <sub>50</sub> = EI meas - (50 - S meas)x((65+EI meas) / (220-S meas))	<b>16</b>



# One-Dimensional Swell or Settlement Potential of Cohesive Soils

(ASTM D 4546)

Project Name: VICTORIA GROVE  
 Project No.: 111446-001  
 Boring No.: LB-4  
 Sample No.: R-1  
 Sample Description: SM, BROWN SILTY SAND

Tested By: JMD Date: 2/7/05  
 Checked By: PSC Date: 2/7/05  
 Sample Type: IN SITU  
 Depth (ft.) 2.5

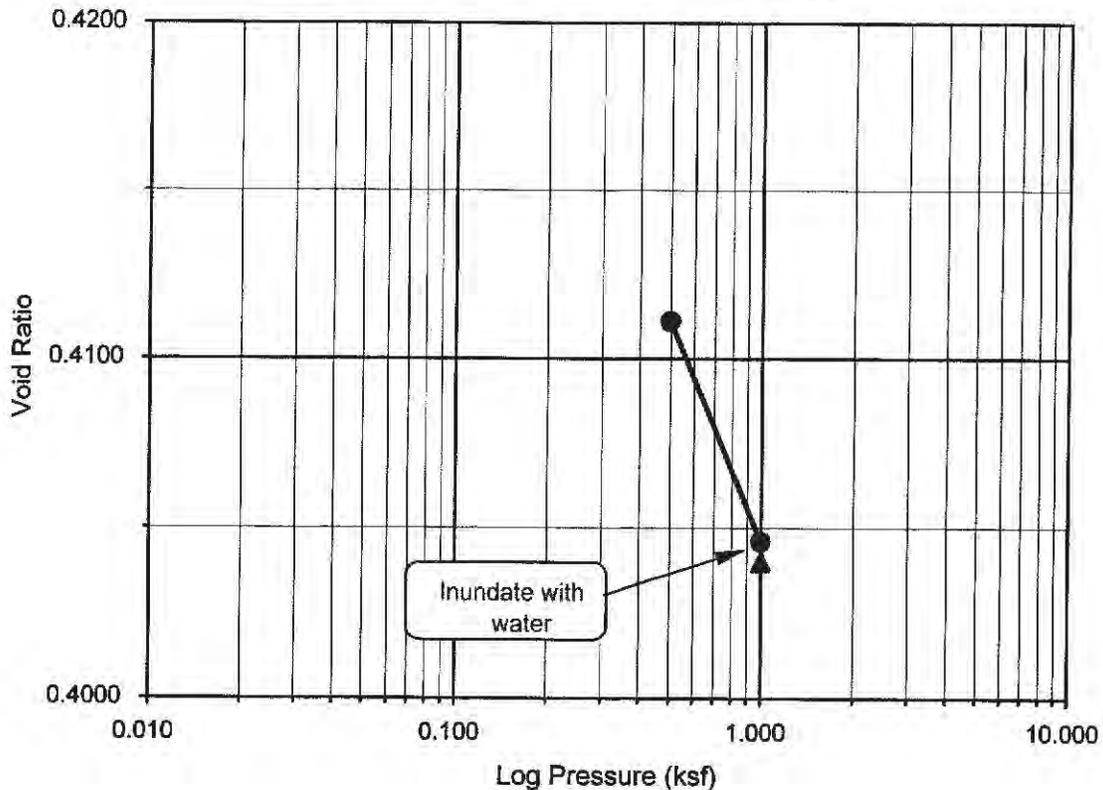
Initial Dry Density (pcf):	118.9
Initial Moisture (%):	14.4
Initial Length (in.):	1.0000
Initial Dial Reading:	0.0500
Diameter(in):	2.416

Final Dry Density (pcf):	120.1
Final Moisture (%):	14.7
Initial Void ratio:	0.4175
Specific Gravity(assumed):	2.70
Initial Saturation (%)	93.1

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.500	0.0545	0.9955	0.00	-0.45	0.4111	-0.45
1.000	0.0591	0.9909	0.00	-0.91	0.4046	-0.91
H2O	0.0595	0.9905	0.00	-0.95	0.4040	-0.95

Percent Swell / Settlement After Inundation = **-0.04**

**Void Ratio - Log Pressure Curve**





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

Project Name: VICTORIA GROVE
Project No.: 111446-001
Boring No.: LB-4
Sample No.: R-3
Sample Description: SM, BROWN SILTY SAND

Tested By: JMD Date: 2/3/05
Checked By: PLS Date: 2/7/05
Sample Type: IN SITU
Depth (ft.): 7.5

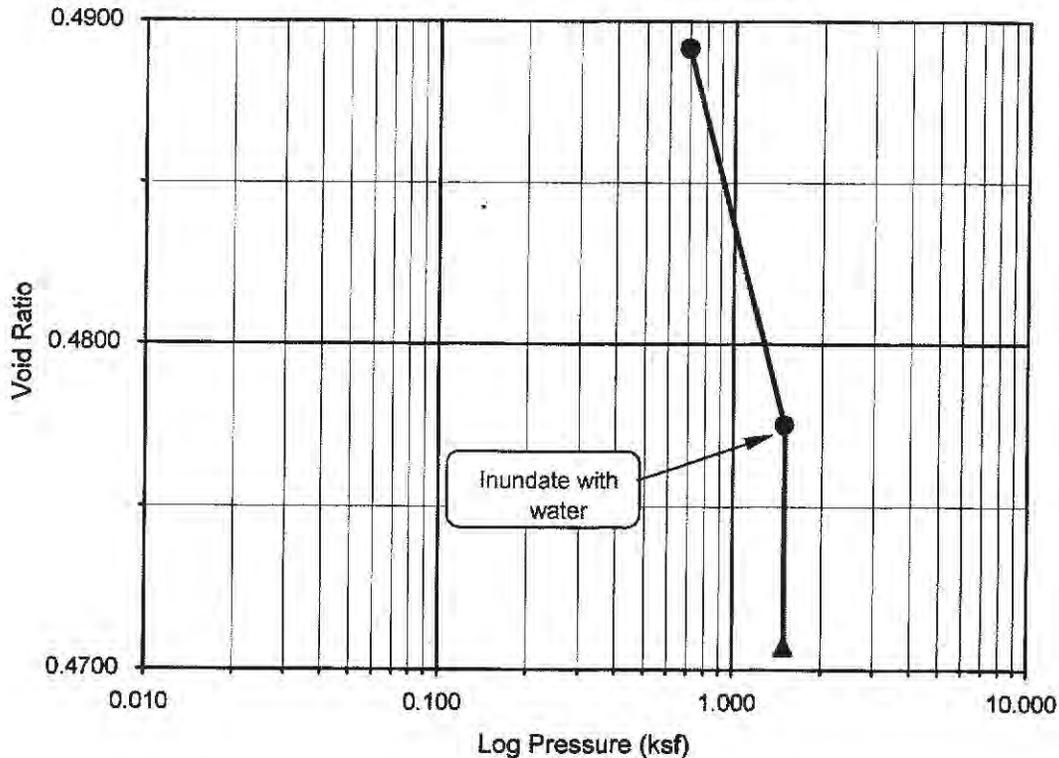
Table with 2 columns: Property and Value. Rows include Initial Dry Density (pcf), Initial Moisture (%), Initial Length (in.), Initial Dial Reading, and Diameter (in).

Table with 2 columns: Property and Value. Rows include Final Dry Density (pcf), Final Moisture (%), Initial Void ratio, Specific Gravity (assumed), and Initial Saturation (%).

Table with 7 columns: Pressure (p) (ksf), Final Reading (in), Apparent Thickness (in), Load Compliance (%), Swell (+) Settlement (-) % of Sample Thickness, Void Ratio, and Corrected Deformation (%). Rows show data for 0.700, 1.500, and H2O pressures.

Percent Swell / Settlement After Inundation = -0.46

Void Ratio - Log Pressure Curve





Leighton and Associates, Inc.

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

Project Name: VICTORIA GROVE  
 Project No.: 111446-001  
 Boring No.: T-6  
 Sample No.: C-1  
 Sample Description: ML, BROWN SANDY SILT

Tested By: JMD Date: 1/5/05  
 Checked By: PRC Date: 1/5/05  
 Sample Type: IN SITU  
 Depth (ft.) 0-6.5

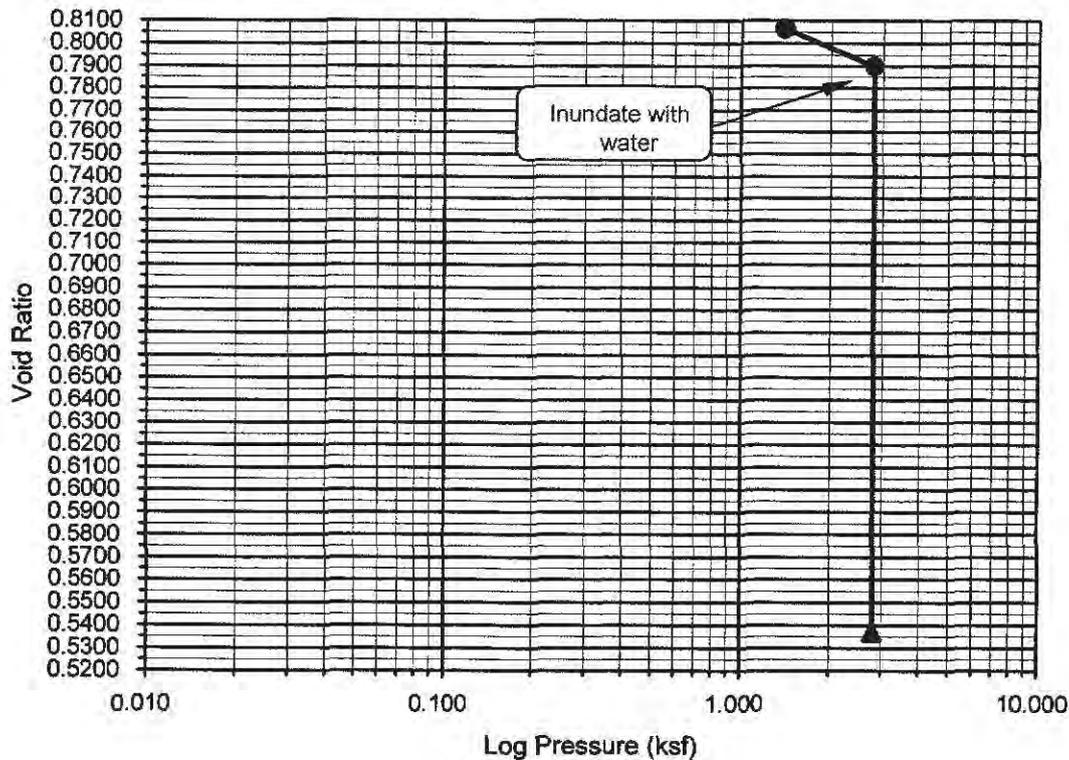
Initial Dry Density (pcf):	91.9
Initial Moisture (%):	7.1
Initial Length (in.):	1.0000
Initial Dial Reading:	0.0500
Diameter(in):	2.416

Final Dry Density (pcf):	109.6
Final Moisture (%):	19.3
Initial Void ratio:	0.8340
Specific Gravity(assumed):	2.70
Initial Saturation (%):	22.8

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
1.400	0.0651	0.9849	0.00	-1.51	0.8063	-1.51
2.800	0.0742	0.9758	0.00	-2.42	0.7896	-2.42
H2O	0.2117	0.8383	0.00	-16.17	0.5374	-16.17

Percent Swell / Settlement After Inundation = **-14.09**

**Void Ratio - Log Pressure Curve**



Rev. 08-04

xCollapse T-6,B-1



**TESTS for SULFATE CONTENT  
CHLORIDE CONTENT and pH of SOILS**

Project Name: VICTORIA GROVE

Tested By : AJP

Date: 1/4/05

Project No. : 111446-001

Data Input By: AJP

Date: 1/4/05

Boring No.	T-6	T-26		
Sample No.	B-2	B-6		
Sample Depth (ft)	0-6.5	3.5-5		
Visual Soil Classification	ML	SM		
Wet Weight of Soil + Container (g)	138.1	312.6		
Dry Weight of Soil + Container (g)	131.9	287.8		
Weight of Container (g)	12.6	12.6		
Moisture Content (%)	5.2	9.0		
Weight of Soaked Soil (g)	100.0	100.0		

**SULFATE CONTENT, DOT California Test 417, Hach Kit Method**

Dilution : 1	3	3		
Water Fraction (ml)	25	25		
Tube Reading	100	50		
PPM Sulfate	300	150		
% Sulfate	0.0300	0.0150		

**CHLORIDE CONTENT, DOT California Test 422**

ml of Chloride Soln. For Titration (B)	30	30		
ml of AgNO3 Soln. Used in Titration (C)	1.4	2.6		
PPM of Chloride (C - 0.2) * 100 * 30 / B	120	240		
<b>PPM of Chloride, Dry Wt. Basis</b>	<b>127</b>	<b>264</b>		

**pH TEST, DOT California Test 532/643**

Container No.	A	A		
pH Value	7.35	7.96		



Leighton and Associates, Inc.

**SOIL RESISTIVITY TEST**  
DOT CA TEST 532 / 643

Project Name: VICTORIA GROVE

Tested By: AJP

Date: 1/4/05

Project No.: 111446-001

Data Input By: AJP

Date: 1/4/05

Boring No.: T-26

Checked By: PRC

Date: 1/5/05

Sample No.: B-6

Depth (ft.): 3.5-5

Visual Soil Identification: SM

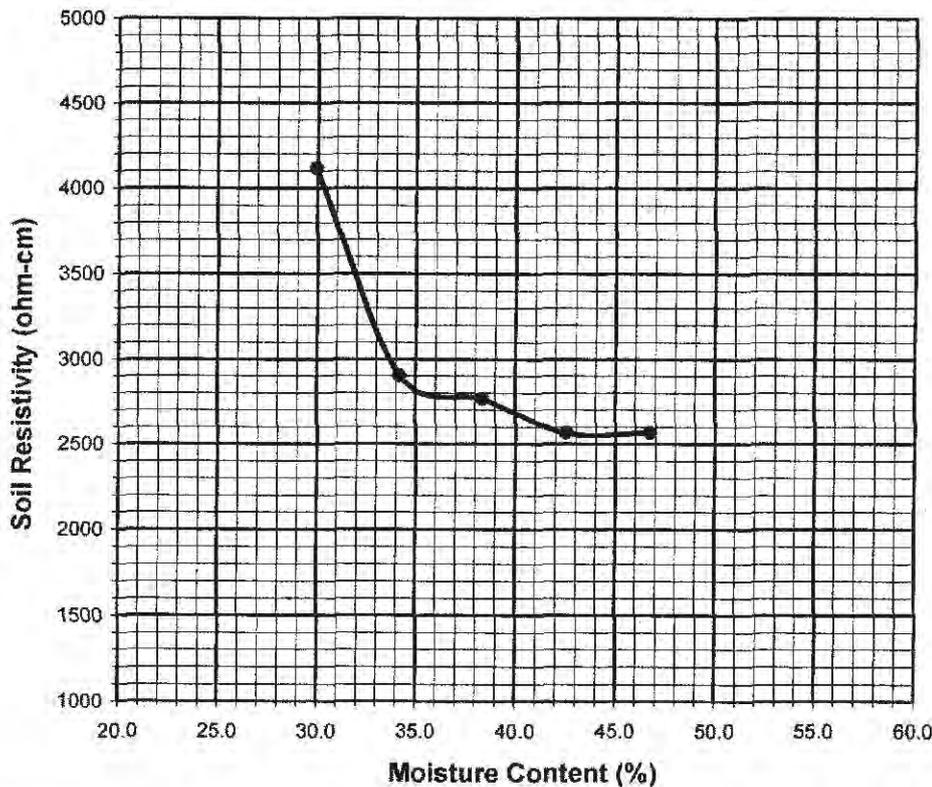
**Initial Moisture Content (%)**

Wet Wt. of Soil + Cont. (gm.)	312.6
Dry Wt. of Soil + Cont. (gm.)	287.8
Wt. of Container (gm.)	12.6
Moisture Content (%) (Mci)	9.0

Initial Soil Weight (gm)(Wt)	1300.0
Box Constant:	6.75

$$MC = (((1 + Mci/100) \times (Wa/Wt + 1)) - 1) \times 100$$

Remolded Specimen	Moisture Adjustments				
	Water Added (ml) (Wa)	250	300	350	400
Adj. Moisture Content (%) (MC)	29.98	34.17	38.36	42.55	46.75
Resistance Rdg. (ohm)	610	430	410	380	380
Soil Resistivity (ohm-cm)	4115	2901	2766	2563	2563



Minimum Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532/643
2563	42.6	150	264	7.96



Leighton and Associates, Inc.

**SOIL RESISTIVITY TEST**  
DOT CA TEST 532 / 643

Project Name: VICTORIA GROVE

Tested By: AJP

Date: 1/4/05

Project No.: 111446-001

Data Input By: AJP

Date: 1/4/05

Boring No.: T-6

Checked By: PRC

Date: 1/5/05

Sample No.: B-2

Depth (ft.): 0-6.5

Visual Soil Identification: ML

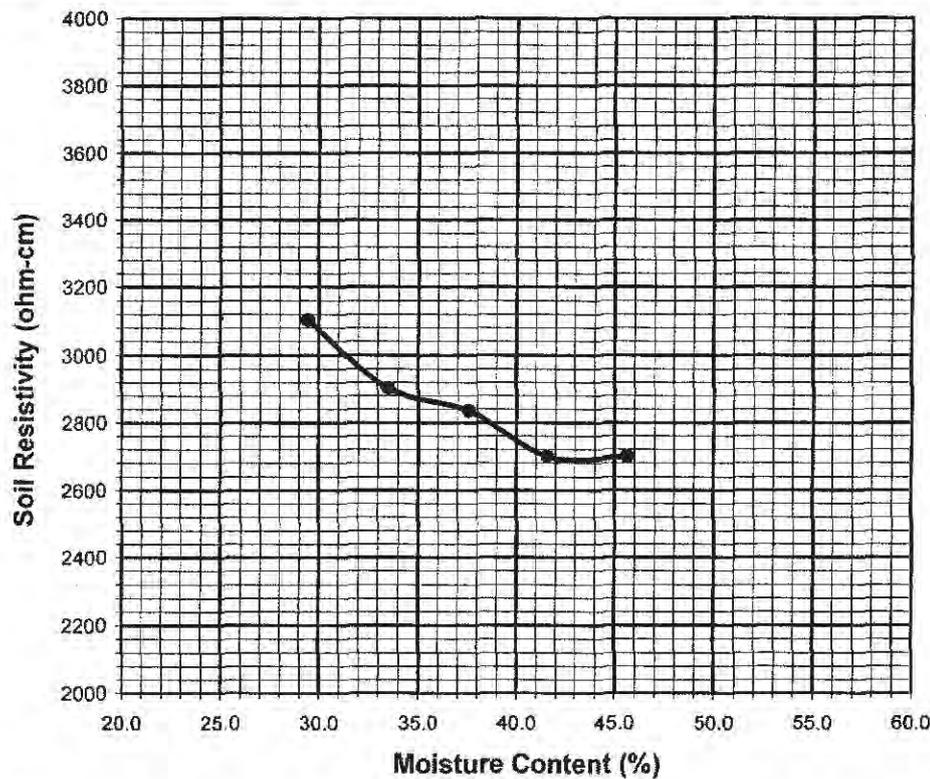
**Initial Moisture Content (%)**

Wet Wt. of Soil + Cont. (g)	138.10
Dry Wt. of Soil + Cont. (g)	131.90
Wt. of Container (g)	12.60
Moisture Content (%) (Mci)	5.20

Initial Soil Weight (gm)(Wt)	1300.0
Box Constant:	6.75

$$MC = (((1 + Mci / 100) \times (Wa / Wt + 1)) - 1) \times 100$$

Remolded Specimen	Moisture Adjustments				
	Water Added (ml) (Wa)	300	350	400	450
Adj. Moisture Content (%) (MC)	29.47	33.52	37.57	41.61	45.66
Resistance Rdg. (ohm)	460	430	420	400	400
Soil Resistivity (ohm-cm)	3103	2901	2833	2698	2698

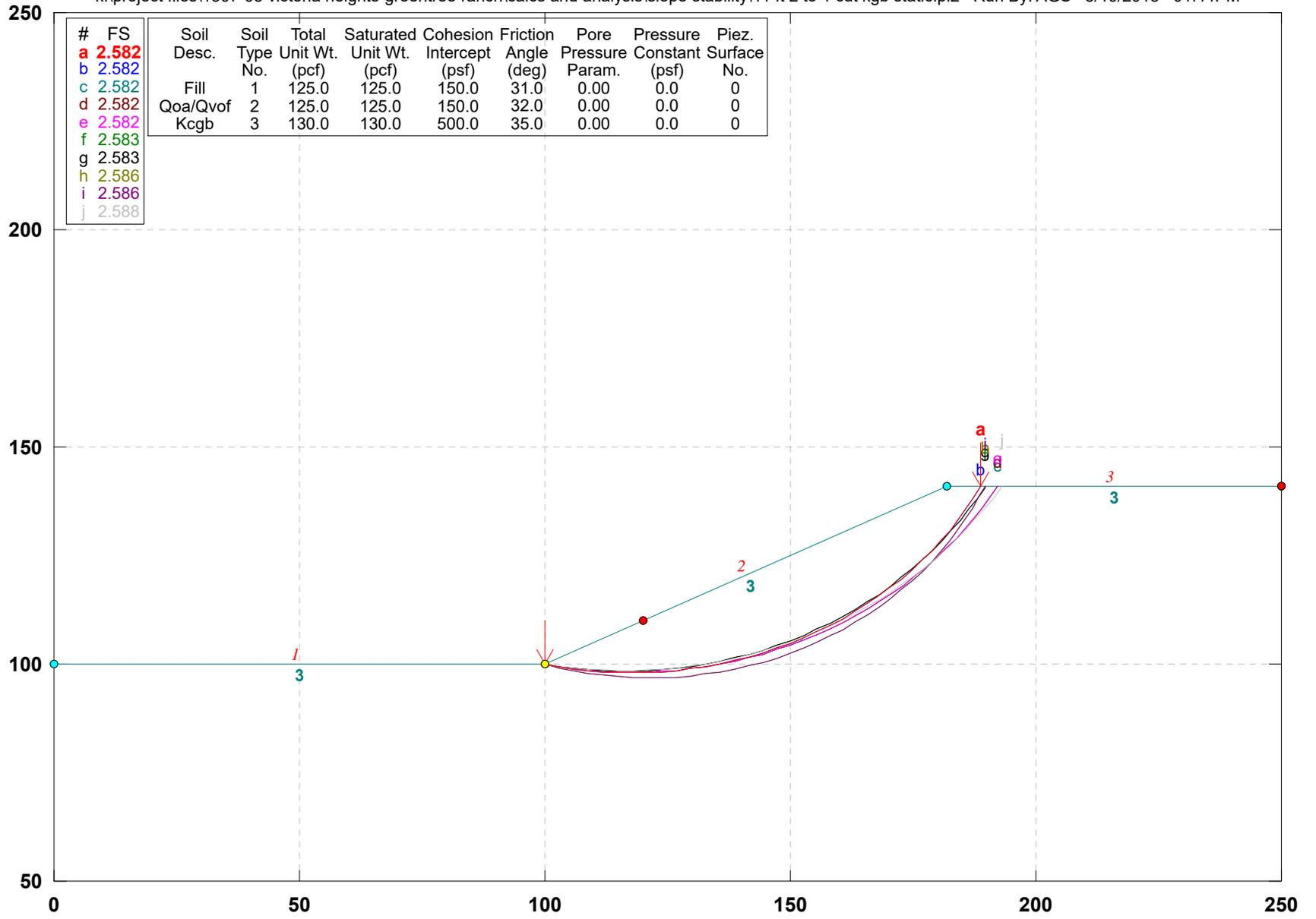


Minimum Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH
DOT CA Test 532 / 643	DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532/643	
2698	41.6	300	127	7.35

**APPENDIX D**  
**SLOPE STABILITY ANALYSIS**

# 1507-05 Green Tree (41 ft Kcgb Cut 2:1 Slope) Static Condition

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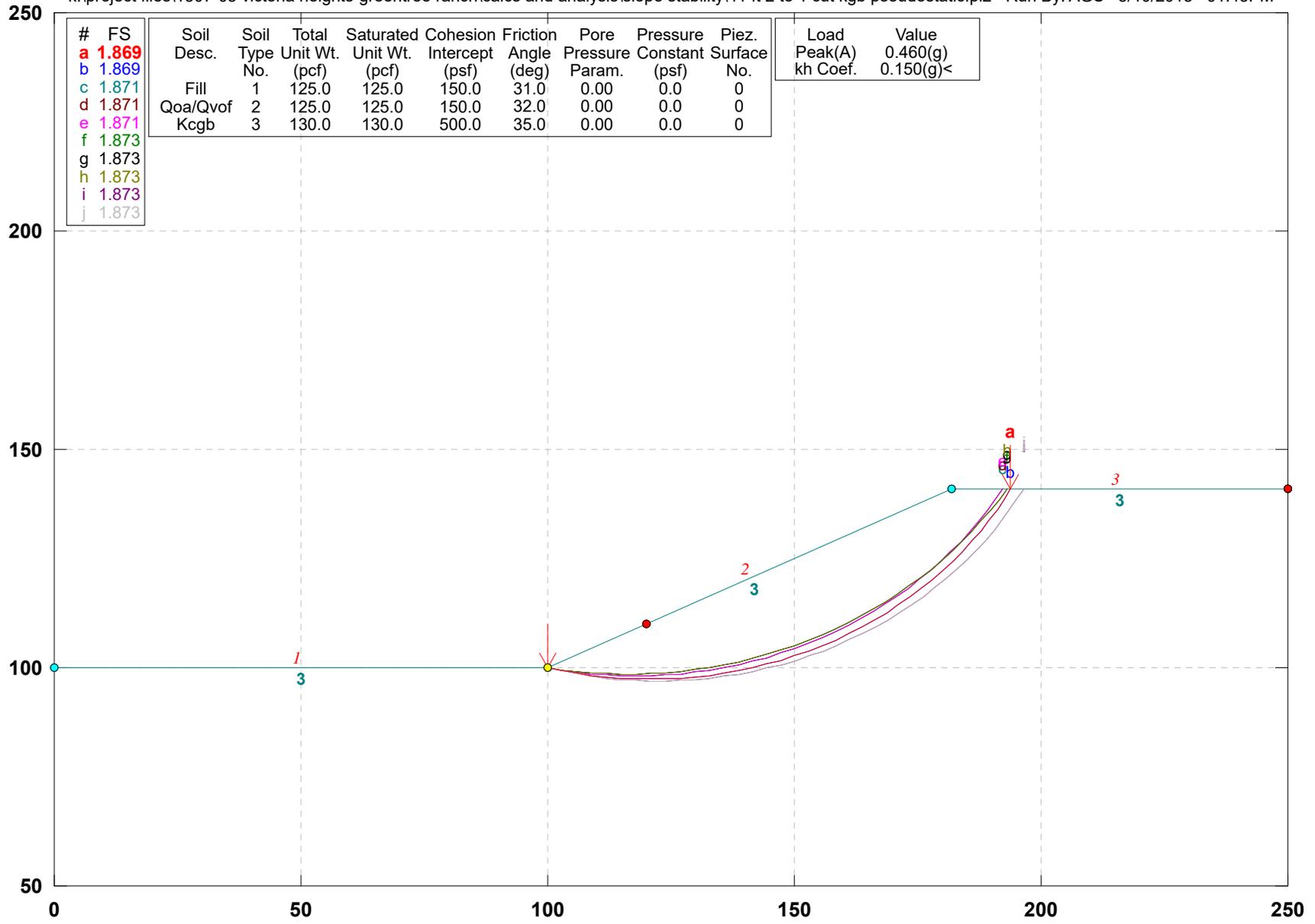


GSTABL7 v.2 FSmin=2.582

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c & phi both > 0

# 1507-05 Green Tree (41 ft Kcgb Cut 2:1 Slope) Pseudostatic Condition

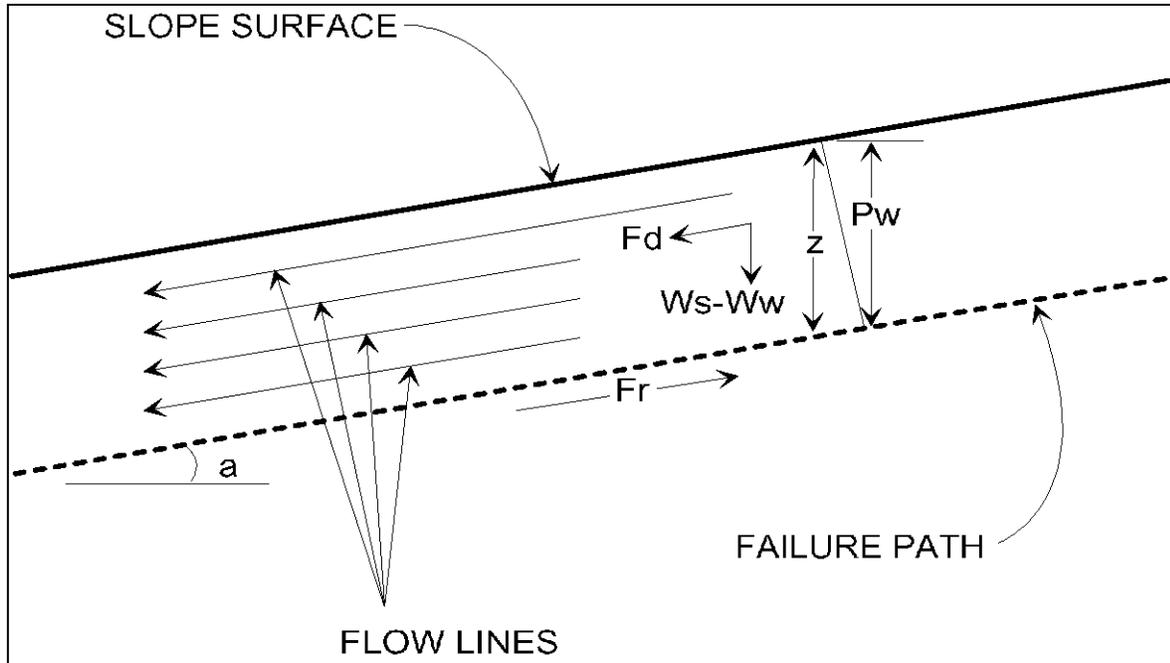
k:\project files\1507-05 victoria heights-greentree ranch\calcs and analysis\slope stability\41 ft 2 to 1 cut kgb pseudostatic.pl2 Run By: AGS 5/10/2018 01:45PM



GSTABL7 v.2 FSmin=1.869

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c & phi both > 0

## SURFICIAL SLOPE STABILITY



- Assume: (1) Saturation To Slope Surface  
 (2) Sufficient Permeability To Establish Water Flow

$$P_w = \text{Water Pressure Head} = (z)(\cos^2(a))$$

$W_s$  = Saturated Soil Unit Weight

$W_w$  = Unit Weight of Water (62.4 lb/cu.ft.)

$$u = \text{Pore Water Pressure} = (W_w)(z)(\cos^2(a))$$

$z$  = Layer Thickness

$a$  = Angle of Slope (2:1 H:V)      $a = 26.5651$  degrees

$\phi$  = Angle of Friction

$c$  = Cohesion

$$F_d = (0.5)(z)(W_s)(\sin(2a))$$

$$F_r = (z)(W_s - W_w)(\cos^2(a))(\tan(\phi)) + c$$

$$\text{Factor of Safety (FS)} = F_r / F_d$$

2:1 CUT SLOPE - Qoa

Given:

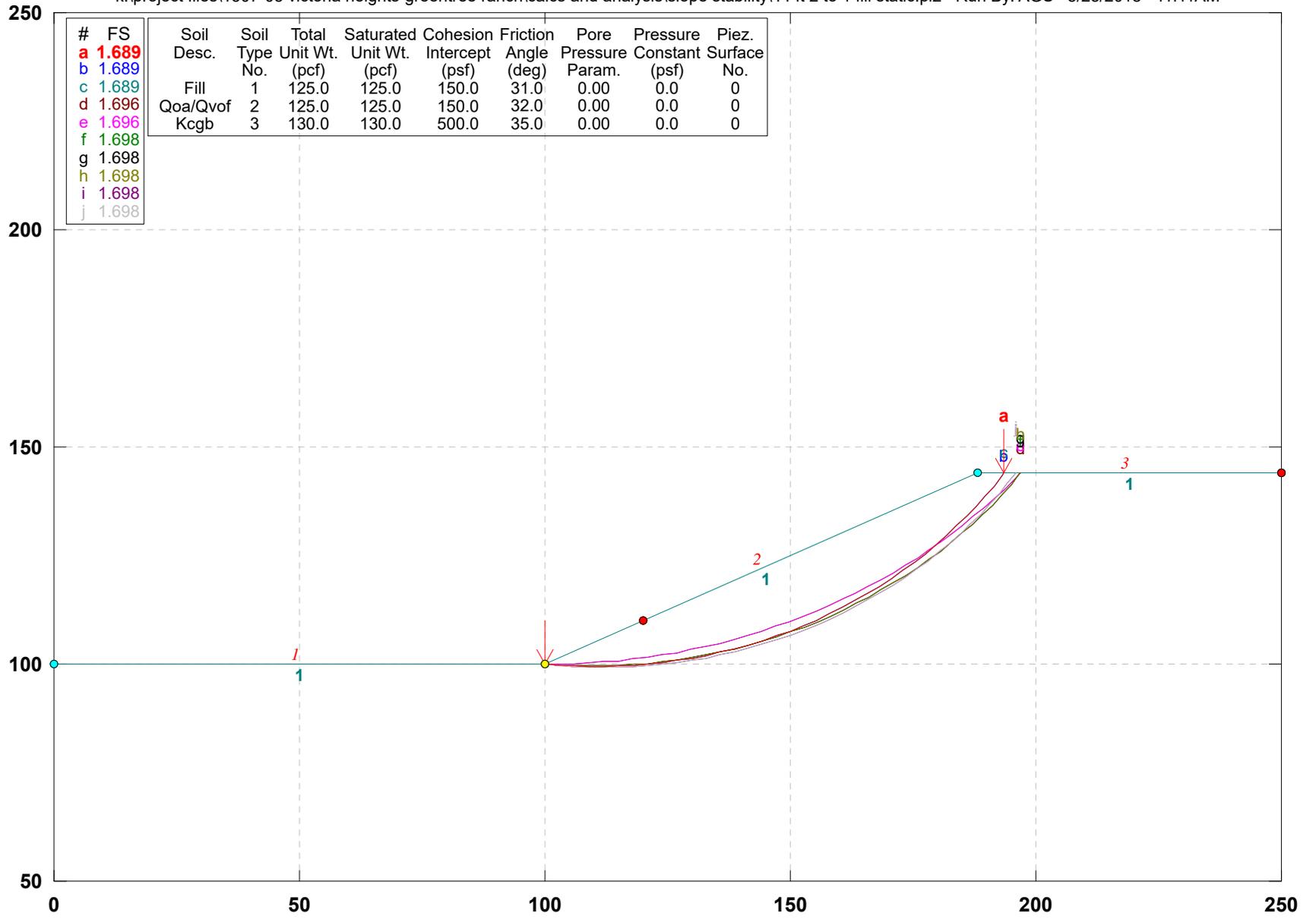
Ws (pcf)	z (ft)	a		phi		c (psf)
		(degrees)	(radians)	(degrees)	(radians)	
125	2	26.5651	0.4636	32.0	0.5585	150

Calculations:

Pw	u	Fd	Fr	FS
1.60	99.84	100.00	212.59	<b>2.13</b>

# 1507-05 Green Tree (44 ft Fill 2:1 Slope) Static Condition

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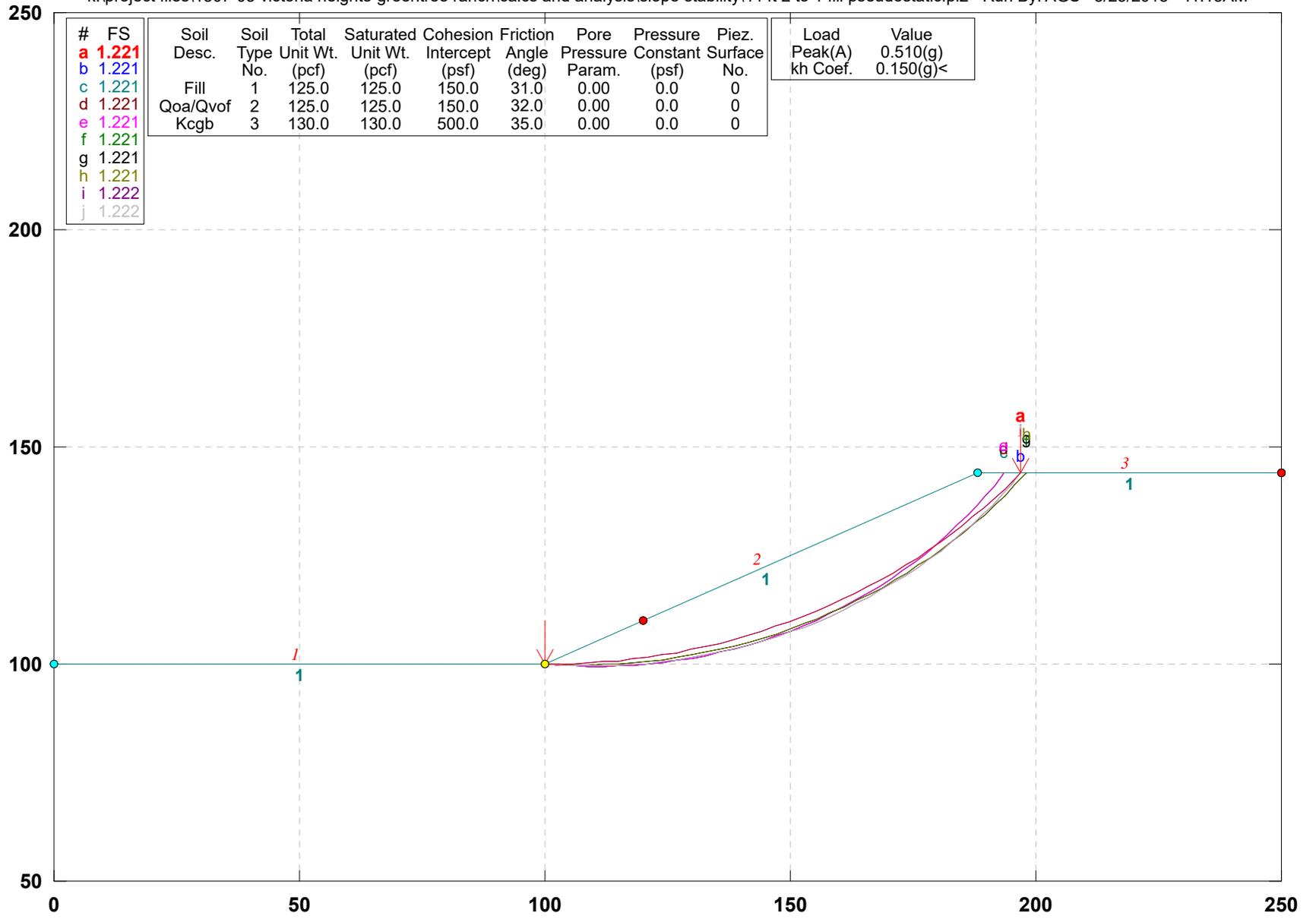


GSTABL7 v.2 FSmin=1.689

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c & phi both > 0

# 1507-05 Green Tree (44 ft Fill 2:1 Slope) Pseudo Static Condition

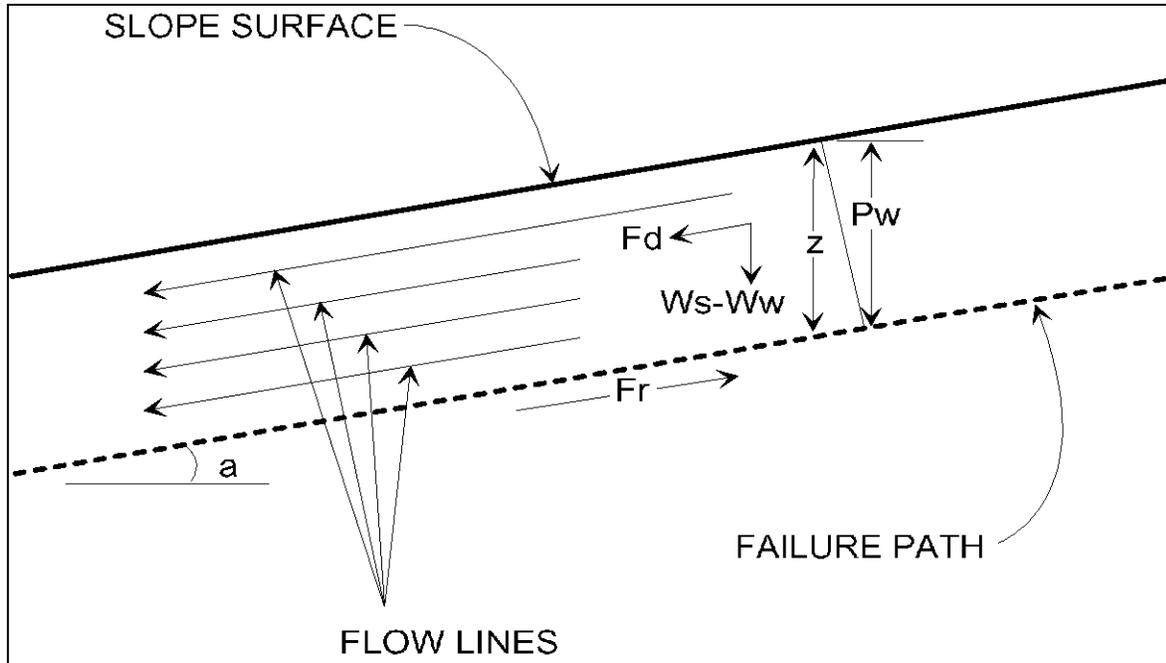
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GSTABL7 v.2 FSmin=1.221

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c & phi both > 0

## SURFICIAL SLOPE STABILITY



- Assume: (1) Saturation To Slope Surface  
 (2) Sufficient Permeability To Establish Water Flow

$$P_w = \text{Water Pressure Head} = (z)(\cos^2(a))$$

$W_s$  = Saturated Soil Unit Weight

$W_w$  = Unit Weight of Water (62.4 lb/cu.ft.)

$u$  = Pore Water Pressure =  $(W_w)(z)(\cos^2(a))$

$z$  = Layer Thickness

$a$  = Angle of Slope (2:1 H:V)      $a = 26.5651$  degrees

$\phi$  = Angle of Friction

$c$  = Cohesion

$$F_d = (0.5)(z)(W_s)(\sin(2a))$$

$$F_r = (z)(W_s - W_w)(\cos^2(a))(\tan(\phi)) + c$$

$$\text{Factor of Safety (FS)} = F_r / F_d$$

### 2:1 FILL SLOPE

Given:

$W_s$ (pcf)	$z$ (ft)	$a$		$\phi$		$c$ (psf)
		(degrees)	(radians)	(degrees)	(radians)	
125	2	26.5651	0.4636	31.0	0.5411	150

Calculations:

$P_w$	$u$	$F_d$	$F_r$	<b>FS</b>
1.60	99.84	100.00	210.18	<b>2.10</b>

**APPENDIX E**  
**EARTHWORK SPECIFICATIONS AND GRADING DETAILS**

## **GENERAL EARTHWORK SPECIFICATIONS**

### **I. General**

A. General procedures and requirements for earthwork and grading are presented herein. The earthwork and grading recommendations provided in the geotechnical report are considered part of these specifications, and where the general specifications provided herein conflict with those provided in the geotechnical report, the recommendations in the geotechnical report shall govern. Recommendations provided herein and in the geotechnical report may need to be modified depending on the conditions encountered during grading.

B. The contractor is responsible for the satisfactory completion of all earthwork in accordance with the project plans, specifications, applicable building codes, and local governing agency requirements. Where these requirements conflict, the stricter requirements shall govern.

C. It is the contractor's responsibility to read and understand the guidelines presented herein and in the geotechnical report as well as the project plans and specifications. Information presented in the geotechnical report is subject to verification during grading. The information presented on the exploration logs depict conditions at the particular time of excavation and at the location of the excavation. Subsurface conditions present at other locations may differ, and the passage of time may result in different subsurface conditions being encountered at the locations of the exploratory excavations. The contractor shall perform an independent investigation and evaluate the nature of the surface and subsurface conditions to be encountered and the procedures and equipment to be used in performing his work.

D. The contractor shall have the responsibility to provide adequate equipment and procedures to accomplish the earthwork in accordance with applicable requirements. When the quality of work is less than that required, the Geotechnical Consultant may reject the work and may recommend that the operations be suspended until the conditions are corrected.

E. Prior to the start of grading, a qualified Geotechnical Consultant should be employed to observe grading procedures and provide testing of the fills for conformance with the project specifications, approved grading plan, and guidelines presented herein. All clearing and grubbing, remedial removals, clean-outs, removal bottoms, keyways, and subdrain installations should be observed and documented by the Geotechnical Consultant prior to placing fill. It is the contractor's responsibility to apprise the Geotechnical Consultant of their schedules and notify the Geotechnical Consultant when those areas are ready for observation.

F. The contractor is responsible for providing a safe environment for the Geotechnical Consultant to observe grading and conduct tests.

### **II. Site Preparation**

A. Clearing and Grubbing: Excessive vegetation and other deleterious material shall be sufficiently removed as required by the Geotechnical Consultant, and such materials shall be

properly disposed of offsite in a method acceptable to the owner and governing agencies. Where applicable, the contractor may obtain permission from the Geotechnical Consultant, owner, and governing agencies to dispose of vegetation and other deleterious materials in designated areas onsite.

B. Unsuitable Soils Removals: Earth materials that are deemed unsuitable for the support of fill shall be removed as necessary to the satisfaction of the Geotechnical Consultant.

C. Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipelines, other utilities, or other structures located within the limits of grading shall be removed and/or abandoned in accordance with the requirements of the governing agency and to the satisfaction of the Geotechnical Consultant. Environmental evaluation of existing conditions is not the responsibility of the Geotechnical Consultant.

D. Preparation of Areas to Receive Fill: After removals are completed, the exposed surfaces shall be processed or scarified to a depth of approximately 8 inches, watered or dried, as needed, to achieve a generally uniform moisture content that is at or near optimum moisture content. The scarified materials shall then be compacted to the project requirements and tested as specified.

E. All areas receiving fill shall be observed and approved by the Geotechnical Consultant prior to the placement of fill. A licensed surveyor shall provide survey control for determining elevations of processed areas and keyways.

### **III. Placement of Fill**

A. Suitability of fill materials: Any materials, derived onsite or imported, may be utilized as fill provided that the materials have been determined to be suitable by the Geotechnical Consultant. Such materials shall be essentially free of organic matter and other deleterious materials, and be of a gradation, expansion potential, and/or strength that is acceptable to the Geotechnical Consultant. Fill materials shall be tested in a laboratory approved by the Geotechnical Consultant, and import materials shall be tested and approved prior to being imported.

B. Generally, different fill materials shall be thoroughly mixed to provide a relatively uniform blend of materials and prevent abrupt changes in material type. Fill materials derived from benching should be dispersed throughout the fill area instead of placing the materials within only an equipment-width from the cut/fill contact.

C. Oversize Materials: Rocks greater than 12 inches in largest dimension shall be disposed of offsite or be placed in accordance with the recommendations by the Geotechnical Consultant in the areas that are designated as suitable for oversize rock placement. Rocks that are smaller than 8 inches in largest dimension may be utilized in the fill provided that they are not nested and are their quantity and distribution are acceptable to the Geotechnical Consultant and do not inhibit the ability to properly compact fill materials.

D. The fill materials shall be placed in thin, horizontal layers such that, when compacted, shall not exceed 6 inches. Each layer shall be spread evenly and shall be thoroughly mixed to obtain a near uniform moisture content and uniform blend of materials.

E. Moisture Content: Fill materials shall be placed at or above the optimum moisture content or as recommended by the geotechnical report. Where the moisture content of the engineered fill is less than recommended, water shall be added, and the fill materials shall be blended so that a near uniform moisture content is achieved. If the moisture content is above the limits specified by the Geotechnical Consultant, the fill materials shall be aerated by discing, blading, or other methods until the moisture content is acceptable.

F. Each layer of fill shall be compacted to the project standards in accordance to the project specifications and recommendations of the Geotechnical Consultant. Unless otherwise specified by the Geotechnical Consultant, the fill shall be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM Test Method: D1557.

G. Benching: Where placing fill on a slope exceeding a ratio of 5 to 1 (horizontal to vertical), the ground should be keyed or benched. The keyways and benches shall extend through all unsuitable materials into suitable materials such as firm materials or sound bedrock or as recommended by the Geotechnical Consultant. The minimum keyway width shall be 15 feet and extend into suitable materials, or as recommended by the geotechnical report and approved by the Geotechnical Consultant. The minimum keyway width for fill over cut slopes is also 15 feet, or as recommended by the geotechnical report and approved by the Geotechnical Consultant. As a general rule, unless otherwise recommended by the Geotechnical Consultant, the minimum width of the keyway shall be equal to  $\frac{1}{2}$  the height of the fill slope.

H. Slope Face: The specified minimum relative compaction shall be maintained out to the finish face of fill and stabilization fill slopes. Generally, this may be achieved by overbuilding the slope and cutting back to the compacted core. The actual amount of overbuilding may vary as field conditions dictate. Alternately, this may be achieved by backrolling the slope face with suitable equipment or other methods that produce the designated result. Loose soil should not be allowed to build up on the slope face. If present, loose soils shall be trimmed to expose the compacted slope face.

I. Slope Ratio: Unless otherwise approved by the Geotechnical Consultant and governing agencies, permanent fill slopes shall be designed and constructed no steeper than 2 to 1 (horizontal to vertical).

J. Natural Ground and Cut Areas: Design grades that are in natural ground or in cuts should be evaluated by the Geotechnical Consultant to determine whether scarification and processing of the ground and/or overexcavation is needed.

K. Fill materials shall not be placed, spread, or compacted during unfavorable weather conditions. When grading is interrupted by rain, filing operations shall not resume until the Geotechnical Consultant approves the moisture and density of the previously placed compacted fill.

#### **IV. Cut Slopes**

- A. The Geotechnical Consultant shall observe all cut slopes, including fill over cut slopes, and shall be notified by the contractor when cut slopes are started.
- B. If adverse or potentially adverse conditions are encountered during grading, the Geotechnical Consultant shall investigate, evaluate, and make recommendations to mitigate the adverse conditions.
- C. Unless otherwise stated in the geotechnical report, cut slopes shall not be excavated higher or steeper than the requirements of the local governing agencies. Short-term stability of the cut slopes and other excavations is the contractor's responsibility.

#### **V. Drainage**

- A. Backdrains and Subdrains: Backdrains and subdrains shall be provided in fill as recommended by the Geotechnical Consultant and shall be constructed in accordance with the governing agency and/or recommendations of the Geotechnical Consultant. The location of subdrains, especially outlets, shall be surveyed and recorded by the Civil Engineer.
- B. Top-of-slope Drainage: Positive drainage shall be established away from the top of slope. Site drainage shall not be permitted to flow over the tops of slopes.
- C. Drainage terraces shall be constructed in compliance with the governing agency requirements and/or in accordance with the recommendations of the Civil Engineer.
- D. Non-erodible interceptor swales shall be placed at the top of cut slopes that face the same direction as the prevailing drainage.

#### **VI. Erosion Control**

- A. All finish cut and fill slopes shall be protected from erosion and/or planted in accordance with the project specifications and/or landscape architect's recommendations. Such measures to protect the slope face shall be undertaken as soon as practical after completion of grading.
- B. During construction, the contractor shall maintain proper drainage and prevent the ponding of water. The contractor shall take remedial measures to prevent the erosion of graded areas until permanent drainage and erosion control measures have been installed.

#### **VII. Trench Excavation and Backfill**

- A. Safety: The contractor shall follow all OSHA requirements for safety of trench excavations. Knowing and following these requirements is the contractor's responsibility. All trench excavations or open cuts in excess of 5 feet in depth shall be shored or laid back. Trench excavations and open cuts exposing adverse geologic conditions may require further evaluation

by the Geotechnical Consultant. If a contractor fails to provide safe access for compaction testing, backfill not tested due to safety concerns may be subject to removal.

B. Bedding: Bedding materials shall be non-expansive and have a Sand Equivalent greater than 30. Where permitted by the Geotechnical Consultant, the bedding materials can be densified by jetting.

C. Backfill: Jetting of backfill materials to achieve compaction is generally not acceptable. Where permitted by the Geotechnical Consultant, the bedding materials can be densified by jetting provided the backfill materials are granular, free-draining and have a Sand Equivalent greater than 30.

### **VIII. Geotechnical Observation and Testing During Grading**

A. Compaction Testing: Fill will be tested and evaluated by the Geotechnical Consultant for evaluation of general compliance with the recommended compaction and moisture conditions. The tests shall be taken in the compacted soils beneath the surface if the surficial materials are disturbed. The contractor shall assist the Geotechnical Consultant by excavating suitable test pits for testing of compacted fill.

B. Where tests indicate that the density of a layer of fill is less than required, or the moisture content is not within specifications, the Geotechnical Consultant shall notify the contractor of the unsatisfactory conditions of the fill. The portions of the fill that are not within specifications shall be reworked until the required density and/or moisture content has been attained. No additional fill shall be placed until the last lift of fill is tested and found to meet the project specifications and approved by the Geotechnical Consultant.

C. If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as adverse weather, excessive rock or deleterious materials being placed in the fill, insufficient equipment, excessive rate of fill placement, results in a quality of work that is unacceptable, the consultant shall notify the contractor, and the contractor shall rectify the conditions, and if necessary, stop work until conditions are satisfactory.

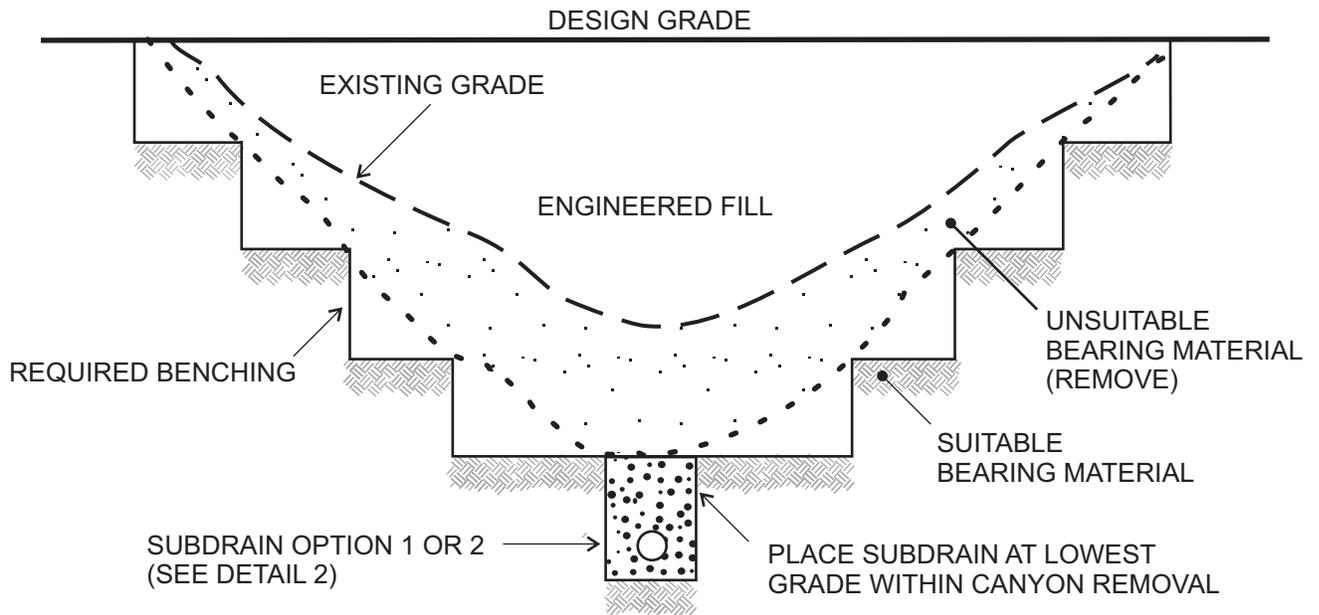
D. Frequency of Compaction Testing: The location and frequency of tests shall be at the Geotechnical Consultant's discretion. Generally, compaction tests shall be taken at intervals approximately two feet in fill height.

E. Compaction Test Locations: The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of the compaction test locations. The contractor shall coordinate with the surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations. Alternately, the test locations can be surveyed and the results provided to the Geotechnical Consultant.

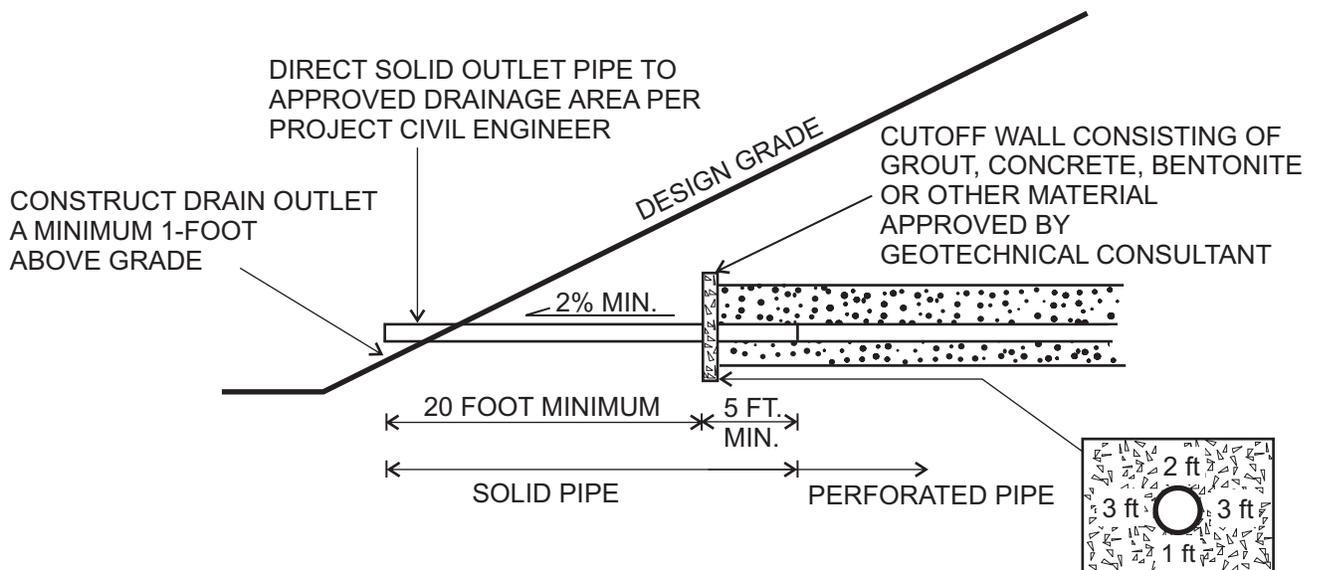
F. Areas of fill that have not been observed or tested by the Geotechnical Consultant may have to be removed and recompacted at the contractor's expense. The depth and extent of removals will be determined by the Geotechnical Consultant.

G. Observation and testing by the Geotechnical Consultant shall be conducted during grading in order for the Geotechnical Consultant to state that, in his opinion, grading has been completed in accordance with the approved geotechnical report and project specifications.

H. Reporting of Test Results: After completion of grading operations, the Geotechnical Consultant shall submit reports documenting their observations during construction and test results. These reports may be subject to review by the local governing agencies.



### CANYON SUBDRAIN PROFILE



NOTE: LOCATION OF CANYON SUBDRAINS AND OUTLETS SHOULD BE DOCUMENTED BY PROJECT CIVIL ENGINEER. OUTLETS MUST BE KEPT UNOBSTRUCTED AT ALL TIMES.

### CANYON SUBDRAIN TERMINUS

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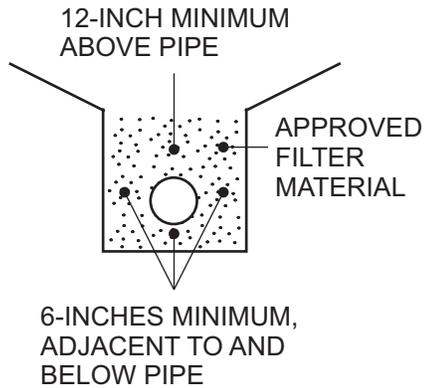
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ADVANCED GEOTECHNICAL SOLUTIONS

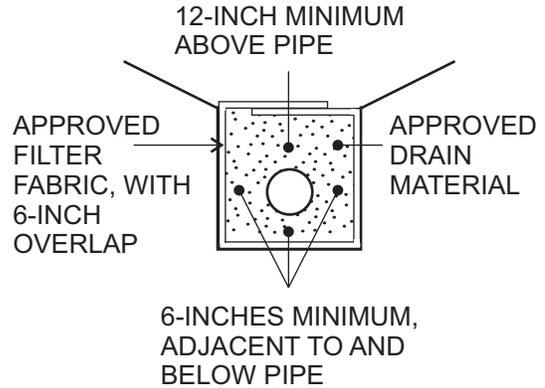
CANYON SUBDRAIN

DETAIL 1



### OPTION 1

**FILTER MATERIAL:** MINIMUM VOLUME OF 9 CUBIC FEET PER LINEAL FOOT OF CALTRANS CLASS 2 PERMEABLE MATERIAL



### OPTION 2

**DRAIN MATERIAL:** MINIMUM VOLUME OF 9 CUBIC FEET PER LINEAL FOOT OF 3/4-INCH MAX ROCK OR APPROVED EQUIVALENT SUBSTITUTE

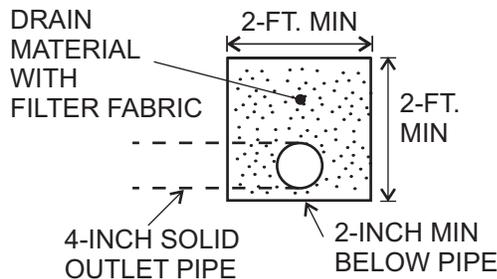
**FILTER FABRIC:** MIRAFL 140 FILTER FABRIC OR APPROVED EQUIVALENT SUBSTITUTE

**PIPE:** 6 OR 8-INCH ABS OR PVC PIPE OR APPROVED SUBSTITUTE WITH A MINIMUM OF 8 PERFORATIONS (1/4-INCH DIAMETER) PER LINEAL FOOT IN BOTTOM HALF OF PIPE

(ASTM D2751, SDR-35 OR ASTM D3034, SDR-35  
ASTM D1527, SCHD. 40 OR ASTM D1785, SCHD. 40)

**NOTE:** CONTINUOUS RUN IN EXCESS OF 500 FEET REQUIRES 8-INCH DIAMETER PIPE (ASTM D3034, SDR-35, OR ASTM D1785, SCHD. 40)

## CANYON SUBDRAIN



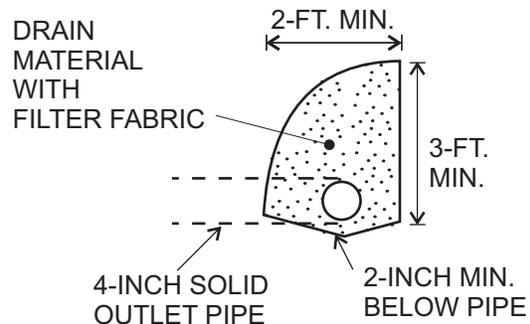
### OPTION 1

**DRAIN MATERIAL:** GRAVEL TRENCH TO BE FILLED WITH 3/4-INCH MAX ROCK OR APPROVED EQUIVALENT SUBSTITUTE

**FILTER FABRIC:** MIRAFL 140 FILTER FABRIC OR EQUIVALENT SUBSTITUTE WITH A MINIMUM 6-INCH OVERLAP

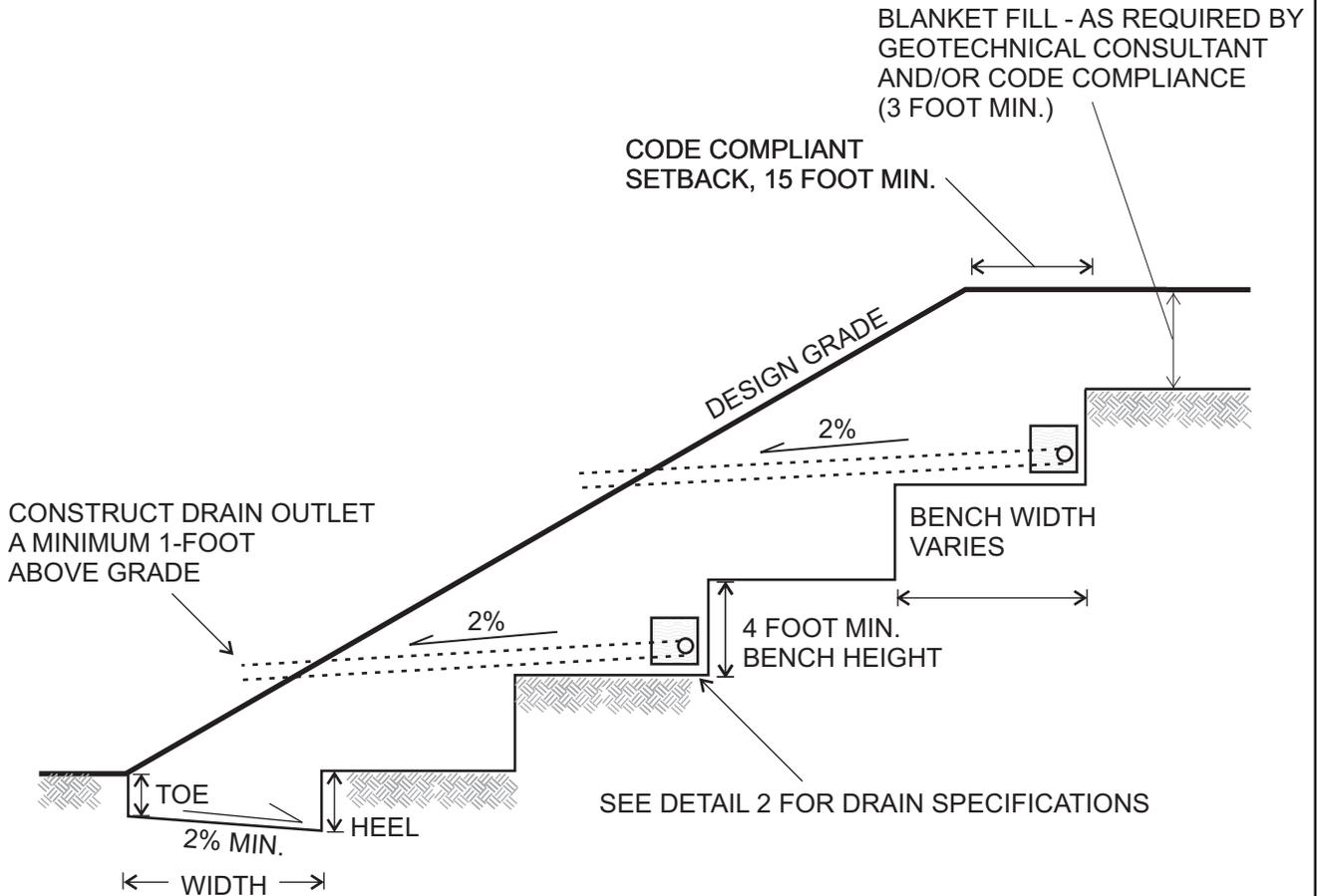
**PIPE:** 4-INCH ABS OR PVC PIPE OR APPROVED EQUIVALENT SUBSTITUTE WITH A MINIMUM OF 8 PERFORATIONS (1/4-INCH DIAMETER) PER LINEAL FOOT IN BOTTOM HALF OF PIPE

(ASTM D2751, SDR-35 OR ASTM D3034, SDR-35  
ASTM D1527, SCHD. 40 OR ASTM D1785, SCHD. 40)



### OPTION 2

## BUTTRESS/STABILIZATION DRAIN



CODE COMPLIANT KEYWAY  
WITH MINIMUM DIMENSIONS:

TOE 2 FOOT MIN.  
HEEL 3 FOOT MIN.  
WIDTH 15 FOOT MIN.

NOTES:

1. DRAIN OUTLETS TO BE PROVIDED EVERY 100 FEET CONNECT TO PERFORATED DRAIN PIPE BY "L" OR "T" AT A MINIMUM 2% GRADIENT.
2. THE NECESSITY AND LOCATION OF ADDITIONAL DRAINS SHALL BE DETERMINED IN THE FIELD BY THE GEOTECHNICAL CONSULTANT. UPPER STAGE OUTLETS SHOULD BE EMPTIED ONTO CONCRETE TERRACE DRAINS.
3. DRAIN PIPE TO EXTEND FULL LENGTH OF STABILIZATION/BUTTRESS WITH A MINIMUM GRADIENT OF 2% TO SOLID OUTLET PIPES.
4. LOCATION OF DRAINS AND OUTLETS SHOULD BE DOCUMENTED BY PROJECT CIVIL ENGINEER. OUTLETS MUST BE KEPT UNOBSTRUCTED AT ALL TIMES.

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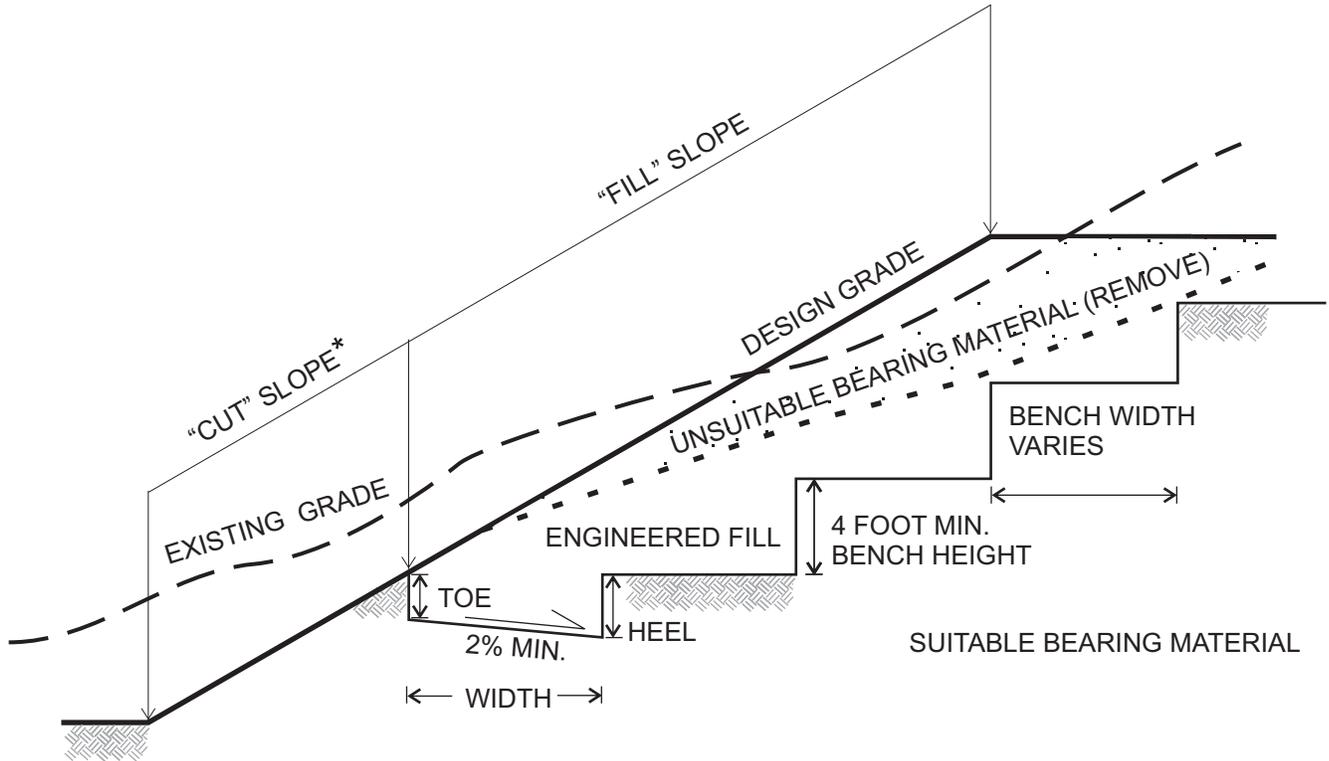


ADVANCED GEOTECHNICAL SOLUTIONS

STABILIZATION/BUTTRESS FILL

DETAIL 3

\* THE "CUT" PORTION OF THE SLOPE SHALL BE EXCAVATED AND EVALUATED BY THE GEOTECHNICAL CONSULTANT PRIOR TO CONSTRUCTING THE "FILL" PORTION



SUITABLE BEARING MATERIAL

CODE COMPLIANT KEYWAY WITH MINIMUM DIMENSIONS:

TOE: 2 FOOT MIN.  
 HEEL: 3 FOOT MIN.  
 WIDTH: 15 FOOT MIN.

NOTES:

1. THE NECESSITY AND LOCATION OF DRAINS SHALL BE DETERMINED IN THE FIELD BY THE GEOTECHNICAL CONSULTANT
2. SEE DETAIL 2 FOR DRAIN SPECIFICATIONS

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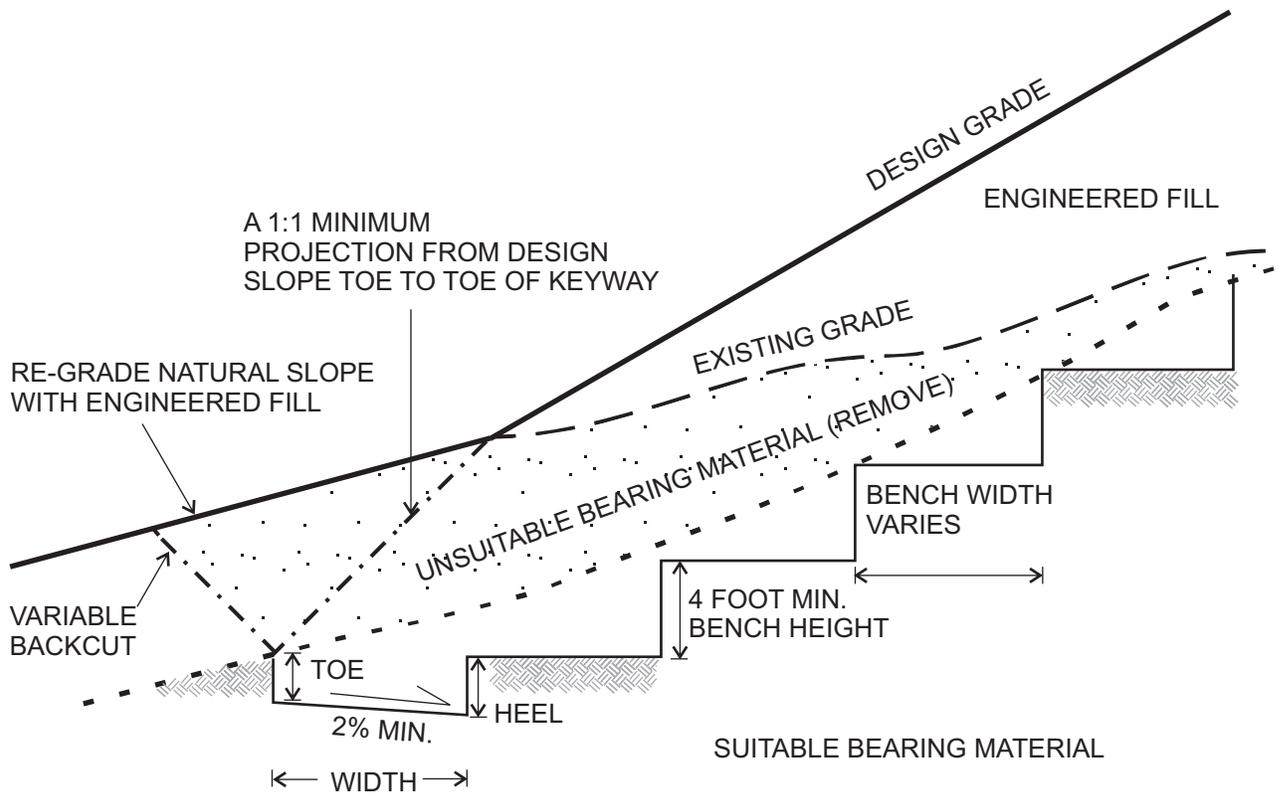
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ADVANCED GEOTECHNICAL SOLUTIONS

FILL OVER CUT SLOPE

DETAIL 4

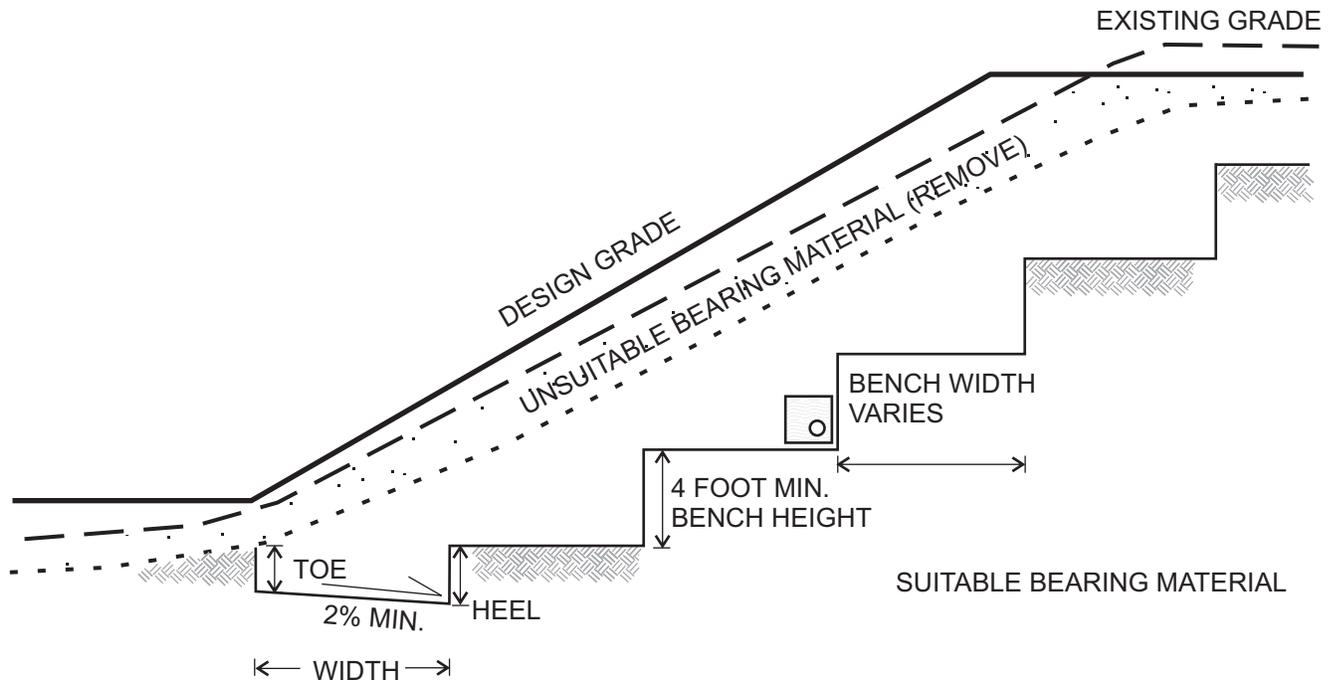


CODE COMPLIANT KEYWAY  
WITH MINIMUM DIMENSIONS:

TOE: 2 FOOT MIN.  
HEEL: 3 FOOT MIN.  
WIDTH: 15 FOOT MIN.

NOTES:

1. WHEN THE NATURAL SLOPE APPROACHES OR EXCEEDS THE DESIGN GRADE SLOPE RATIO, SPECIAL RECOMMENDATIONS ARE NECESSARY BY THE GEOTECHNICAL CONSULTANT
2. THE GEOTECHNICAL CONSULTANT WILL DETERMINE THE REQUIREMENT FOR AND LOCATION OF SUBSURFACE DRAINAGE SYSTEMS.
3. MAINTAIN MINIMUM 15 FOOT HORIZONTAL WIDTH FROM FACE OF SLOPE TO BENCH/BACKCUT

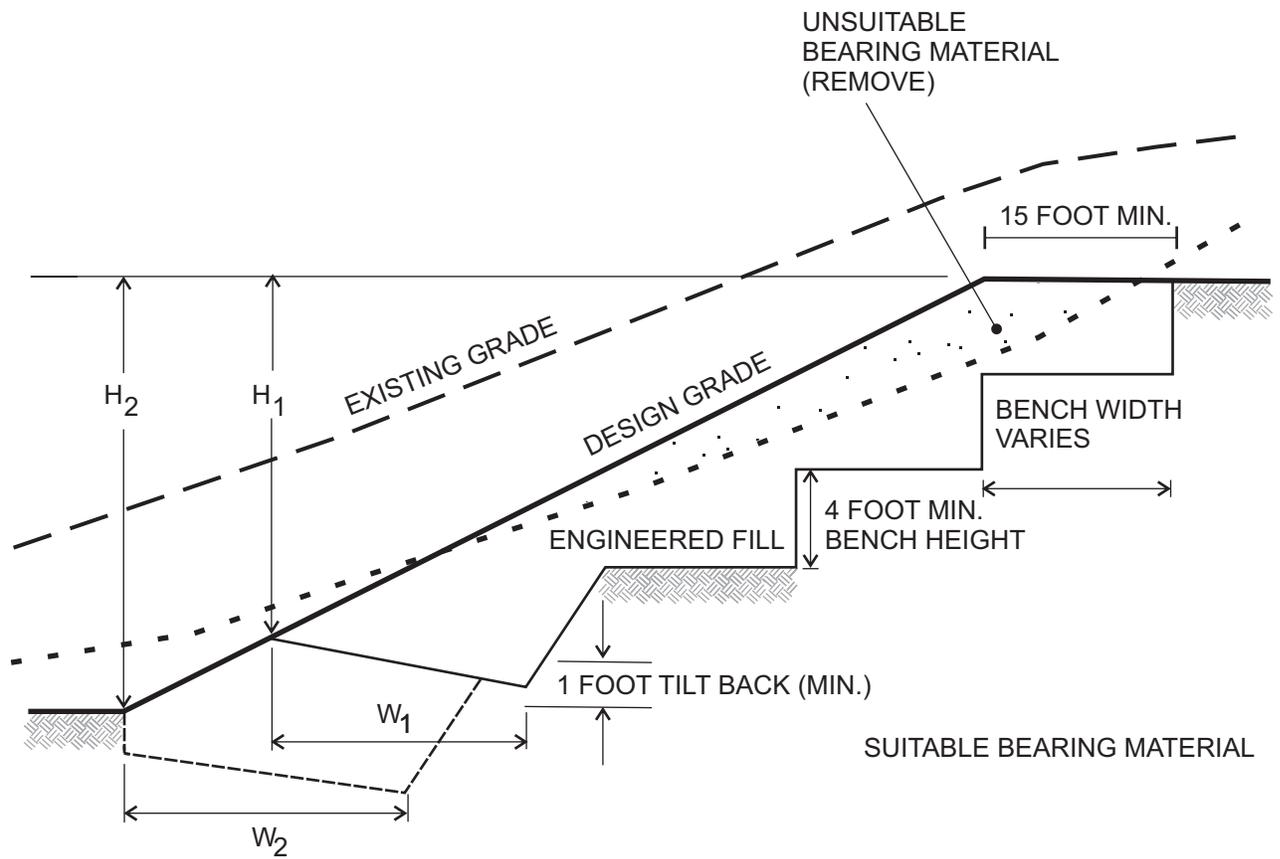


CODE COMPLIANT KEYWAY  
WITH MINIMUM DIMENSIONS:

TOE: 2 FOOT MIN.  
HEEL: 3 FOOT MIN.  
WIDTH: 15 FOOT MIN.

NOTES:

1. MAINTAIN MINIMUM 15 FOOT HORIZONTAL WIDTH FROM FACE OF SLOPE TO BENCH/BACKCUT
2. SEE DETAIL 2 FOR DRAIN SPECIFICATIONS



NOTES:

1. IF RECOMMENDED BY THE GEOTECHNICAL CONSULTANT, THE REMAINING CUT PORTION OF THE SLOPE MAY REQUIRE REMOVAL AND REPLACEMENT WITH AN ENGINEERED FILL
2. "W" SHALL BE EQUIPMENT WIDTH (15 FEET) FOR SLOPE HEIGHT LESS THAN 25 FEET. FOR SLOPES GREATER THAN 25 FEET, "W" SHALL BE DETERMINED BY THE GEOTECHNICAL CONSULTANT. AT NO TIME SHALL "W" BE LESS THAN H/2
3. DRAINS WILL BE REQUIRED (SEE DETAIL 2)

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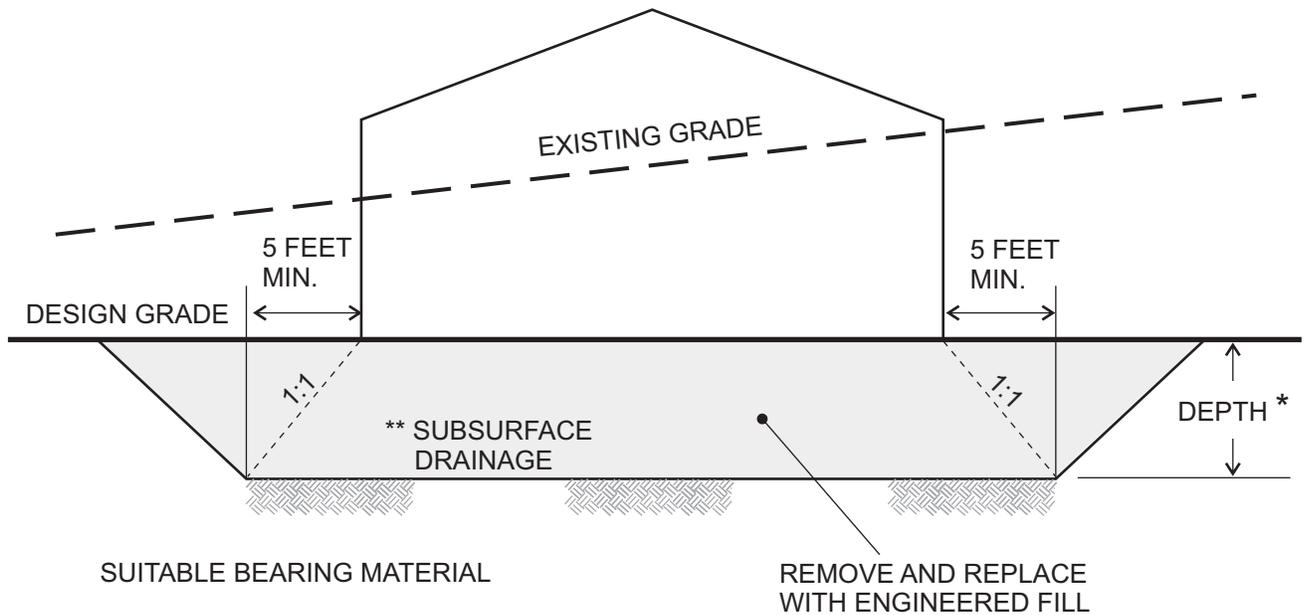
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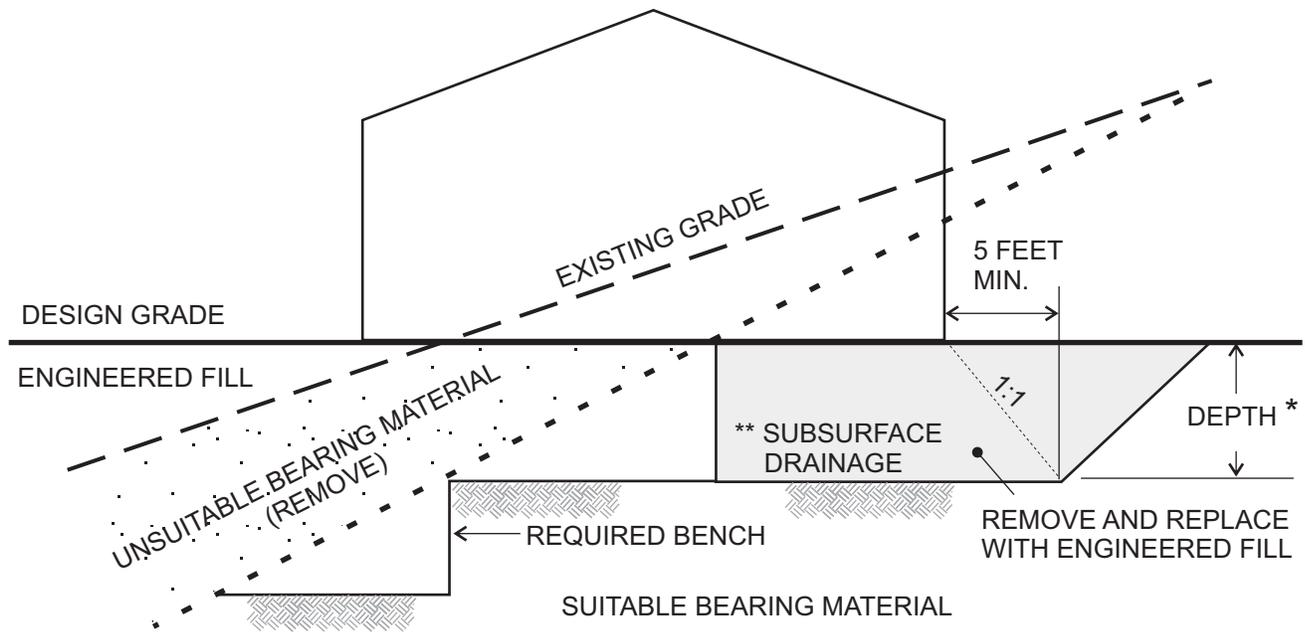
ADVANCED GEOTECHNICAL SOLUTIONS

PARTIAL CUT SLOPE  
STABILIZATION

DETAIL 7



**CUT LOT OVEREXCAVATION**



**CUT-FILL LOT OVEREXCAVATION**

NOTES:

\* SEE REPORT FOR RECOMMENDED DEPTHS, DEEPER OVEREXCAVATION MAY BE REQUIRED BY THE GEOTECHNICAL CONSULTANT BASED ON EXPOSED FIELD CONDITIONS

\*\* CONSTRUCT EXCAVATION TO PROVIDE FOR POSITIVE DRAINAGE TOWARDS STREETS, DEEPER FILL AREAS OR APPROVED DRAINAGE DEVICES BASED ON FIELD CONDITIONS

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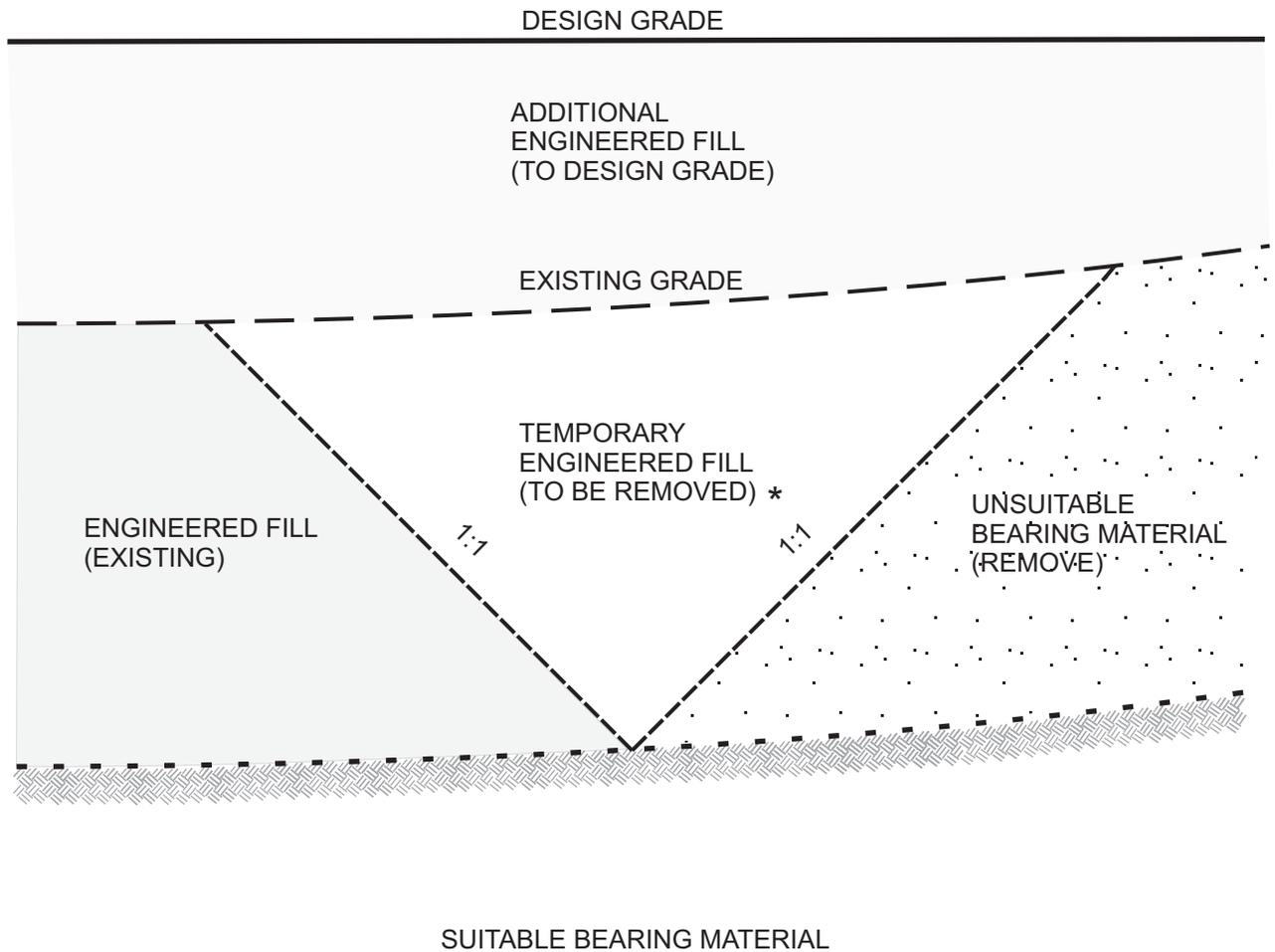
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ADVANCED GEOTECHNICAL SOLUTIONS

**CUT & CUT-FILL LOT OVEREXCAVATION**

**DETAIL 8**



\* REMOVE BEFORE PLACING ADDITIONAL ENGINEERED FILL

### TYPICAL UP-CANYON PROFILE

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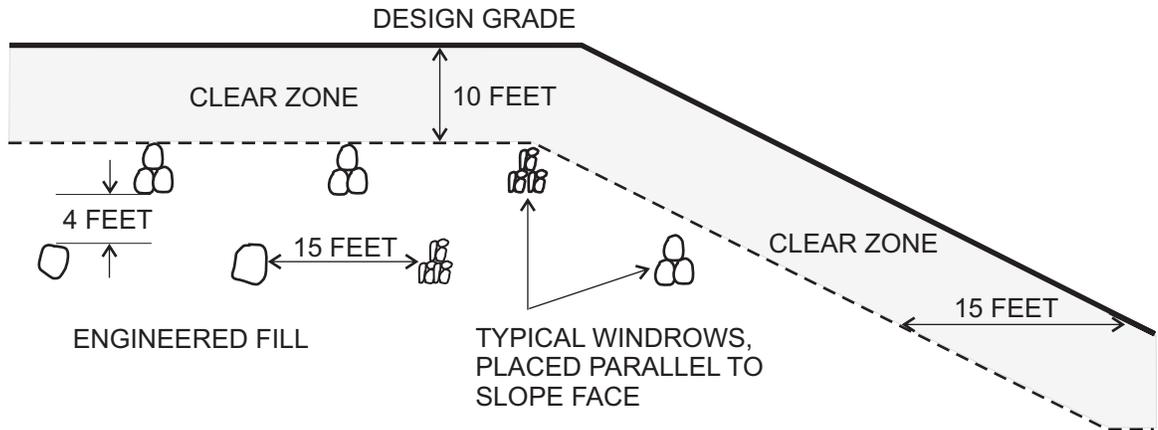
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ADVANCED GEOTECHNICAL SOLUTIONS

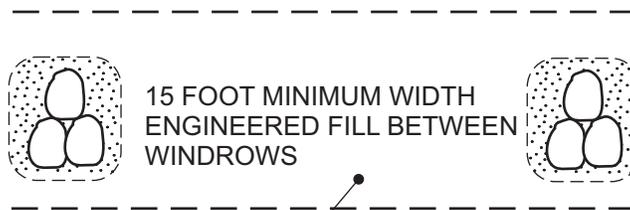
REMOVAL ADJACENT TO  
EXISTING FILL

DETAIL 9



CLEAR ZONE DIMENSIONS FOR REFERENCE ONLY, ACTUAL DEPTH, WIDTH, WINDROW LENGTH, ETC. TO BE BASED ON ELEVATIONS OF FOUNDATIONS, UTILITIES OR OTHER STRUCTURES PER THE GEOTECHNICAL CONSULTANT OR GOVERNING AGENCY APPROVAL

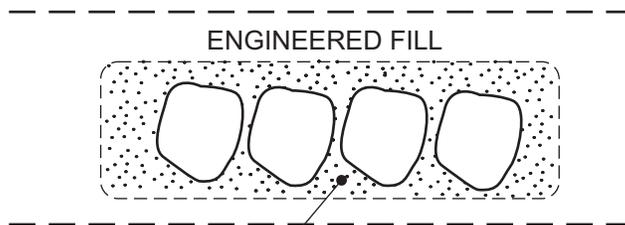
### OVERSIZED MATERIAL DISPOSAL PROFILE



HORIZONTALLY PLACED ENGINEERED FILL, FREE OF OVERSIZED MATERIALS AND COMPACTED TO MINIMUM PROJECT STANDARDS

COMPACT ENGINEERED FILL ABOVE OVERSIZED MATERIALS TO FACILITATE "TRENCH" CONDITION PRIOR TO FLOODING GRANULAR MATERIALS

### WINDROW CROSS-SECTION



GRANULAR MATERIAL APPROVED BY THE GEOTECHNICAL CONSULTANT AND CONSOLIDATED IN-PLACE BY FLOODING

### WINDROW PROFILE

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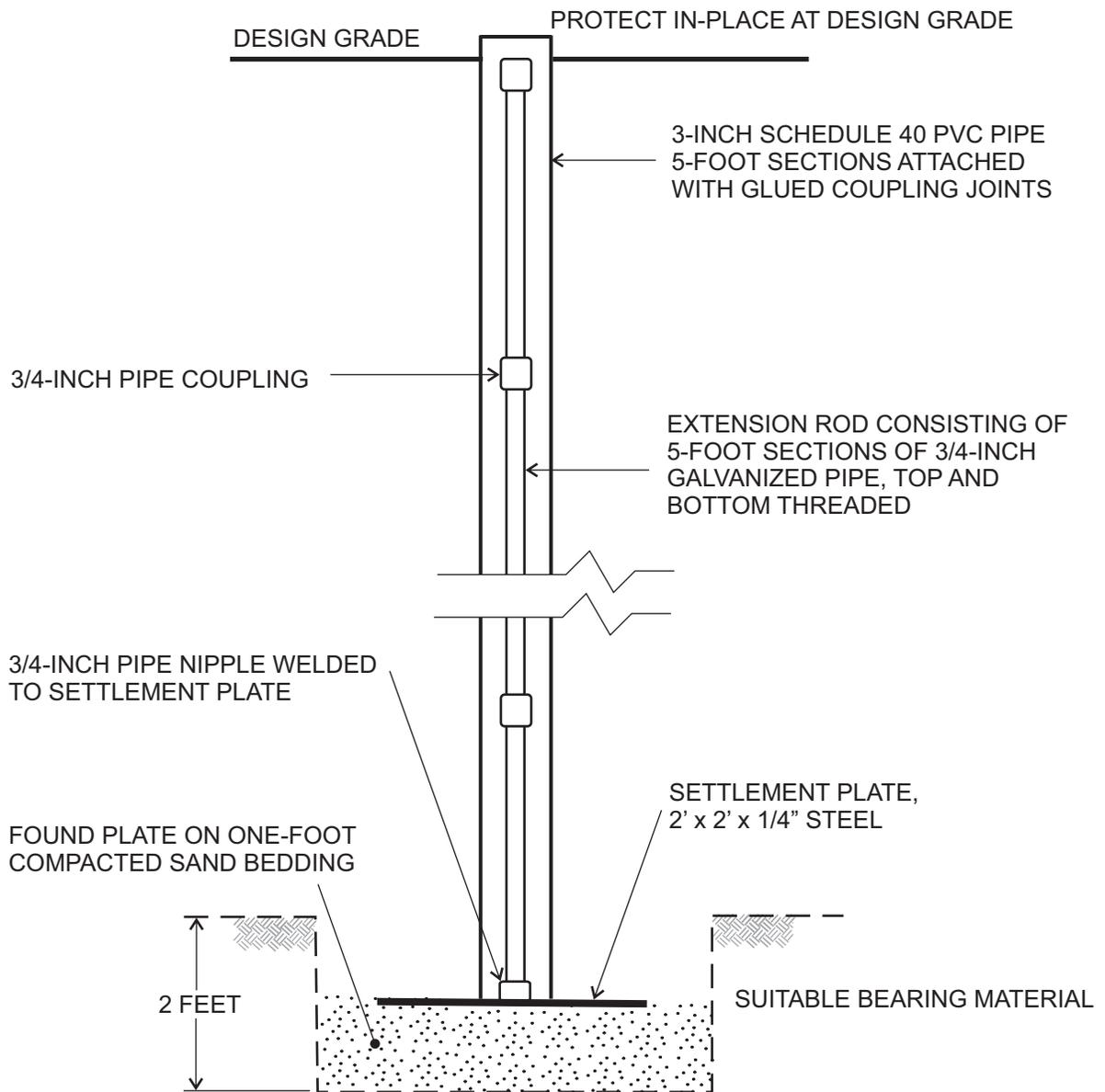
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ADVANCED GEOTECHNICAL SOLUTIONS

OVERSIZED MATERIAL DISPOSAL CRITERIA

DETAIL 10



NOTES:

1. SETTLEMENT PLATE LOCATIONS SHALL BE SUFFICIENTLY IDENTIFIED BY THE CONTRACTOR AND BE READILY VISIBLE TO EQUIPMENT OPERATORS.
2. CONTRACTOR SHALL MAINTAIN ADEQUATE HORIZONTAL CLEARANCE FOR EQUIPMENT OPERATION AND SHALL BE RESPONSIBLE FOR REPAIRING ANY DAMAGE TO SETTLEMENT PLATE DURING SITE CONSTRUCTION.
3. A MINIMUM 5-FOOT ZONE ADJACENT TO SETTLEMENT PLATE/EXTENSION RODS SHALL BE ESTABLISHED FOR HAND-HELD MECHANICAL COMPACTION OF ENGINEERED FILL. ENGINEERED FILL SHALL BE COMPACTED TO MINIMUM PROJECT STANDARD.
4. ELEVATIONS OF SETTLEMENT PLATE AND ALL EXTENSION ROD PLACEMENT SHALL BE DOCUMENTED BY PROJECT CIVIL ENGINEER OR SURVEYOR.

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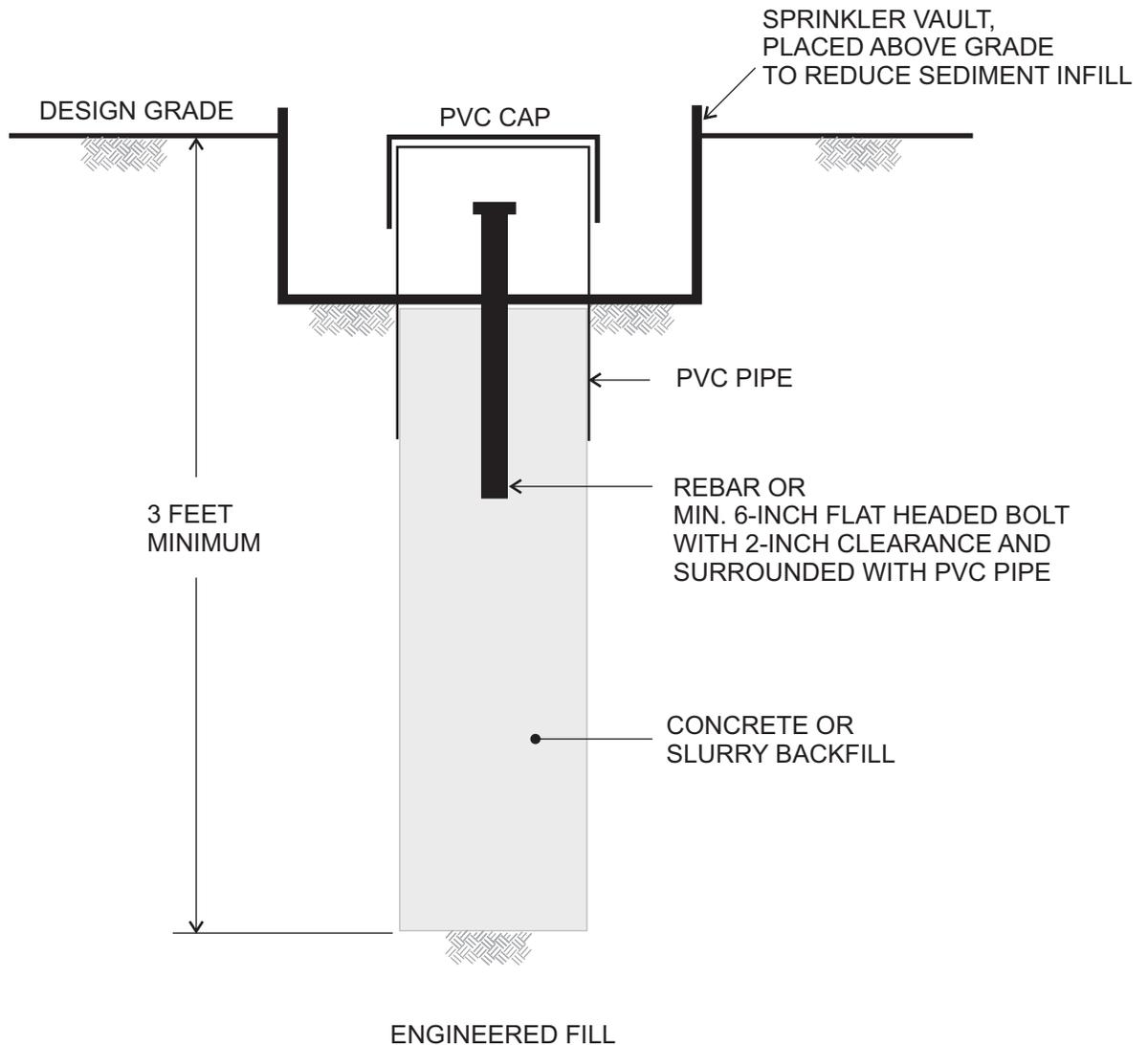
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ADVANCED GEOTECHNICAL SOLUTIONS

SETTLEMENT PLATE

DETAIL 11



NOTES:

1. SETTLEMENT MONUMENT LOCATIONS SHALL BE SUFFICIENTLY IDENTIFIED AND BE READILY VISIBLE TO EQUIPMENT OPERATORS.
2. ELEVATIONS OF SURFACE MONUMENTS SHALL BE DOCUMENTED BY PROJECT CIVIL ENGINEER OR SURVEYOR.

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ADVANCED GEOTECHNICAL SOLUTIONS

SETTLEMENT MONUMENT

DETAIL 12

**APPENDIX F**  
**HOMEOWNERS MAINTENANCE GUIDELINES**

## HOMEOWNERS MAINTENANCE GUIDELINES

Homeowners are accustomed to maintaining their homes. They expect to paint their houses periodically, replace wiring, clean out clogged plumbing, and repair roofs. Maintenance of the home site, particularly on hillsides, should be considered on the same basis, or even on a more serious basis because neglect can result in serious consequences. In most cases, lot and site maintenance can be taken care of along with landscaping, and can be carried out more economically than repair after neglect.

Most slope and hillside lot problems are associated with water. Uncontrolled water from a broken pipe, cesspool, or wet weather causes most damage. Wet weather is the largest cause of slope problems, particularly in California where rain is intermittent, but may be torrential. Therefore, drainage and erosion control are the most important aspects of home site stability; these provisions must not be altered without competent professional advice. Further, maintenance must be carried out to assure their continued operation.

As geotechnical engineers concerned with the problems of building sites in hillside developments, we offer the following list of recommended home protection measures as a guide to homeowners.

### Expansive Soils

Some of the earth materials on site have been identified as being expansive in nature. As such, these materials are susceptible to volume changes with variations in their moisture content. These soils will swell upon the introduction of water and shrink upon drying. The forces associated with these volume changes can have significant negative impacts (in the form of differential movement) on foundations, walkways, patios, and other lot improvements. In recognition of this, the project developer has constructed homes on these lots on post-tensioned or mat slabs with pier and grade beam foundation systems, intended to help reduce the potential adverse effects of these expansive materials on the residential structures within the project. Such foundation systems are not intended to offset the forces (and associated movement) related to expansive soil, but are intended to help soften their effects on the structures constructed thereon.

Homeowners purchasing property and living in an area containing expansive soils must assume a certain degree of responsibility for homeowner improvements as well as for maintaining conditions around their home. Provisions should be incorporated into the design and construction of homeowner improvements to account for the expansive nature of the onsite soils material. Lot maintenance and landscaping should also be conducted in consideration of the expansive soil characteristics. Of primary importance is minimizing the moisture variation below all lot improvements. Such design, construction and homeowner maintenance provisions should include:

- ❖ Employing contractors for homeowner improvements who design and build in recognition of local building code and site specific soils conditions.
- ❖ Establishing and maintaining positive drainage away from all foundations, walkways, driveways, patios, and other hardscape improvements.

- ❖ Avoiding the construction of planters adjacent to structural improvements. Alternatively, planter sides/bottoms can be sealed with an impermeable membrane and drained away from the improvements via subdrains into approved disposal areas.
- ❖ Sealing and maintaining construction/control joints within concrete slabs and walkways to reduce the potential for moisture infiltration into the subgrade soils.
- ❖ Utilizing landscaping schemes with vegetation that requires minimal watering. Alternatively, watering should be done in a uniform manner as equally as possible on all sides of the foundation, keeping the soil "moist" but not allowing the soil to become saturated.
- ❖ Maintaining positive drainage away from structures and providing roof gutters on all structures with downspouts installed to carry roof runoff directly into area drains or discharged well away from the structures.
- ❖ Avoiding the placement of trees closer to the proposed structures than a distance of one-half the mature height of the tree.
- ❖ Observation of the soil conditions around the perimeter of the structure during extremely hot/dry or unusually wet weather conditions so that modifications can be made in irrigation programs to maintain relatively constant moisture conditions.

### **Sulfates**

On site soils were tested for the presence of soluble sulfates. Based on the results of that testing, the soluble sulfate exposure level was determined to be “negligible” to “severe” when classified in accordance with the ACI 318-05 Table 4.3.1 (per 2010 CBC). Concrete mixes should be designed based on Code standards.

Homeowners should be cautioned against the import and use of certain fertilizers, soil amendments, and/or other soils from offsite sources in the absence of specific information relating to their chemical composition. Some fertilizers have been known to leach sulfate compounds into soils otherwise containing “negligible” sulfate concentrations and increase the sulfate concentrations in near-surface soils to “moderate” or “severe” levels. In some cases, concrete improvements constructed in soils containing high levels of soluble sulfates may be affected by deterioration and loss of strength.

### **Water - Natural and Man Induced**

Water in concert with the reaction of various natural and man-made elements, can cause detrimental effects to your structure and surrounding property. Rain water and flowing water erodes and saturates the ground and changes the engineering characteristics of the underlying earth materials upon saturation. Excessive irrigation in concert with a rainy period is commonly associated with shallow slope failures and deep seated landslides, saturation of near structure soils, local ponding of water, and transportation of water soluble substances that are deleterious to building materials including concrete, steel, wood, and stucco.

Water interacting with the near surface and subsurface soils can initiate several other potentially detrimental phenomena other than slope stability issues. These may include

expansion/contraction cycles, liquefaction potential increase, hydro-collapse of soils, ground surface settlement, earth material consolidation, and introduction of deleterious substances.

The homeowners should be made aware of the potential problems which may develop when drainage is altered through construction of retaining walls, swimming pools, paved walkways and patios. Pondered water, drainage over the slope face, leaking irrigation systems, over-watering or other conditions which could lead to ground saturation must be avoided.

- ❖ Before the rainy season arrives, check and clear roof drains, gutters and down spouts of all accumulated debris. Roof gutters are an important element in your arsenal against rain damage. If you do not have roof gutters and down spouts, you may elect to install them. Roofs, with their, wide, flat area can shed tremendous quantities of water. Without gutters or other adequate drainage, water falling from the eaves collects against foundation and basement walls.
- ❖ Make sure to clear surface and terrace drainage ditches, and check them frequently during the rainy season. This task is a community responsibility.
- ❖ Test all drainage ditches for functioning outlet drains. This should be tested with a hose and done before the rainy season. All blockages should be removed.
- ❖ Check all drains at top of slopes to be sure they are clear and that water will not overflow the slope itself, causing erosion.
- ❖ Keep subsurface drain openings (weep-holes) clear of debris and other material which could block them in a storm.
- ❖ Check for loose fill above and below your property if you live on a slope or terrace.
- ❖ Monitor hoses and sprinklers. During the rainy season, little, if any, irrigation is required. Oversaturation of the ground is unnecessary, increases watering costs, and can cause subsurface drainage.
- ❖ Watch for water backup of drains inside the house and toilets during the rainy season, as this may indicate drain or sewer blockage.
- ❖ Never block terrace drains and brow ditches on slopes or at the tops of cut or fill slopes. These are designed to carry away runoff to a place where it can be safely distributed.
- ❖ Maintain the ground surface upslope of lined ditches to ensure that surface water is collected in the ditch and is not permitted to be trapped behind or under the lining.
- ❖ Do not permit water to collect or pond on your home site. Water gathering here will tend to either seep into the ground (loosening or expanding fill or natural ground), or will overflow into the slope and begin erosion. Once erosion is started, it is difficult to control and severe damage may result rather quickly.
- ❖ Never connect roof drains, gutters, or down spouts to subsurface drains. Rather, arrange them so that water either flows off your property in a specially designed pipe or flows out into a paved driveway or street. The water then may be dissipated over a wide surface or, preferably, may be carried away in a paved gutter or storm drain. Subdrains are constructed to take care of ordinary subsurface water and cannot handle the overload from roofs during a heavy rain.

- ❖ Never permit water to spill over slopes, even where this may seem to be a good way to prevent ponding. This tends to cause erosion and, in the case of fill slopes, can eat away carefully designed and constructed sites.
- ❖ Do not cast loose soil or debris over slopes. Loose soil soaks up water more readily than compacted fill. It is not compacted to the same strength as the slope itself and will tend to slide when laden with water; this may even affect the soil beneath the loose soil. The sliding may clog terrace drains below or may cause additional damage in weakening the slope. If you live below a slope, try to be sure that loose fill is not dumped above your property.
- ❖ Never discharge water into subsurface blanket drains close to slopes. Trench drains are sometimes used to get rid of excess water when other means of disposing of water are not readily available. Overloading these drains saturates the ground and, if located close to slopes, may cause slope failure in their vicinity.
- ❖ Do not discharge surface water into septic tanks or leaching fields. Not only are septic tanks constructed for a different purpose, but they will tend, because of their construction, to naturally accumulate additional water from the ground during a heavy rain. Overloading them artificially during the rainy season is bad for the same reason as subsurface subdrains, and is doubly dangerous since their overflow can pose a serious health hazard. In many areas, the use of septic tanks should be discontinued as soon as sewers are made available.
- ❖ Practice responsible irrigation practices and do not over-irrigate slopes. Naturally, ground cover of ice plant and other vegetation will require some moisture during the hot summer months, but during the wet season, irrigation can cause ice plant and other heavy ground cover to pull loose. This not only destroys the cover, but also starts serious erosion. In some areas, ice plant and other heavy cover can cause surface sloughing when saturated due to the increase in weight and weakening of the near-surface soil. Planted slopes should be planned where possible to acquire sufficient moisture when it rains.
- ❖ Do not let water gather against foundations, retaining walls, and basement walls. These walls are built to withstand the ordinary moisture in the ground and are, where necessary, accompanied by subdrains to carry off the excess. If water is permitted to pond against them, it may seep through the wall, causing dampness and leakage inside the basement. Further, it may cause the foundation to swell up, or the water pressure could cause structural damage to walls.
- ❖ Do not try to compact soil behind walls or in trenches by flooding with water. Not only is flooding the least efficient way of compacting fine-grained soil, but it could damage the wall foundation or saturate the subsoil.
- ❖ Never leave a hose and sprinkler running on or near a slope, particularly during the rainy season. This will enhance ground saturation which may cause damage.
- ❖ Never block ditches which have been graded around your house or the lot pad. These shallow ditches have been put there for the purpose of quickly removing water toward the driveway, street or other positive outlet. By all means, do not let water become ponded above slopes by blocked ditches.

- ❖ Seeding and planting of the slopes should be planned to achieve, as rapidly as possible, a well-established and deep-rooted vegetal cover requiring minimal watering.
- ❖ It should be the responsibility of the landscape architect to provide such plants initially and of the residents to maintain such planting. Alteration of such a planting scheme is at the resident's risk.
- ❖ The resident is responsible for proper irrigation and for maintenance and repair of properly installed irrigation systems. Leaks should be fixed immediately. Residents must undertake a program to eliminate burrowing animals. This must be an ongoing program in order to promote slope stability. The burrowing animal control program should be conducted by a licensed exterminator and/or landscape professional with expertise in hill side maintenance.

### **Geotechnical Review**

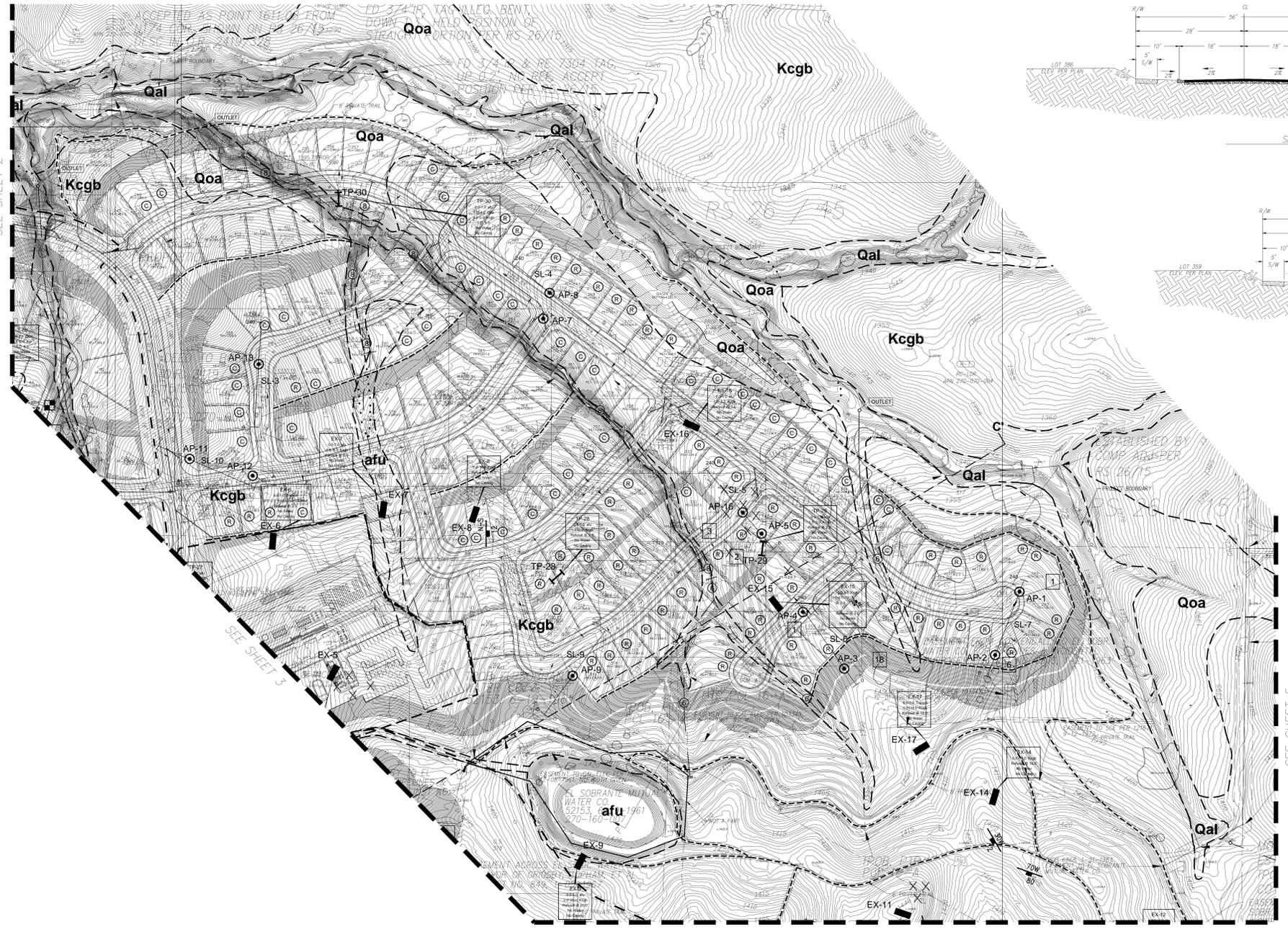
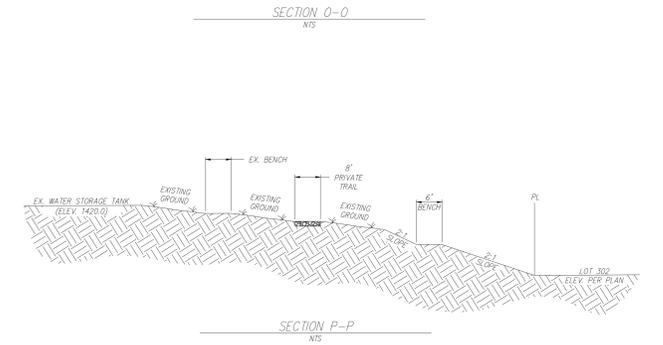
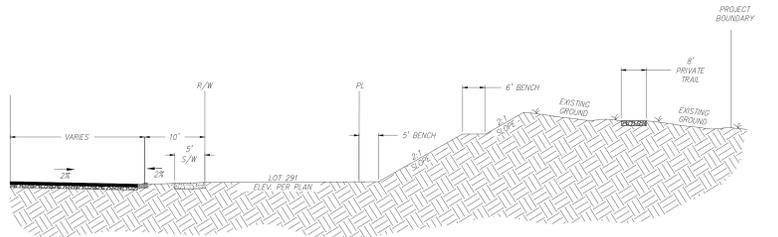
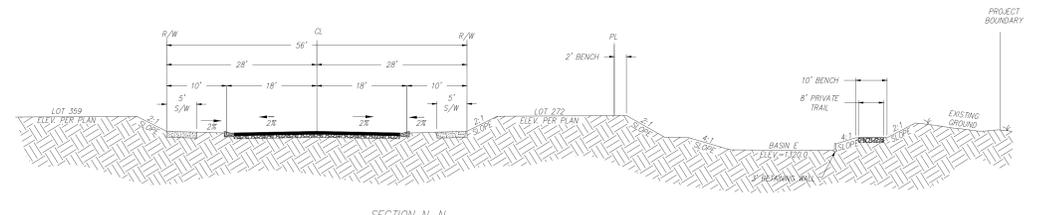
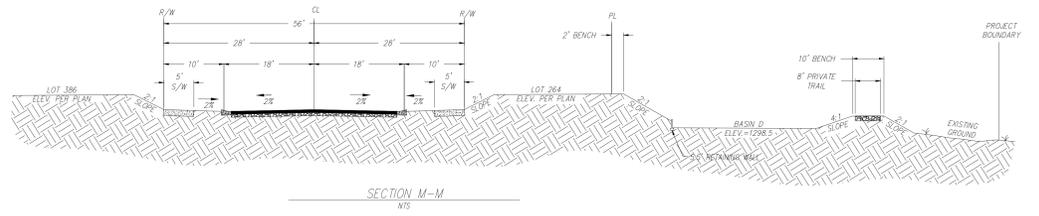
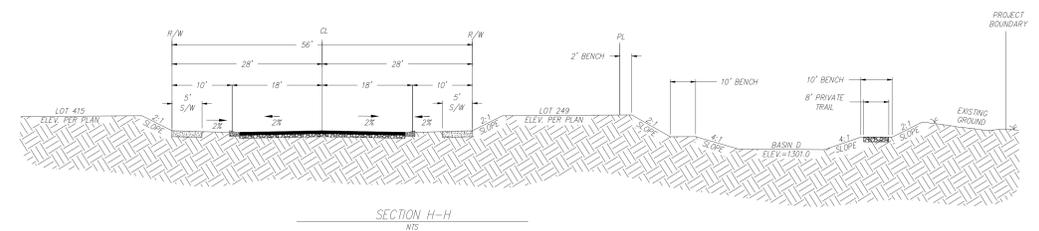
Due to the presence of expansive soils on site and the fact that soil types may vary with depth, it is recommended that plans for the construction of rear yard improvements (swimming pools, spas, barbecue pits, patios, etc.), be reviewed by a geotechnical engineer who is familiar with local conditions and the current standard of practice in the vicinity of your home.

In conclusion, your neighbor's slope, above or below your property, is as important to you as the slope that is within your property lines. For this reason, it is desirable to develop a cooperative attitude regarding hillside maintenance, and we recommend developing a "good neighbor" policy. Should conditions develop off your property, which are undesirable from indications given above, necessary action should be taken by you to insure that prompt remedial measures are taken. Landscaping of your property is important to enhance slope and foundation stability and to prevent erosion of the near surface soils. In addition, landscape improvements should provide for efficient drainage to a controlled discharge location downhill of residential improvements and soil slopes.

Additionally, recommendations contained in the Geotechnical Engineering Study report apply to all future residential site improvements, and we advise that you include consultation with a qualified professional in planning, design, and construction of any improvements. Such improvements include patios, swimming pools, decks, etc., as well as building structures and all changes in the site configuration requiring earth cut or fill construction.







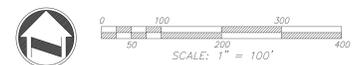
SEE PLATE 1 FOR LEGEND PLATE 3

**AGS** ADVANCED GEOTECHNICAL SOLUTIONS, INC.  
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 Escondido, California 92029  
 Telephone: (714) 766-5661 Fax: (714) 409-3287

Project# P/W 1507-05 Report# 1507-05-B-10 Date: MAY 2018

- LEGEND**
- 8' PRIVATE TRAIL
  - 10' PUBLIC TRAIL
  - 10' PRIVATE TRAIL

REVISIONS		
INT.	DESCRIPTION	APPR. DATE



PREPARED BY: **adkan ENGINEERS**  
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TENTATIVE TRACT 37217  
 PREPARATION DATE: MAY 2018



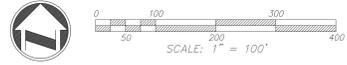
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PER RS 19/27 &

SEE SHEET 4

SEE PLATE 1 FOR LEGEND PLATE 4

**AGS** ADVANCED GEOTECHNICAL SOLUTIONS, INC.  
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REVISIONS		
NO.	DESCRIPTION	DATE

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TENTATIVE TRACT 37217  
PREPARATION DATE: MAY 2018





December 11, 2023

Project No. RCE-23220-01

TO: adkan Engineers  
6879 Airport Drive  
Riverside, CA 92504

ATTENTION: Mitch Adkison

SUBJECT: Soil Report & Seismic (CBC 2022) Update, Green Tree Ranch Project, Proposed 165 Lots Residential Development, Tentative Tract Map 38650 (APN 270-070-005, -006, -007 and 270-160-005), El Sobrante Road, Riverside County, California.

REFERENCE: AGS, Inc., "Updated Preliminary Geotechnical Investigation, TTM 37217, Green Tree Ranch Project, County of Riverside, California.", Dated May 25, 2018 (Project No. 1057-05-B-10).

**Introduction**

Per your authorization, we have reviewed the referenced report and prepared this CBC (2022) seismic update for the subject site (see attached).

**California Building Code (CBC) 2022 Update**

2022 CBC – SEISMIC PARAMETERS		
SITE COORDINATES	LATITUDE	LONGITUDE
		33.8650
Mapped Spectral Response Acceleration	$S_s = 1.5$	$S_1 = 0.593$
Site Coefficients (Class "C")	$F_a = 1.2$	$F_v = 1.407$
Maximum Considered Earthquake (MCE) Spectral Response Acceleration	$S_{MS} = 1.8$	$S_{M1} = 0.834$
Design Spectral Response Acceleration Parameters	$S_{DS} = 1.2$	$S_{D1} = 0.556$
Seismic Design Category	D	
Peak Ground Acceleration (PGA)	0.555g	
Site Amplification factor at PGA ( $F_{PGA}$ )	1.2	
Site Modified Peak Ground Acceleration ( $PGA_m$ )	0.666	

References:

- [Earthquake.usgs.gov/research/hazmaps/design](http://Earthquake.usgs.gov/research/hazmaps/design)
- 2022 California Building Code, California Code of Regulations, Title 24, Part 2, Volume 2 of 2, Section 1613, Earthquake Loads

## **Conclusions and Recommendations**

### **General**

Based on our review, conclusions and recommendations presented in the referenced report, except as modified herein, remain pertinent.

### **Foundation Design**

Continuous footings should be reinforced with at least two No. 4 bars at the top and two at the bottom. Please note foundation design is under the purview of structural design engineer and structural considerations may have other more stringent requirements.

### **Seismic Considerations**

The site is located in a region of generally high seismicity, as is all of Southern California. During its design life, the site is expected to experience moderate to strong ground motions from earthquakes on regional and/or nearby causative faults. The structural engineer should consider City/County local codes, California Building Code (CBC) 2022, seismic data presented herein, the latest requirements of the Structural Engineers Association, and any other pertinent data in selecting design parameters.

### **Lateral Earth Pressures/Retaining Walls**

Retaining walls supporting more than 6 feet of backfill should be designed for seismic lateral earth pressure due to earthquake ground motions.

- Seismic lateral force (level)  $F(\text{seismic}) = 12H^2$  plf, yielding
  - Seismic lateral force (slope backfill\*)  $F(\text{seismic}) = 20H^2$  plf, yielding
- \*Applicable for sloping backfill that is no steeper than 2:1 (horizontal: vertical).

Seismic force should be applied at  $1/3 H$  from the bottom wall footings.

### **Additional Observations/Testing**

Our conclusions and recommendations should be reviewed, verified during grading and construction, and revised as necessary. Rodriguez Consulting and Engineering should review the grading and foundation plans and observe and/or test at the following stages of construction:

- During all overexcavation and grading.
- Following footing excavation and prior to placement of footing materials.
- During wetting of slab subgrade and prior to placement of slab materials.
- During all trench backfills,
- When any unusual conditions are encountered.

### **Limitation**

Rodriguez Consulting and Engineering has striven to perform our services within the limits prescribed by our client. No other representation, express or implied, and no warranty or guarantee is included or intended by virtue of the services performed or reports, opinion, documents or otherwise supplied.

### **Closure**

If you should have any questions regarding this report, please do not hesitate to call this office. We appreciate this opportunity to be of service.

Very truly yours,  
Rodriguez Consulting and Engineering



Gene K. Luy, PE C 53417  
Project Engineer

Distribution: [1] Addressee



**GEOTECHNICAL DUE DILIGENCE EVALUATION  
PROPOSED HIGHLAND GROVE III  
LAKE MATHEWS AREA  
RIVERSIDE COUNTY, CALIFORNIA**

**Prepared For** **PULTE HOME CORPORATION**  
27401 LOS ALTOS, SUITE 400  
MISSION VIEJO, CA 92691

**Prepared By** **LEIGHTON AND ASSOCIATES, INC.**  
41715 ENTERPRISE CIRCLE N, SUITE 103  
TEMECULA, CA 92590

Project Number 13979.001

September 7, 2023

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Leighton and Associates, Inc.

A Leighton Group Company

September 7, 2023

Project No. 13979.001

Pulte Home Corporation  
27401 Los Altos, Suite 400  
Mission Viejo, CA 92691

Attention: Mr. Patrick Lynam

**Subject: Geotechnical Due Diligence Evaluation  
Proposed Highland Grove III Residential Development, Tract 38605  
Lake Mathews Area, Riverside County, California**

In accordance with your request, this report is presenting our findings, conclusions and recommendations pertaining to the geotechnical aspects of the proposed development. It is our opinion that the overall site appears suitable for the intended use provided our recommendations included herein are properly incorporated during the design and construction phases of development. Please note that pertinent information from previous geotechnical/geologic studies performed for this site (see references) are incorporated/included in this report. As such, this report is a stand-alone document and supersedes previous reports. The main geotechnical/geologic findings that impact the cost for the proposed developing is the presence of potentially unrippable rock in the northern portion of the site and collapsible potential in the site alluvium/colluvium.

If you have any questions regarding this report, please do not hesitate to contact the undersigned. We appreciate this opportunity to be of service on this project.

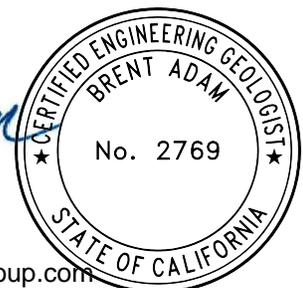
Respectfully submitted,

LEIGHTON AND ASSOCIATES, INC.

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Distribution: (1) Addressee (PDF copy)

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## 1.0 INTRODUCTION

### 1.1 Purpose and Scope

This geotechnical evaluation report is for Proposed Highland Grove III Residential Development, Tract 38605, located generally northeast of the intersection of McAllister Street and El Sobrante Road in Riverside County, California (see Figure 1). Our scope of services for this geotechnical evaluation included the following:

- Review of available geologic information and relevant publications listed in the references at the end of this report.
- A site geologic reconnaissance, mapping and visual observations of surface conditions.
- Excavation of twelve (12) excavator test pits to explore the subsurface soil conditions and general rock rippability within the site. Approximate locations of these explorations are depicted on the Geotechnical Map (Plate 1).
- Laboratory testing was performed on representative samples and results (including previous test results) are included in Appendix B.
- Geotechnical engineering review and analyses performed or as directed by a California registered Geotechnical Engineer (GE). A California Certified Engineering Geologist (CEG) performed engineering geology review of site geologic hazards.
- Preparation of this report, which presents the results of our geotechnical review, update of seismic design coefficients in accordance with the 2022 California Building Code (CBC).

This report is not intended to be used as an environmental assessment (Phase I or other), and foundation and/or a rough grading plan review.

### 1.2 Site Location and Description

The site covers approximately 96 acres located in Riverside County, California (see Figure 1, Site Location Map). The site is bounded on the west by open land and Pulte's Highland Grove residential development, on the south by agricultural facilities and El Sobrante Road, on the east by undeveloped land, and on the north by vacant land and a residential development. The area of proposed development slopes away from a high southern-central portion of the site, at an elevation of approximately 1,405 feet above mean sea level (msl) located along the north-western portion of the site to lower elevations along the northern and western boundaries of the site and a low of approximately 1,205 feet (msl) in the northeastern

portion of the property. A deeply incised, heavily vegetated drainage traverses the northern and southern edges of the site in a northwestern direction. The site is currently undeveloped with minor previous grading likely associated with agricultural activities that consisted of minor cuts and fills for drainage and access purposes. A northwest Western Municipal Water District water supply pipeline easement traverses the central portion of the site. Vegetation consists of seasonal grass and weeds to previous orchard stumps and associated dead trees/vegetation.

### **1.3 Proposed Development**

Based on the Tentative Tract Map (Adkan, 2023), we understand that the project will consist of 163 residential lots with associated site improvements including roadways, retaining walls, retention basins and open space areas. It is our understanding; the residential lots will host typical one- or two-story single-family homes consisting of wood-frame structure with slab-on-grade foundations. Grading will generally require maximum cuts and fills on the order of  $\pm 20$  feet and  $\pm 25$  feet, respectively. Slopes are proposed at 2:1 inclination (horizontal to vertical) and flatter (basins) with maximum heights on the order of 45 feet.

## **2.0 FIELD EXPLORATION AND LABORATORY TESTING**

### **2.1 Previous Studies**

Albus-Keefe, 2004: A “Summary of Key Geotechnical and Environmental Issues” for this and surrounding tracts was prepared by AKA and was based on background review and a seismic refraction survey. Key issues included difficult excavating conditions, generation of oversized materials, and low permeability of bedrock materials resulting in perched groundwater conditions.

Leighton, 2005: Leighton prepared a “Preliminary Geotechnical Investigation” for the overall Victoria Grove residential development, which partially encompassed the subject site. Field exploration for this study included 65 backhoe test pits, and 6 hollow stem auger borings. Additionally, rotary air percussion borings and seismic refraction surveys performed by AKA were reviewed in preparation of this report. Logs of subsurface exploration and laboratory testing from this study that were performed in the vicinity of the subject site.

AGS, 2018: AGS prepared a “Preliminary Geotechnical Investigation” for the previously proposed greater Victoria Heights residential development, which encompasses the proposed footprint of the subject site. As a part of the AGS report, previous studies were reviewed, and additional field exploration was conducted. Field exploration for this study included 32 backhoe test pits and 19 excavator test pits as well as a subcontracted seismic refraction survey performed by Southwest Geophysics. Predominant geotechnical constraints and opportunities presented by AGS remain consistent with other reports prepared for the site.

All previous exploration logs and seismic lines are included in Appendix A and their approximate locations are depicted on Plate 1 (Geotechnical Map).

### **2.2 Field Exploration – This Study**

Our field exploration for this report consisted of the excavation of twelve (12) excavator test pits located throughout the site to supplement previous investigations and provide basis for site grading and foundation design. During exploration, disturbed/bulk samples were collected for further laboratory testing and evaluation. Approximate locations of these and previous field explorations are depicted on the Geotechnical Map (see Plate 1). Sampling was conducted by a geologist from our firm. After logging and sampling, the excavations were loosely backfilled with spoils

generated during excavation. The exploration logs from this and previous explorations are provided in Appendix A.

### **2.3 Laboratory Testing**

Previous and current laboratory testing on representative soils samples are presented in Appendix B. Soils were visually classified in the field according to the Unified Soil Classification System (U.S.C.S.). Laboratory tests were performed in general accordance with the American Society of Testing and Materials (ASTM) procedures and/or applicable California Test Methods (CTM).

## 3.0 GEOTECHNICAL AND GEOLOGIC FINDINGS

### 3.1 Regional Geology

The site is located within the Peninsular Ranges, a prominent physiographic province forming much of southwestern California. This region is characterized by relatively steep, elongated northwest trending mountain ranges and valleys. More specifically, the site is situated within the Perris Block, an eroded mass of Cretaceous and older crystalline bedrock.

The Perris Block, approximately 20 miles by 50 miles in extent, is bounded by the San Jacinto Fault Zone to the northeast, the Elsinore Fault Zone to the southwest, the Cucamonga Fault Zone to the northwest, and the Temecula Basin to the southeast. The southeast boundary of the Perris block is poorly defined. The Perris Block has had a complex tectonic history, apparently experiencing relative vertical land movements of several thousand feet in response to movement along the Elsinore and San Jacinto Fault Zones. Sedimentary and volcanic deposits locally mantle the crystalline bedrock. Alluvial and colluvial deposits fill the valley areas.

Geologic deposits underlying the property include Quaternary alluvium within the low lying drainage areas of the site and Cretaceous-age granitic bedrock exposed on the hillsides and underlying the alluvium.

### 3.2 Site Specific Geology

The geologic units encountered are discussed in the following sections in order of increasing age and further described on the logs of geotechnical borings in Appendix A.

#### 3.2.1 Artificial Fill (map Symbols and Afu)

Artificial fill was observed as existing fill embankments supporting the unpaved access roads that traverse the site, as well as the berms associated with the water storage pond. Some minor undocumented fill exists associated with some end dump piles and previous grading associated with past agricultural activities and a home site.

#### 3.2.2 Topsoil/Colluvium (not a mapped unit)

Topsoil/ soil was observed in the majority of the explorations overlying the bedrock and appear to be derived from in-place weathering of the bedrock

below. As encountered in the explorations on-site, the alluvial deposits are generally comprised of silty sand, and clayey sand with varying amounts of gravel. The topsoil/colluvium is anticipated possess very low to low expansive potential ( $EI < 51$ ) and have a slight collapse potential.

### 3.2.3 Alluvium (mapped as Qal)

Shallow alluvial soils should be expected in natural drainages crossing the site. As encountered in the explorations on-site, the alluvial deposits are generally comprised of silty to clayey sand and sandy silt with varying amounts of gravel. The alluvial soils are anticipated possess very low to low expansive potential ( $EI < 51$ ) and have a slight collapse potential.

### 3.2.4 Granitic Bedrock (mapped as Kcgb)

Granitic bedrock is observed at ground surface (outcrops) along the elevated portions of the site and was encountered in all of our test pits. The bedrock consists of highly to moderately weathered gabbro and granodiorite within the depth explored.

Due to the foliated and relatively dense crystalline nature of the near-surface granitic bedrock, very heavy ripping or localized blasting may be required in areas of deep excavation and/or areas underlain by shallow rock. Further information is provided as to rippability in Section 3.3 below. The approximate limits and general distribution of granitic bedrock within the site is depicted on the *Geotechnical Map (Plate 1)*. Special placement of oversized material (greater than 12 inches) will be required as described later in Section 5.2 of this report.

Fill generated for granitic rock excavation is expected to have a “Very Low” expansion potential ( $EI < 21$ ). Highly weathered portions of the bedrock may have a “low” expansion potential ( $EI < 51$ ).

## 3.3 Rippability

Based on previous studies (AGS, 2018), our review of our geotechnical exploration and the seismic refraction survey conducted previously for the site (Southwest, 2018), we anticipate the bedrock in most of the planned excavations deeper than about 10 to 20 feet will be considered marginally to non-rippable as further described in the table below. The remaining areas of excavations are considered rippable to the proposed design grades with conventional heavy earth moving equipment in good operating conditions (Caterpillar D9L or D10 with single shank ripper and rock teeth). Additional details and discussion on rippability and contractors review considerations are presented in appendix A-2.

In general, deep cuts on the site (particularly near existing rock outcrops) may be difficult to excavate and will generate a significant number of boulders or core stones. Other areas may also encounter buried core stones or non-rippable rock within the design excavation depths or during excavation for the underground utility trenches. In addition, due to differential weathering of the bedrock materials, very heavy ripping and/or other specialized excavation techniques may be required to maintain desired excavation rates. For proposed building pads and utility trenches in marginally ripplable to non-rippable rock areas, it may be desirable to over-excavate at least 2 feet below the bottom of proposed utility trenches or 5 feet below pad grade to facilitate future trenching operations.

The California Building Code and County of Riverside require that no oversize rock (>12-inches) be placed within 10 feet of the surface of a structural fill and/or building pad. The grading plan should be carefully reviewed during grading to verify that oversized rocks are buried below a 10-foot fill cap. Generally, oversize rock will require windrowing, individual burial, or other special placement methods as further described in Appendix D. In addition, an adequate supply of granular fill material will be needed for placement around the rocks. A grading contractor with experience in the handling and placement of oversize rock should be selected for this project.

### **3.4 Groundwater and Surface Water**

Groundwater was not encountered in any of the exploratory borings or test pits during this or previous studies. Depth to ground water at the site is anticipated to be greater than 100 feet and not a design concern.

Although not anticipated, groundwater may be locally encountered during grading or future development. It should be noted that local perched water conditions may occur and may fluctuate seasonally, depending on rainfall conditions. Any seepage conditions should be evaluated on a case-by-case basis to provide the mitigation recommendations, if needed. No standing or surface water was observed on the site at the time of our field subsurface explorations.

### **3.5 Faulting**

No evidence of active or potentially active faults are known nor observed on-site or trending to the project site. The closest active fault is the Temecula Segment of the Elsinore Fault Zone. The subject site is not included within an Earthquake Fault Zone

as created by the Alquist-Priolo Earthquake Fault Zoning Act (CGS, 2018, Bryant, 2007). The nearest zoned active faults are the Glen Ivy Segment of the Elsinore Fault Zone, located approximately 8.3 miles (13.3 km) southwest of the site and the Chino-Central Avenue Segment of the Elsinore Fault Zone, located approximately 9.0 miles (14.5 km) northwest of the site (Blake, 2000c). This site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone or County of Riverside Fault Zone.

### 3.6 Seismicity

As is common for virtually all of Southern California, strong ground shaking can be expected at the site during moderate to severe earthquakes in this general region. Intensity of ground shaking at a given location depends primarily upon earthquake magnitude, site distance from the source, and site response (soil type) characteristics. The seismic coefficients were calculated utilizing an interactive program on current United States Geological Survey (USGS) website using ASCE 7-16 procedures, as well as USGS Unified Hazard Maps. Based on our explorations and review, the site will be underlain by relatively shallow dense fill and granitic bedrock. As such, the site is classified as a Class C site, and the site-specific seismic coefficients following this USGS general procedure are as listed in the following table:

**Table 1. 2019 CBC Seismic Coefficients per USGS General Procedure**

Site Seismic Coefficients / Coordinates		Value
Latitude		33.8656
Longitude		-117.4242
Mapped Spectra (OSHDPD)	Spectral Response – Class C (short), $S_s$	1.50
	Spectral Response – Class C (1 sec), $S_1$	0.60
	Site Modified Peak Ground Acceleration, $PGA_M$	0.66
	Max. Considered Earthquake Spectral Response Acceleration (short), $S_{MS}$	1.80
	Max. Considered Earthquake Spectral Response Acceleration – (1 sec), $S_{M1}$	0.83
	5% Damped Design Spectral Response Acceleration (short), $S_{DS}$	1.20
	5% Damped Design Spectral Response Acceleration (1 sec), $S_{D1}$	0.56
	Site-Specific Peak Ground Acceleration, $PGA$	0.55

g = Gravity acceleration

### 3.7 Dynamic Settlement (Liquefaction and Dry Settlement)

Assuming that loose, near-surface soils will be removed and recompacted in accordance with the recommendations of Section 5.0 of this report in the areas of

development, the potential for liquefaction or dynamic settlement due to the design earthquake event to affect structures at this site is considered very low. Following completion of the recommended remedial grading, we estimate that the total settlement to be less than ½ inch and differential settlement to be ¼ inch in 40 feet horizontal distance.

### **3.8 Expansive Soils**

Limited laboratory testing indicates that near surface soils generally possess very low to low expansion potential ( $0 \leq EI \leq 51$ ). Any silty to clay-rich expansive soil may be encountered locally within the alluvial or highly weathered bedrock portions of the project site and should be addressed during the grading process and final design.

### **3.9 Corrosion**

Limited laboratory tests were conducted for corrosion potential (soluble sulfate, chloride, pH, and minimum resistivity) of on-site soils (see Appendix B). Excessive sulfate or chloride in either the soil or native water may result in an adverse reaction between the cement in concrete and the soil. Laboratory tests indicate a negligible concentration of soluble sulfate and chloride in onsite soils for representative samples (Appendix B). Based on our test results, Type II cement or equivalent may be used.

Electrical resistivity testing indicates onsite soils may have a severe corrosion potential for buried metal. A qualified corrosion engineer may be consulted regarding the corrosion effects of the onsite soils on underground metal utilities.

### **3.10 Slope Stability**

The provided Tentative Tract Map (Adkan, 2023) indicates that fill slopes up to 45-feet and cut slopes up to 20-feet in height at 2:1 (horizontal to vertical) are anticipated. Based on field observations and geologic maps, the proposed 2:1 inclination (horizontal to vertical) cut slopes will be predominantly within the granitic bedrock. Slope instability is not considered an issue at this site. All cut slopes should be mapped by project geologist to confirm joint configuration do not create a local slope stability concern.

Cut and fill slopes should be provided with appropriate surface drainage features and landscaped (with drought tolerant vegetation) as soon as possible after grading to minimize the potential for erosion. Brow ditches should be constructed at the top

of cut slopes. Drainage should be directed such that surface runoff on the slope face is minimized.

### **3.11 Landslide/Debris Flow and Rock Fall Hazard**

No evidence of onsite landslides/debris flow was observed during our field investigation or in review of California Geologic Survey landslide inventory maps (CGS, 2012). However, the potential for rockfall due to either erosion or seismic ground shaking is considered possible in areas where boulder outcrops are present. Based on our review of the tentative tract map (MDS), we anticipate that exposed boulders will remain on the natural slope above the planned slope and may require mitigation.

Ways to mitigate the potential rock fall hazard are to remove the rocks, partially bury or break the rocks, construct a barrier (a berm, a fence, or a ditch), or create a combination of barriers that remove the kinetic energy of the boulders prior to their causing damage to a residence. If additional loose rocks are exposed during grading, removal, repositioning, embedment or stabilization may be needed to prevent rockfall. Methods to further mitigate the rockfall hazard should be based on further rock stability evaluation and review of rough grading plans.

## 4.0 PRELIMINARY RECOMMENDATIONS

### 4.1 General

The proposed development of the site appears feasible from a geotechnical viewpoint provided that the following recommendations are incorporated into the design and construction phases of development. The main geotechnical/geologic findings that may impact the construction cost for this project is the presence of potentially unrippable rock, especially in deeper excavations within the site. As such, blasting may be necessary in deep cuts.

### 4.2 Earthwork

Earthwork should be performed in accordance with the following recommendations and the *Earthwork and Grading Specifications* Appendix C. The recommendations contained in Appendix C, are general grading specifications provided for typical grading projects and some of the recommendations may not be strictly applicable to this project. The specific recommendations contained in the text of this report supersede the general recommendations in Appendix C. The contract between the developer and earthwork contractor should be worded such that it is the responsibility of the contractor to place the fill properly in accordance with the recommendations of this report, the specifications in Appendix C, applicable County Grading Ordinances, notwithstanding the testing and observation of the geotechnical consultant.

#### 4.2.1 Site Preparation and Remedial Grading

Prior to grading, the proposed structural improvement areas (i.e. all structural fill areas, pavement areas, buildings, etc.) of the site should be cleared of surface and subsurface obstructions, heavy vegetation, root balls and boulders. Roots and debris should be disposed of offsite. Septic tanks or seepage pits, water wells, if encountered, should be abandoned in accordance with the County of Riverside Department of Health Services guidelines.

Undocumented fill, surficial topsoil, alluvial deposits, and highly weathered bedrock are potentially compressible in their present state and may settle under the surcharge of fills or foundation loading. In areas supporting additional fill soils or structural improvements, these soils should be removed down to competent bedrock material. In general, competent material is considered to be dense granitic bedrock. Acceptability of all removal bottoms should be reviewed by a representative of Leighton. The removal bottom elevations should be documented in the as-graded geotechnical report.

The removal depths are generally expected to range from approximately 3 to 5 feet below existing ground over much of the site. However, deeper removal will be required in the alluvial channels and may extend from 5 feet to as much as 15 feet. However, this removal depth may be limited to upper 5 to 7 feet BGS if further compressibility evaluation of alluvium left in place confirms that post-construction settlement is acceptable or tolerable by the proposed structures. Estimated removal depths are depicted on Plate 1. The exploration logs in Appendix A should be carefully reviewed for depth of granitic bedrock. The removal limit should be established by a 1:1 projection from the edge of fill soils supporting settlement-sensitive structures downward and outward to competent material identified by the geotechnical consultant. Removals will also include benching into competent material as the fills rise. Areas adjacent to existing roadways may require special monitoring. Temporary slopes in these areas should be no steeper than 1:1 gradient. Friable materials, if encountered, may require additional layback.

#### 4.2.2 Cut Lots and Streets

Remedial grading/overexcavation of cut pads in weathered bedrock should extend to a minimum depth of 3 feet below pad grade or one-half of the maximum fill thickness beneath the proposed structure, whichever is deeper. Overexcavation should encompass the entire lot. If alluvial soils extend into cut pads, a complete removal of alluvium is recommended. Overexcavation bottoms should be sloped as needed to prevent the accumulation of subsurface water. After overexcavation, the lots should then capped with compacted fill. We also recommend that streets in granitic rock be overexcavated to a depth of 1 foot below the deepest utility and then brought back up to design grades with compacted fill.

#### 4.2.3 Suitability of Site Soils for Fills

The onsite soils are generally suitable for re-use as compacted fill, provided they are free of debris, organic matter, and oversize rock. Fills placed within 10 feet of finish pad grades or slope faces should contain no rocks over 12 inches in maximum dimension. In addition, expansive clayey soils ( $EI > 51$ ) should be placed at depth greater than 3 feet below finished grades where feasible. All structural fill should be compacted throughout to 90 percent of the ASTM D 1557 laboratory maximum density, at or slightly above optimum moisture.

Areas to receive structural fill and/or other surface improvements should be approved by the geotechnical consultant then scarified to a minimum depth of 8 inches, conditioned to at least optimum moisture content, and

recompacted. Fill soils should be placed at a minimum of 90 percent relative compaction (based on ASTM D1557) and near or above optimum moisture content. Placement and compaction of fill should be performed in accordance with local grading ordinances under the observation and testing of the geotechnical consultant. The optimum lift thickness to produce a uniformly compacted fill will depend on the type and size of compaction equipment used. In general, fill should be placed in uniform lifts not exceeding 8 inches in thickness.

Fill slope keyways will be necessary at the toe of all fill slopes and at fill-over-cut contacts. Keyway schematics, including dimensions and subdrain recommendations, are provided in Appendix C. All keyways should be excavated into dense bedrock or dense alluvium as determined by the geotechnical engineer. The cut portions of all slope and keyway excavations should be geologically mapped and approved by a geologist prior to fill placement.

Fills placed on slopes steeper than 5:1 (horizontal:vertical) should be benched into dense soils (see Appendix C for benching detail). Benching should be of sufficient depth to remove all loose material. A minimum bench height of 2 feet into approved material should be maintained at all times. A grading contractor with experience in the handling and placement of oversize rock should be selected for this project.

#### 4.2.4 Oversize Rock

We anticipate that grading will produce a significant amount of oversized rock (greater than 12 inches in maximum dimension). No rock in excess of 12 inches in maximum dimension may be placed in any fill within 10 feet of finish grade. Oversized rock may be placed in fills more than 10 feet below finish grade, if placed in accordance with the following guidelines and the specifications contained in Appendix C.

Within the upper 5 feet of finish grade, fill soils should not contain rock greater than 6 inches in maximum dimension in order to facilitate foundation and utility trench excavation. For fill soils between 5 and 10 feet below finish grade, the fill may contain rock up to 12 inches in maximum dimension and should be mixed with sufficient soil to eliminate voids. Below a depth of 10 feet, rocks up to a maximum dimension of 36 inches may be incorporated into the fill provided adequate fines to fill all voids are present. Rocks greater than 36 inches in diameter may be placed on a case-by-case basis.

#### 4.2.5 Shrinkage and Bulking

The volume-change of excavated onsite materials upon recompaction is expected to vary with materials, density, insitu moisture content, location, and compaction effort. The in-place and compacted densities of soil materials vary and accurate overall determination of shrinkage and bulking cannot be made. Therefore, we recommend site grading include, if possible, a balance area or ability to adjust import quantities to accommodate some variation. Based on our experience with similar materials, the following values are provided as guidelines:

**Table 2. Earthwork Shrinkage and Bulking Estimates**

Geologic Unit	Estimated Shrinkage/Bulking
Undocumented Fill/Surficial Soils (upper 3 feet)	10 to 15 percent shrinkage
Alluvium	5 to 15 percent shrinkage
Granitic Bedrock	0 to 10 percent bulking

#### 4.2.6 Import Soils

Import soils and/or borrow sites, if needed, should be evaluated by us prior to import. Import soils should be uncontaminated, granular in nature, free of organic material (loss on ignition less-than 2 percent), rocks smaller than 12-inches (6 inches to cap pads), have low expansion potential (with an Expansion Index less than 21) and have a low corrosion impact to the proposed improvements.

#### 4.2.7 Utility Trenches

Utility trenches should be backfilled with compacted fill in accordance with the *Standard Specifications for Public Works Construction*, ("Greenbook"), 2021 Edition. Fill material above the pipe zone should be placed in lifts not exceeding 8 inches in uncompacted thickness and should be compacted to at least 90 percent relative compaction (ASTM D 1557) by mechanical means only. Site soils may generally be suitable as trench backfill provided these soils are screened of rocks over 1½ inches in diameter and organic matter. The upper 6 inches of backfill in all pavement areas should be compacted to at least 95 percent relative compaction.

Excavation of utility trenches should be performed in accordance with the project plans, specifications and the "Greenbook". The contractor should be responsible for providing a "competent person" as defined in Article 6 of the *California Construction Safety Orders*. Contractors should be advised that sandy soils (such as fills generated from the onsite alluvium) could make

excavations particularly unsafe if all safety precautions are not properly implemented. In addition, excavations at or near the toe of slopes and/or parallel to slopes may be highly unstable due to the increased driving force and load on the trench wall. Spoil piles from the excavation(s) and construction equipment should be kept away from the sides of the trenches. Leighton does not consult in the area of safety engineering.

#### 4.2.8 Drainage

All drainage should be directed away from structures a minimum of 1% by means of approved permanent/temporary drainage devices. Adequate surface drainage of any building pad should be provided to avoid wetting of foundation soils. Irrigation adjacent to buildings should be avoided when possible. As an option, sealed-bottom planter boxes and/or drought resistant vegetation should be used within 5-feet of buildings. As shown on Plate 1, a permanent subdrain system is recommended in the deeper fills beneath lots 233 and 239 through 244. This subdrain system can be outletted into Retention Basin "A". Further evaluation and recommendations should be provided based on actual conditions encountered during grading.

#### 4.2.9 Slope Construction

Compacted fill or granitic bedrock cut slopes at 2:1 (horizontal:vertical) are considered grossly stable for static and pseudostatic conditions. Cut slopes exposing Older Fan Deposits should be replaced as compacted fill. Higher or steeper slopes should be subject to further review and evaluation. Any new 2:1 slopes using the onsite soils compacted to minimum 90 percent should also be stable under short and long-term conditions. The outer portion of new fill slopes should be either overbuilt by 2 feet (minimum) and trimmed back to the finished slope configuration or compacted in vertical increments of 5 feet (maximum) by a weighted sheepsfoot roller as the fill is placed. The slope face should then be track-walked by dozers of appropriate weight to achieve the final slope configuration and compaction to the slope face.

New fill or replacement fill slopes should be provided a toe of slope keyways as depicted in Appendix C. If fill is placed against existing cut slope (exposing older alluvium), the minimum fill width should be 15 feet per Appendix C. All cut slopes exposing Old Fan Deposits should be replaced by compacted fill as depicted in Appendix C. All cut slopes in granitic bedrock should be observed and mapped by a Leighton geologist to confirm the exposed conditions are stable.

Slope faces are inherently subject to erosion, particularly if exposed to rainfall and irrigation. Landscaping and slope maintenance should be conducted as soon as possible in order to increase long-term surficial stability. Berms

should be provided at the top of fill slopes. Drainage should be directed such that surface runoff on the slope face is minimized.

### 4.3 Preliminary Foundation Design

#### 4.3.1 Bearing and Lateral Pressures

Based on our analysis, proposed single-family residential structures may be founded on conventional slab-on-grade system based on prevailing finish pad soils conditions after grading. The compacted fill is anticipated to be very low expansion potential. As such, we recommend that the structural consultant and/or foundation engineer presents foundation design categories (i.e. conventional or stiffened slab-on-grade design) based on actual expansion potential of subgrade soils of each pad at completion of grading. Foundation footings may be designed with the following geotechnical design parameters:

Allowable Bearing Capacity:	2,000 psf at a minimum depth of embedment of 12 inches (minimum width of 12 inches). This bearing capacity may be increased by $\frac{1}{3}$ for short-term loading conditions (e.g., wind, seismic).
Sliding Coefficient:	0.35
Total Settlement:	1 inch
Differential Settlement:	0.5 inch in 40 feet

The conventional slabs should be designed in accordance with the 2019 CBC.

#### 4.3.2 Stiffened Slab Design ( $21 < EI \leq 91$ )

Per the California Building Code, slab-on-grade design for expansive soils ( $EI > 21$ ) should be designed in accordance with WRI/CRSI Design of Slab-On-Ground Foundations or PTI DC 10.5 or any other approved method taking into consideration the anticipated differential movement.

If these slabs are to be designed per PTI DC 10.5, the table below provides two sets of PTI design parameters based on Expansion Index (EI) or Plasticity Index (PI) of prevailing subgrade conditions. The following parameters were derived using VOLFLO 1.5 computer program developed by Geostructural Tool Kit, Inc. and the laboratory test results included in Appendix B.

**Table 3. PTI Method Design Parameters (3<sup>rd</sup> Edition)**

Design Parameters	Category I PI≤15 or EI≤51	Category II 15<PI≤25 or 51≤EI≤90
Thornthwaite Moisture Index	-20	-20
Depth to Constant Soil Suction	9.0 feet	9.0 feet
Constant Soil Suction	3.9 feet	3.9 feet
Edge Moisture Variation Distance, $e_m$		
-Edge Lift	5.5 feet	4.7 feet
-Center Lift	9.0 feet	9.0 feet
Soil Differential Movement, $y_m$		
-Edge Lift - Swell	0.75 inch	1.1 inch
-Center Lift - Shrink	0.35 inch	0.55 inch

The allowable pressures provided in Section 4.3.1 above may be used for slab-on-grade design using the PTI method. Moisture content for the upper 12 inches of subgrade should be near optimum moisture content ( $\pm 2\%$ ) prior to placing concrete.

Based on past experience with similar compacted fills and application of elastic settlement due to weight of additional fill, settlement is expected to be less than 1-inch. As such, a differential settlement of 0.5-inch across a lateral distance of 40 feet should be considered for design in addition to the shrink/swell settlement given in table above.

#### 4.3.3 Vapor Retarder

It has been a standard of care to install a moisture-vapor retarder underneath all slabs where moisture condensation is undesirable. Moisture vapor retarders may retard but not totally eliminate moisture vapor movement from the underlying soils up through the slabs. Moisture vapor transmission may be additionally reduced by use of concrete additives. Leighton and Associates, Inc. does not practice in the field of moisture vapor transmission evaluation/mitigation. Therefore, we recommend that a qualified person/firm be engaged/consulted with to evaluate the general and specific moisture vapor transmission paths and any impact on the proposed construction. This person/firm should provide recommendations for mitigation of potential adverse impact of moisture vapor transmission on various components of the structure as deemed appropriate.

However, based on our experience, the standard of practice in Southern California has evolved over the last 15 to 20 years into a construction of a vapor retarder system that generally consisted of a membrane (such as 10-mil thick or greater), underlain by a capillary break consisting of 4 inches of clean ½-inch-minimum gravel or 2-inch sand layer (SE>30). The structural

engineer/architect or concrete contractor often require a sand layer be placed over the membrane (typically 2-inch thick layer) to help in curing and reduction of curling of concrete. If such sand layer is placed on top of the membrane, the contractor should not allow the sand to become wet prior to concrete placement (e.g., sand should not be placed if rain is expected).

In conclusion, the construction of the vapor barrier/retarder system is dependent on several variables which cannot be all geotechnically evaluated and/or tested. As such, the design of this system should be a design team/owner decision taking into consideration finish flooring materials and manufacture’s installation requirements of proposed membrane. Moreover, we recommend that the design team also follow ACI Committee 302 publication for “Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials” (ACI 302.2R-06) which includes a flow chart that assists in determining if a vapor barrier /retarder is required and where it is to be placed.

#### 4.4 Retaining Walls

Retaining wall earth pressures are a function of the amount of wall yielding horizontally under load. If the wall can yield enough to mobilize full shear strength of backfill soils, then the wall can be designed for "active" pressure. If the wall cannot yield under the applied load, the shear strength of the soil cannot be mobilized and the earth pressure will be higher. Such walls should be designed for "at rest" conditions. If a structure moves toward the soils, the resulting resistance developed by the soil is the "passive" resistance. Retaining walls backfilled with non-expansive soils should be designed using the following equivalent fluid pressures:

**Table 4. Retaining Wall Design Earth Pressures (Static, Drained)**

Loading Conditions	Equivalent Fluid Density (pcf)	
	Level Backfill	2:1 Backfill
Active	33	52
At-Rest	55	75
Passive*	300	150 (2:1, sloping down)

\* This assumes level condition in front of the wall will remain for the duration of the project, not to exceed 3,000 psf at depth. If sloping down (2:1) grades exist in front of walls, then they should be designed using passive values reduced to ½ of level backfill passive resistance values.

Unrestrained (yielding) cantilever walls should be designed for the active equivalent-fluid weight value provided above for very low expansive soils that are free draining. In the design of walls restrained from movement at the top (non-yielding) such as

basement or elevator pit/utility vaults, the at-rest equivalent fluid weight value should be used. Total depth of retained earth for design of cantilever walls should be measured as the vertical distance below the ground surface measured at the wall face for stem design or measured at the heel of the footing for overturning and sliding calculations. Should a sloping backfill other than a 2:1 (horizontal:vertical) be constructed above the wall (or a backfill is loaded by an adjacent surcharge load), the equivalent fluid weight values provided above should be re-evaluated on an individual case basis by us. Non-standard wall designs should also be reviewed by us prior to construction to check that the proper soil parameters have been incorporated into the wall design.

All retaining walls should be provided with appropriate drainage. The outlet pipe should be sloped to drain to a suitable outlet. Typical wall drainage design is illustrated in Appendix C, *Retaining Wall Backfill and Subdrain Detail*. Wall backfill should be non-expansive ( $EI \leq 21$ ) sands compacted by mechanical methods to a minimum of 90 percent relative compaction (ASTM D 1557). Clayey site soils should not be used as wall backfill. Walls should not be backfilled until wall concrete attains the 28-day compressive strength and/or as determined by the Structural Engineer that the wall is structurally capable of supporting backfill. Lightweight compaction equipment should be used, unless otherwise approved by the Structural Engineer.

#### 4.5 Foundation Setback from Slopes

We recommend a minimum horizontal setback distance from the face of slopes for all structural footings (retaining and decorative walls, flatwork, building footings, pools, etc.). This distance is measured from the outside bottom edge of the footing horizontally to the slope face (or the face of a retaining wall) and should be a minimum of  $H/2$ , where H is the slope height (in feet).

**Table 5. Footing Setbacks**

Slope Height	Recommended Footing Setback
<5 feet	5 feet minimum
5 to 15 feet	7 feet minimum
>15 feet	$H/2$ , where H is the slope height, not to exceed 10 feet to 2:1 slope face

The soils within the structural setback area generally possess poor lateral stability and improvements (such as retaining walls, pools, sidewalks, fences, pavements, decorative flatwork, etc.) constructed within this setback area will be subject to lateral

movement and/or differential settlement. Potential distress to such improvements may be mitigated by providing a deepened footing or a pier and grade-beam foundation system to support the improvement. The deepened footing should meet the setback described above. Modifications of slope inclinations near foundations may increase the setback and should be reviewed by the design team prior to completion of design or implementation.

#### **4.6 Sulfate Attack**

The results of limited laboratory testing indicated negligible exposure to concrete per ACI 318. Further testing should be performed during site grading to confirm soluble-sulfate content of near finish subgrade soils. Additional testing for general corrosion potential to ferrous materials should also be performed during grading.

#### **4.7 Concrete Flatwork**

Sidewalk/Flatwork should conform to applicable County standards. A representative of Leighton should verify subgrade soil expansion, moisture conditions and compaction prior to formwork and reinforcement placement. If subgrade soils possess expansion index greater than 21, we recommend a minimum 8-inch deepened edge be constructed for all flatwork to reduce moisture variation in subgrade soils along concrete edges adjacent to open (unfinished) or irrigated landscape areas.

Concrete flatwork should be constructed of uniformly cured, low-slump concrete and should contain sufficient control/contraction joints. Additional provisions such as ascending/descending slope conditions, perched (irrigation) water, special surcharge loading conditions, potential expansive soil pressure and differential settlement/heave should be incorporated into the design of exterior improvements. Additional exterior slab details are suggested in the American Concrete Institute (ACI) guidelines.

#### **4.8 Preliminary Pavement Design**

The preliminary pavement design provided below is based on the locally accepted Caltrans Highway Design Manual and a laboratory-determined R-value of 65 for subgrade and traffic indices of 5, 6 and 7 were used for the design. The following range of pavement sections is to be used for preliminary planning purposes only.

**Table 6. Asphalt Pavement Sections**

<b>General Traffic Condition*</b>	<b>Traffic Index (TI)**</b>	<b>Asphalt Concrete (inches)</b>	<b>Aggregate Base* (inches)</b>
Private Street	5.0	3.0	4.0
General Local Street	6.0	4.0	4.0
Collector/Enhanced Local	7.0	4.0	6.0

\*Per county minimum or as calculated

Tests of the exposed subgrade soils during rough grading should be performed to confirm the appropriate pavement section. Appropriate TI data should be selected by the project civil engineer or traffic-engineering consultant for finalization of the pavement section and should be in general accordance with County of Riverside and industry standards. The pavement sections should meet or exceed County of Riverside standards.

The subgrade soils in the upper 6 inches should be properly compacted to at least 95 percent relative compaction and should be moisture-conditioned to near optimum and kept in this condition until the pavement section is constructed. Proof-rolling subgrade to identify localized areas of yielding subgrade (if any) should be performed prior to placement of aggregate base and under the observation of the geotechnical consultant.

Minimum relative, compaction requirements for aggregate base should be 95 percent of the maximum laboratory density as determined by ASTM D1557. Base rock should conform to the “Standard Specifications for Public Works Construction” (green book) current edition or Caltrans Class 2 aggregate base having a minimum R-value of 78.

The preliminary pavement sections provided in this section are meant as minimum, if thinner or highly variable pavement sections are constructed, increased maintenance and repair may be needed.

## 5.0 GEOTECHNICAL CONSTRUCTION SERVICES

Geotechnical review is of paramount importance in engineering practice. Poor performances of many foundation and earthwork projects have been attributed to inadequate construction review. We recommend that Leighton be provided the opportunity to review the grading plan and foundation plan(s) prior to bid.

Reasonably continuous construction observation and review during site grading and foundation installation allows for evaluation of the actual soil conditions and the ability to provide appropriate revisions where required during construction. Geotechnical conclusions and preliminary recommendations should be reviewed and verified by Leighton during construction and revised accordingly if geotechnical conditions encountered vary from our findings and interpretations. Geotechnical observation and testing should be provided:

- After completion of site clearing,
- During preparation and overexcavation of surface soils as described herein,
- During rock placement and compaction of all fill materials,
- Testing of slab subgrade moisture content, prior to placement of vapor retarder,
- After excavation of all footings, and prior to placement of concrete,
- During utility trench backfilling and compaction, and
- When any unusual conditions are encountered.

Additional geotechnical exploration and analysis may be required based on final development plans, for reasons such as significant changes in proposed structure locations/footprints. We should review grading (civil) and foundation (structural) plans, and comment further on geotechnical aspects of this project.

## 6.0 LIMITATIONS

This report was necessarily based in part upon data obtained from a limited number of observances, site visits, soil samples, tests, analyses, histories of occurrences, spaced subsurface explorations and limited information on historical events and observations. Such information is necessarily incomplete. The nature of many sites is such that differing characteristics can be experienced within small distances and under various climatic conditions. Changes in subsurface conditions can and do occur over time. This investigation was performed with the understanding that the subject site is proposed for residential and commercial development. The client is referred to Appendix D regarding important information provided by the GBA (Geoprofessional Business Association) on geotechnical engineering studies and reports and their applicability.

This report was prepared for Pulte Home Corporation based on Pulte Home Corporation's needs, directions, and requirements at the time of our investigation. This report is not authorized for use by and is not to be relied upon by any party except Pulte Home Corporation, and its successors and assigns as owner of the property, with whom Leighton and Associates, Inc. has contracted for the work. Use of or reliance on this report by any other party is at that party's risk. Unauthorized use of or reliance on this report constitutes an agreement to defend and indemnify Leighton and Associates, Inc. from and against any liability which may arise as a result of such use or reliance, regardless of any fault, negligence, or strict liability of Leighton and Associates, Inc.

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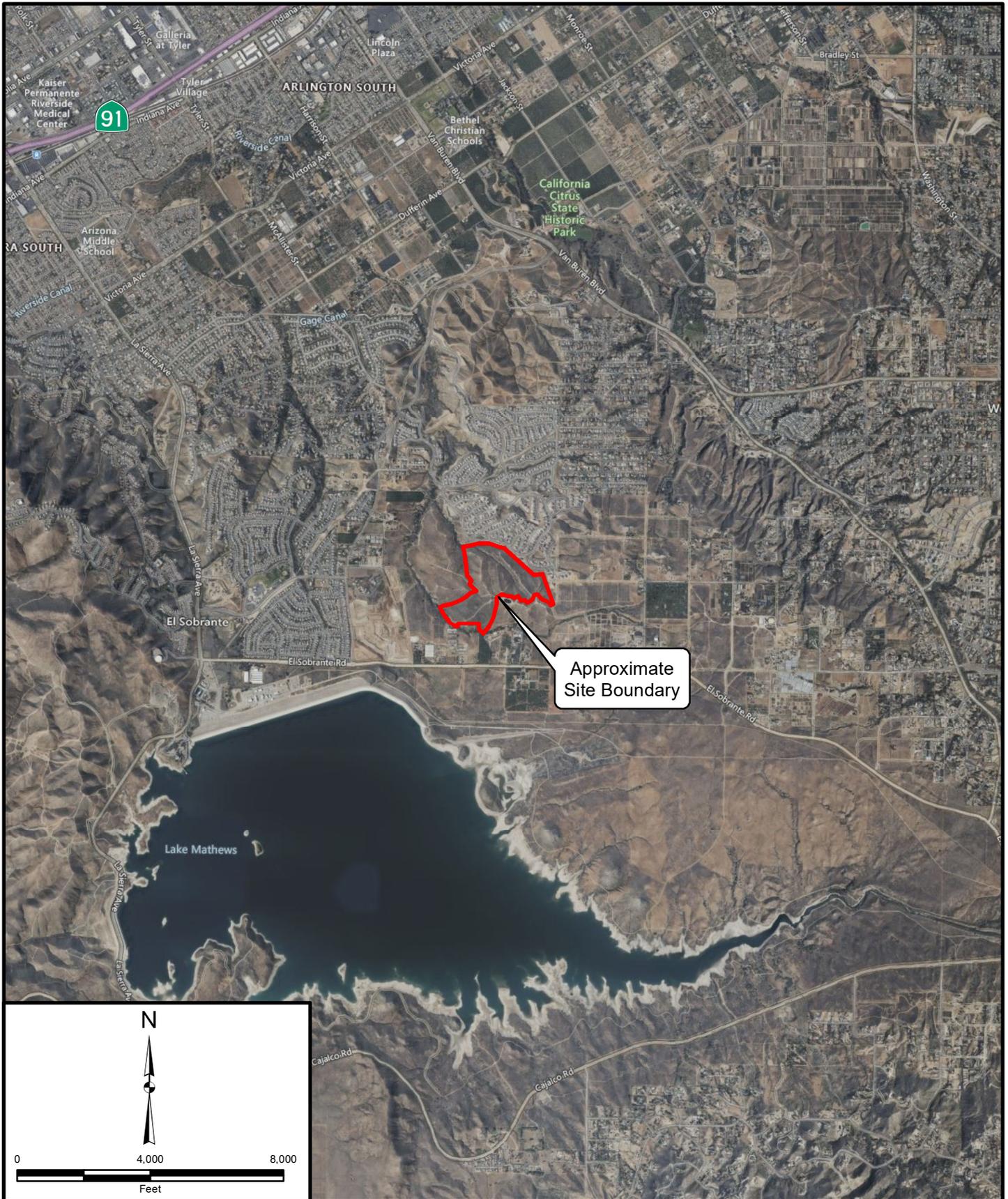
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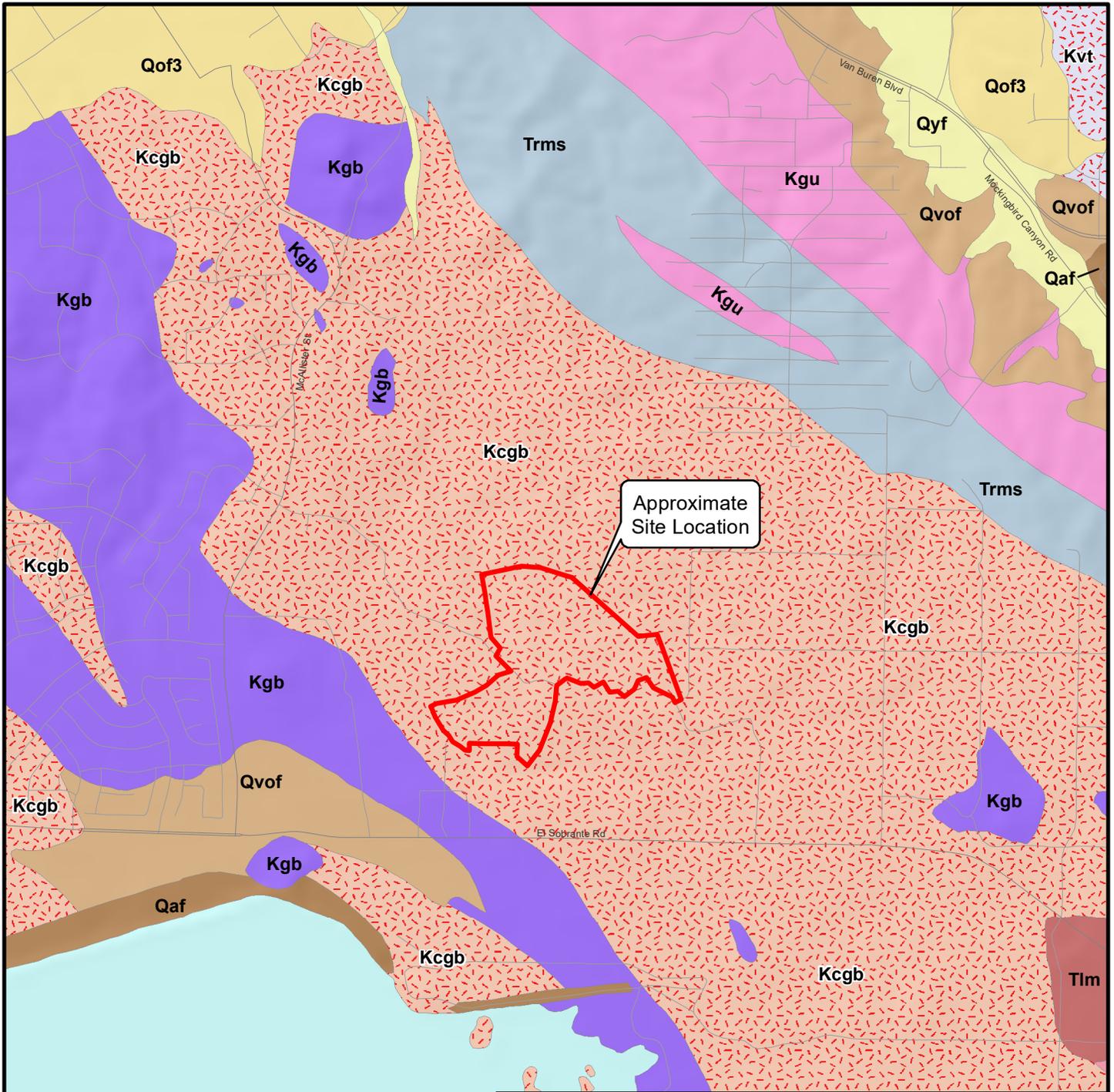


Project: 13979.001	Eng/Geol: SIS/BAA
Scale: 1" = 4,000'	Date: August 2023
Base Map: ESRI ArcGIS Online 2023	

**SITE LOCATION MAP**  
 Highland Grove III  
 Tract No. 38605  
 Riverside County, California

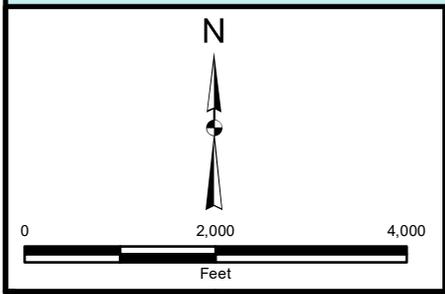
**FIGURE 1**





**Legend**

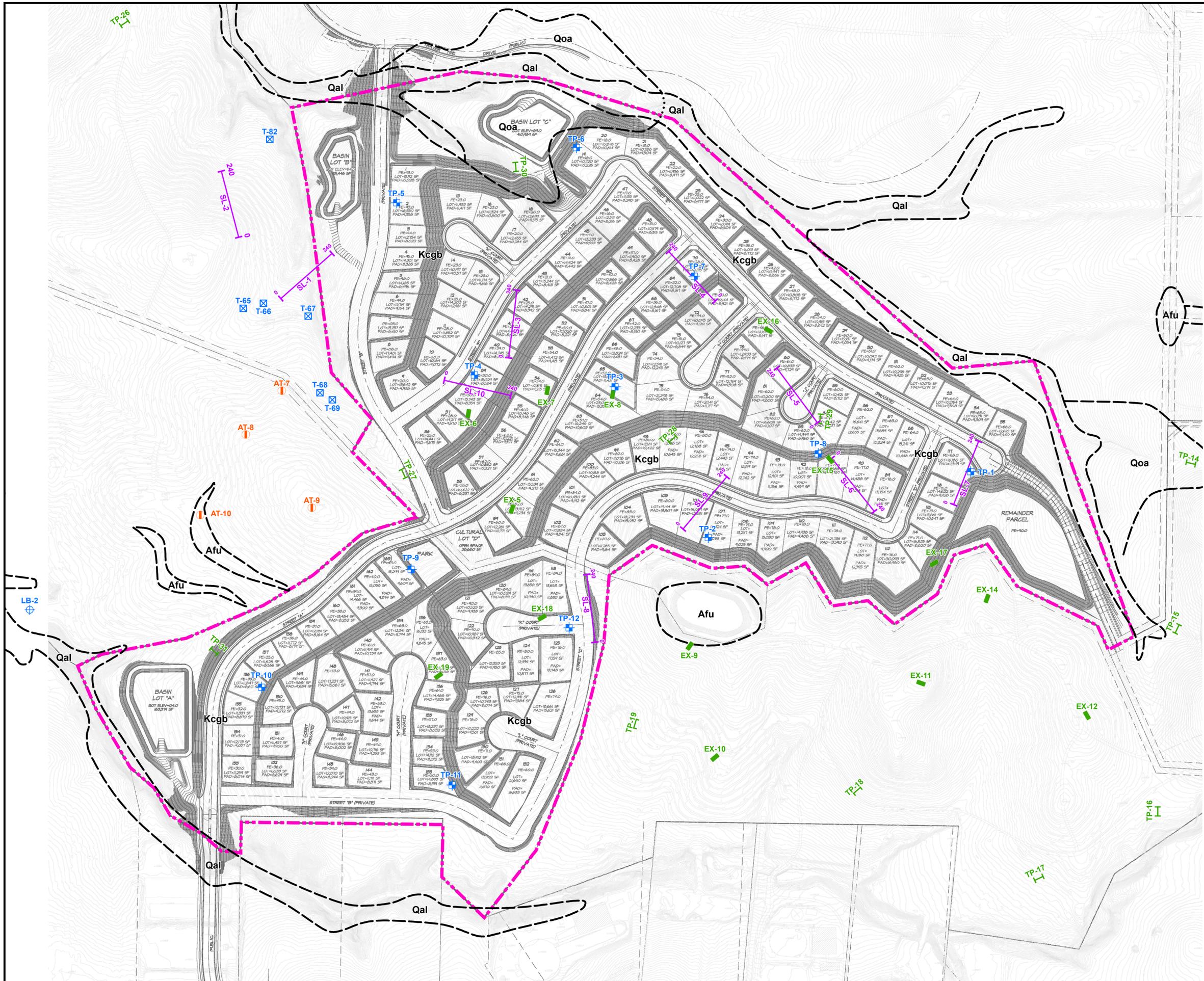
- |                                   |  |
|-----------------------------------|--|
| Qaf - Artificial fill             | Kvt - Val Verde Pluton                   |
| Qyf - Young alluvial-fan deposits | Tlm - Lake Mathews Formation             |
| Kcgb - Cajalco Pluton             | Trms - Rocks of Meniffee Valley          |
| Kcgd - Cajalco Pluton             | Qof3 - Old alluvial-fan deposits, Unit 3 |
| Kgb - Gabbro, undifferentiated    | Qvof - Very old alluvial-fan deposits    |
| Kgu - Granite, undifferentiated   | Water Body                               |



Project: 13979.001    Eng/Geol: SIS/BAA  
 Scale: 1" = 2,000'    Date: August 2023  
 Reference: USGS, 2006 Geologic map of the San Bernardino and Santa Ana 30'x60' quadrangle, California Version 1.0 Open File Report 2006-1217.

**REGIONAL GEOLOGY MAP**  
 Highland Grove III  
 Tract No. 38605  
 Riverside County, California

**FIGURE 2**

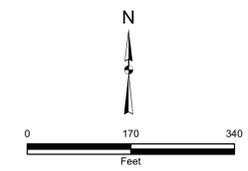


**Legend**

- + TP-12 Approximate Location of Test Pit (Leighton, This Study)
- ⊕ LB-3 Approximate Location of Hollow Stem Boring (Leighton, 2006)
- ⊗ T-83 Approximate Location of Backhoe Test Pit (Leighton, 2005)
- ⊕ AT-12 Approximate Location of Air Track Boring (Albus Keefe)
- + EX-17 Approximate Location of Excavator Test Pit (AGS, 2015)
- ⊕ TP-37 Approximate Location of Backhoe Test Pit (AGS, 2015)
- SL-10 Approximate Location of Seismic Line (Southwest Geophysics, Inc., April 2018)
- Approximate Geologic Contact (dotted where buried)
- Approximate Site Boundary

**Geologic Units**

- Afu** Artificial Fill (Undocumented)
- Qal** Alluvium
- Qoa** Older Alluvium
- Qvof** Alluvial Fan Deposits
- Kcgb** Granodiorite and Gabbro - Undifferentiated



<b>GEOTECHNICAL MAP</b>		<b>PLATE 1</b>
Highland Grove III Tract No. 38605 Riverside County, California		Scale: 1" = 150 feet
<b>Leighton</b>		Date: September 2023
Base Map: Adkan, 2023.		Proj: 13979.001 Eng/Geol: SIS/BAA

APPENDIX A-1

FIELD EXPLORATION LOGS (THIS STUDY)

LOG OF TRENCH PITS

PROJECT NO.: 13979.001  
PROJECT NAME: Highland Grove 3

LOGGED BY: BAA  
DATE: 7/31/2023

TEST PIT#	LAB TEST	USCS	DESCRIPTION
TP-1		SM	<p><b>Residual / Topsoil:</b> 0' - 2' – Silty SAND, light reddish brown, dry to slightly moist, trace clay, weathered in place</p> <p><b>Gabbro Bedrock:</b> 2 - 6' – soft, gray, moist completely to moderately weathered, heavily fractured, recovers as: silty SAND, becomes fresher with depth</p> <p>Terminated at 6' on marginally to non-rippable rock, no groundwater, backfilled with spoils.</p>



LOG OF TRENCH PITS

PROJECT NO.: 13979.001  
PROJECT NAME: Highland Grove 3

LOGGED BY: DH  
DATE: 7/31/2023

TEST PIT#	LAB TEST	USCS	DESCRIPTION
TP-2		SM	<p><b>Topsoil:</b> 0' 2' – Silty SAND, light reddish-brown, slightly moist, trace clay</p> <p><b>Gabbro Bedrock:</b> 2'-5' – soft, gray to white, moist, completely to moderately weathered, heavily fractured, recovered as silty SAND, fresher in depth</p> <p>Total Depth 5', no groundwater, backfilled with spoils.</p>



## LOG OF TRENCH PITS

**PROJECT NO.:** 13979.001  
**PROJECT NAME:** Highland Grove 3

**LOGGED BY:** DH  
**DATE:** 7/31/2023

TEST PIT#	LAB TEST	USCS	DESCRIPTION
TP-3		SM	<p><b>Topsoil:</b> 0' 1' – Silty SAND, light red to red, slightly moist, few to little clay</p> <p><b>Gabbro Bedrock:</b> 1'- 4' – soft, gray to orange, moist, completely to moderately weathered, heavily fractured, recovered as silty SAND</p> <p>4' 13' – gray, fresher, iron oxide staining</p> <p>Total Depth 13', no groundwater, backfilled with spoils.</p>



LOG OF TRENCH PITS

PROJECT NO.: 13979.001  
PROJECT NAME: Highland Grove 3

LOGGED BY: DH  
DATE: 7/31/2023

TEST PIT#	LAB TEST	USCS	DESCRIPTION
TP-4		SM	<p><u>Topsoil:</u> 0' - 1' – Silty SAND, red to light reddish-brown, slightly moist, few to little clay</p> <p><u>Gabbro Bedrock:</u> 1'- 3' – soft, white to gray, moist, completely to moderately weathered, heavily fractured, recovered as silty SAND</p> <p>Total Depth 3', no groundwater, backfilled with spoils.</p>



LOG OF TRENCH PITS

PROJECT NO.: 13979.001  
PROJECT NAME: Highland Grove 3

LOGGED BY: DH  
DATE: 7/31/2023

TEST PIT#	LAB TEST	USCS	DESCRIPTION
TP-5		SM	<p><u>Topsoil:</u> 0' - 2' – Silty SAND, brown to light brown, slightly moist, little trace clay</p> <p><u>Gabbro Bedrock:</u> 2'- 4' – soft, gray to dark gray, moist, moderately weathered, heavily fractured, recovered as silty SAND</p> <p>Total Depth 4', no groundwater, backfilled with spoils.</p>



LOG OF TRENCH PITS

PROJECT NO.: 13979.001  
PROJECT NAME: Highland Grove 3

LOGGED BY: DH  
DATE: 7/31/2023

TEST PIT#	LAB TEST	USCS	DESCRIPTION
TP-6		SM	<p><u>Topsoil:</u> 0' - 1' – Silty SAND, light brown to light reddish-brown, slightly moist, little trace clay</p> <p><u>Gabbro Bedrock:</u> 1'- 4' – soft, light gray to orange, moist, completely to moderately weathered, heavily fractured, recovered as silty SAND</p> <p>Total Depth 4', no groundwater, backfilled with spoils.</p>



LOG OF TRENCH PITS

PROJECT NO.: 13979.001  
PROJECT NAME: Highland Grove 3

LOGGED BY: DH  
DATE: 7/31/2023

TEST PIT#	LAB TEST	USCS	DESCRIPTION
TP-7		SM	<p><b>Topsoil:</b> 0' - 1' – Silty SAND, light brown to brown, slightly moist, little trace clay</p> <p><b>Gabbro Bedrock:</b> 1'- 4' – soft, light gray to white, moist, completely to moderately weathered, heavily eroded, recovered as silty SAND</p> <p>Total Depth 4', no groundwater, backfilled with spoils.</p>



LOG OF TRENCH PITS

PROJECT NO.: 13979.001  
PROJECT NAME: Highland Grove 3

LOGGED BY: DH  
DATE: 7/31/2023

TEST PIT#	LAB TEST	USCS	DESCRIPTION
TP-8		SM	<p><b>Topsoil:</b> 0' - 1' – Silty SAND, light brown, slightly moist, few to little clay</p> <p><b>Gabbro Bedrock:</b> 1'- 4' – soft, gray to light gray, moist, moderately weathered, heavily fractured, recovered as silty SAND</p> <p>Total Depth 4', no groundwater, backfilled with spoils.</p>

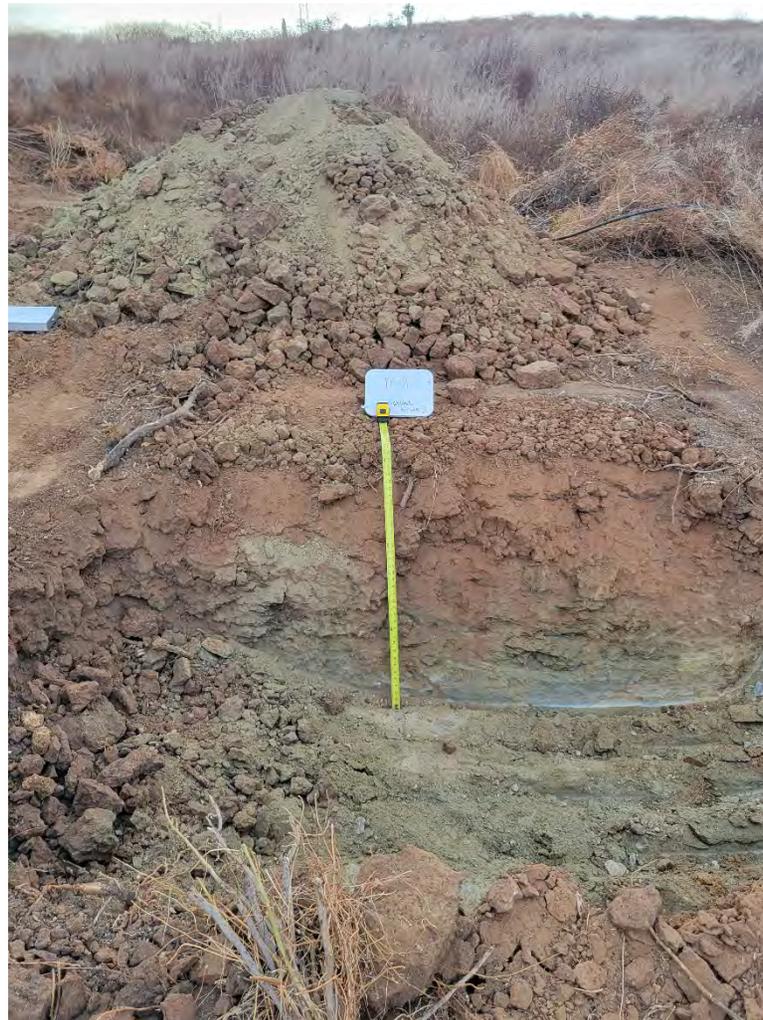


## LOG OF TRENCH PITS

**PROJECT NO.:** 13979.001  
**PROJECT NAME:** Highland Grove 3

**LOGGED BY:** DH  
**DATE:** 8/1/2023

TEST PIT#	LAB TEST	USCS	DESCRIPTION
TP-9		SM	<p><b>Topsoil:</b> 0' - 1' – Silty SAND, dark red to light brown, slightly moist, few to little clay</p> <p><b>Gabbro Bedrock:</b> 1' - 3' – soft, dark green to gray, moist, completely to moderately weathered, heavily fractured, recovered as silty SAND</p> <p>Total Depth 3', no groundwater, backfilled with spoils.</p>



LOG OF TRENCH PITS

PROJECT NO.: 13979.001  
PROJECT NAME: Highland Grove 3

LOGGED BY: DH  
DATE: 8/1/2023

TEST PIT#	LAB TEST	USCS	DESCRIPTION
TP-10		SM	<p><b>Topsoil:</b> 0' - 2' – Silty SAND, light brown to gray, slightly moist, little trace clay</p> <p><b>Gabbro Bedrock:</b> 2'- 4' – soft, light gray, moderately weathered, moderate to heavily fractured, recovered as silty SAND</p> <p>4' – 7': color changes to gray, fresh</p> <p>Total Depth 7', no groundwater, backfilled with spoils.</p>



LOG OF TRENCH PITS

PROJECT NO.: 13979.001  
PROJECT NAME: Highland Grove 3

LOGGED BY: DH  
DATE: 8/1/2023

TEST PIT#	LAB TEST	USCS	DESCRIPTION
TP-11		SC	<p><b>Topsoil:</b> 0' - 3' – Clayey SAND, light brown, slightly moist</p> <p><b>Gabbro Bedrock:</b> 3'- 4' – soft, gray, slightly weathered, slightly fractured, recovered as silty SAND</p> <p>4' – 8': Color change to dark gray, fresh</p> <p>Total Depth 8', no groundwater, backfilled with spoils.</p>



LOG OF TRENCH PITS

PROJECT NO.: 13979.001  
PROJECT NAME: Highland Grove 3

LOGGED BY: DH  
DATE: 8/1/2023

TEST PIT#	LAB TEST	USCS	DESCRIPTION
TP-12		SM	<p><b>Topsoil:</b> 0' - 1' – Silty SAND, light brown, slightly moist</p> <p><b>Gabbro Bedrock:</b> 1'- 3' – soft, light gray to dark gray, moist, completely to moderately weathered, recovered as silty SAND</p> <p>Total Depth 3', no groundwater, backfilled with spoils.</p>



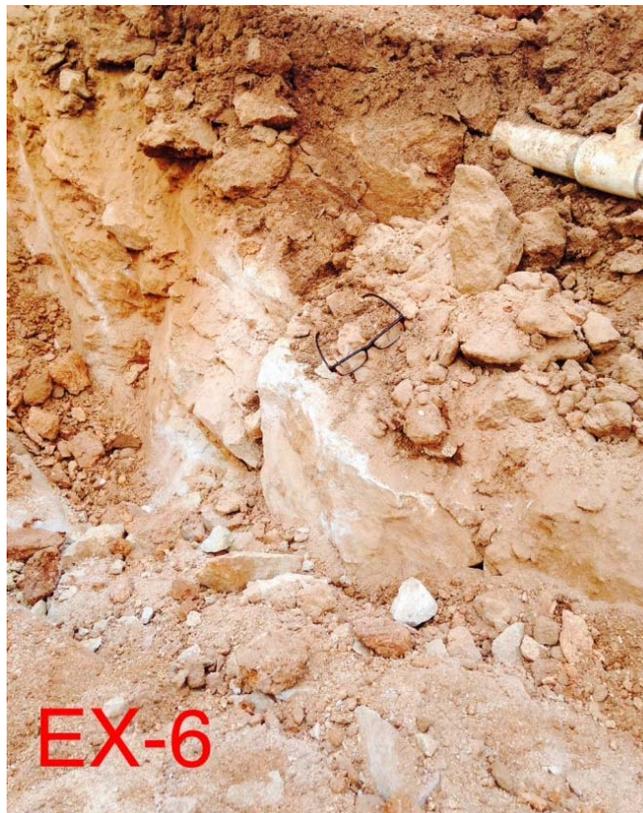
APPENDIX A-2

LOGS OF EXPLORATORY BORINGS/TEST PITS  
(PREVIOUS STUDIES)

Test			
Pit No.	Depth (ft.)	USCS	Description
EX-4	0.0 – 1.0	SC	<b><u>Topsoil:</u></b> CLAYEY SAND; reddish brown, dry, loose, fine to medium grained.
	1.0 – 16.5		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Yellowish red, dry, soft, fine to medium grained, highly weathered, abundant secondary clays. @ 3 ft. light olive with horizontal iron oxide staining along fine fractures, moderately soft, breaks into sand with some silt and clay. @ 15 ft. light olive, hard  TOTAL DEPTH 16.5 FT./PRACTICAL REFUSAL NO WATER, NO CAVING
-----			
EX-5	0.0 – 0.5	SM	<b><u>Topsoil:</u></b> SILTY SAND, grayish brown, dry, loose, fine to medium grained.
	0.5 – 4.0		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Yellowish brown and reddish brown, dry, moderately hard, fine to medium grained, moderately weathered. @ 2.5 ft. light gray to gray, fine grained, hard. @ 3.0 ft. very hard @ 3.0 ft. N 45 E, 85 SE – Joint @ 3.0 ft. N 35 E, 70 NE – Joint  TOTAL DEPTH 4 FT./REFUSAL NO WATER, NO CAVING

Test	Depth (ft.)	USCS	Description
Pit No.			
EX-6	0.0 – 1.0	SC	<b><u>Topsoil:</u></b> CLAYEY SAND; reddish brown, slightly moist, loose, fine to medium grained.
	1.0 – 2.5		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Quartz Latite; yellowish brown, slightly moist, moderately hard, moderately weathered, fine grained, soft. @1.5 ft. white, dry, very hard, slightly weathered.  TOTAL DEPTH 2.5 FT./REFUSAL NO WATER, NO CAVING





Test			
Pit No.	Depth (ft.)	USCS	Description
EX-7	0.0 – 7.0	SC	<b><u>Artificial Fill - undocumented:</u></b> CLAYEY SAND; yellowish brown and grayish brown, moist, loose, fine to medium grained. @ 6 ft. 4-inch clay pipe.
	7.0 – 8.0		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Light olive, slightly moist, moderately hard, coarse grained/large crystal size.  TOTAL DEPTH 8 FT. / REFUSAL NO WATER, NO CAVING

Test			
Pit No.	Depth (ft.)	USCS	Description
EX-8	0.0 – 18.5		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Brownish red, dry, soft, fine to medium grained, highly weathered, abundant secondary clays. @ 2 ft. yellowish brown, moderately soft, breaks into sand with some silt and clay. @ 6 ft. moderately hard, slow digging. @ 16 ft. light gray, hard, still rippable.  TOTAL DEPTH 18.5 FT./PRACTICAL REFUSAL NO WATER, NO CAVING



Date Excavated 8/28/2015

Test Pit No.	Depth (ft.)	USCS	Description
EX-9	0.0 – 2.0	SM	<b><u>Artificial Fill - undocumented:</u></b> SILTY SAND; brown, moist, loose, fine to coarse grained.
	2.0 – 20.0		<b><u>Granodiorite/Gabbro undifferentiated (Kcgb):</u></b> Red, dry, soft, fine to medium grained, highly weathered to clayey sand, abundant secondary clays. @ 4 ft. brownish gray, moderately soft, breaks into clayey sand. @ 6 ft. breaks into fine to coarse grained sand, some silt and clay. @ 7 ft. Some ½ inch thick pegmatite dikes. @ 11 ft. gray, large crystal size/coarse grained. @ 15 ft. moderately hard. @ 16 ft. light gray, breaks into fine to coarse grained sand, (SE 30+) @ 20 ft. still rippable.  TOTAL DEPTH 20 FT. NO WATER, NO CAVING



Test			
Pit No.	Depth (ft.)	USCS	Description
EX-10	0.0 – 2.0	SM	<b><u>Artificial Fill - undocumented:</u></b> SILTY SAND; reddish brown and brown, slightly moist, loose, fine to coarse grained.
	2.0 – 20.5		<b><u>Granodiorite/Gabbro undifferentiated (Kcgb):</u></b> Yellowish brown and gray, dry, moderately hard, coarse grained, moderately weathered, breaks into fine to coarse grained sand with some silt and clay. Steeply dipping clay-lined joints, approximately 8-inch spacing. @ 7 ft. N32E, 82SE - Joint @ 7 ft. N33W, 85N - Joint @ 10 ft. moderately hard. @ 16 ft. gray with trace of iron oxide, moderately hard to hard. @ 19 ft. bluish gray, hard, very slow digging. @ 20.5 ft. still rippable.  TOTAL DEPTH 20.5 FT. NO WATER, NO CAVING



Test			
Pit No.	Depth (ft.)	USCS	Description
EX-11	0.0 – 1.0	SM	<b><u>Topsoil:</u></b> SILTY SAND; reddish brown, dry, loose, fine to coarse grained, some angular granitic gravel.
	1.0 – 20.0		<b><u>Granodiorite/Gabbro undifferentiated (Kcgb):</u></b> Red, dry, soft, fine to medium grained, highly weathered, densely fractured, abundant secondary clays. @ 2.5 ft. gray to dark gray (Gabbro), hard, some flat-lying to shallowly dipping fine fractures with iron oxide. @ 5 ft. N20W, 55NE – parallel joints. @ 18 ft. very slow digging. @ 20 ft. still rippable.  TOTAL DEPTH 20 FT. NO WATER, NO CAVING



Test			
Pit No.	Depth (ft.)	USCS	Description
EX-12	0.0 – 6.5		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Brownish red, slightly moist, moderately soft, fine to medium grained, highly weathered, abundant secondary clays. @ 3 ft. yellowish brown, moderately soft, breaks into sand with some silt and clay. @4 ft. some dark gray mafic inclusions up to 6-inch thick and elongated within the Granodiorite. @ 5 ft. gray, hard, slow digging. @ 6 ft. very hard.  TOTAL DEPTH 6.5 FT./Refusal NO WATER, NO CAVING



Test			
Pit No.	Depth (ft.)	USCS	Description
EX-14	0.0 – 16.5		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Brownish red, slightly moist, moderately soft, fine to coarse grained, highly to moderately weathered. @4 ft. light yellowish brown, moderately hard, breaks-up to fine to coarse grained sand. @ 5 ft. gray, hard, slow digging. @ 6 ft. N60E, Vertical - Joint @ 6 ft. N40W, 80NE - Joint @ 12 ft. gray, very slow digging. @ 16.5 ft. Practical Refusal.  TOTAL DEPTH 16.5 FT NO WATER, NO CAVING





Test

Pit No.	Depth (ft.)	USCS	Description
EX-15	0.0 – 3.5		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Reddish brown, slightly moist, moderately soft, fine to medium grained, moderately weathered, densely fractured. @ 2.5 ft. gray to light gray (Gabbro), breaks into sand with angular clasts to 8-inch diameter. @ 2.5 ft. N30W, 60NE  TOTAL DEPTH 3.5 FT./REFUSAL NO WATER, NO CAVING



Test Pit No.	Depth (ft.)	USCS	Description
EX-16	0.0 – 1.0	SM	<b><u>Artificial Fill - undocumented:</u></b> SILTY SAND; reddish brown, slightly moist, loose, fine to coarse grained.
	1.0 – 3.5		<b><u>Granodiorite/Gabbro undifferentiated (Kcgb):</u></b> Yellowish brown and gray, dry, moderately hard, very fine grained, moderately weathered, thinly foliated along mica minerals (Phyllite). @ 3 ft. gray, hard  TOTAL DEPTH 3.5 FT./REFUSAL NO WATER, NO CAVING



Test Pit No.	Depth (ft.)	USCS	Description
EX-17	0.0 – 0.5	SC	<b><u>Topsoil:</u></b> CLAYEY SAND; reddish brown, dry, loose, fine grained.
	0.5 – 19.0		<b><u>Granodiorite/Gabbro undifferentiated (Kcgb):</u></b> Reddish brown, dry, soft, fine to medium grained, highly weathered, abundant secondary clays. @ 2.5 ft. yellowish brown, slightly moist, fine to coarse grained. @ 16 ft. olive with iron oxide staining, slow digging. @ 18 ft. very hard.  TOTAL DEPTH 19 FT./PRACTICAL REFUSAL NO WATER, NO CAVING



Test			
Pit No.	Depth (ft.)	USCS	Description
EX-18	0.0 – 1.5	SC	<b><u>Older Alluvium (Qoa):</u></b> CLAYEY SAND, yellowish brown, dry, medium dense, fine to medium grained, highly weathered, some clay, some visible porosity. Sharp contact with underlying Kcgb.
	1.5 – 17.5		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Gray with iron oxide along fine fractures, dry, moderately soft, fine grained, moderately weathered. @ 7.0 ft. moderately hard, moderately weathered. @ 11 ft. hard, some clay lined steeply dipping joints. @ 11 ft. N5E, 70SW – Joint
TOTAL DEPTH 17.5 FT./ PRACTICAL REFUSAL NO WATER, NO CAVING			



Test			
Pit No.	Depth (ft.)	USCS	Description
EX-19	0.0 – 2.0	SC	<b><u>Artificial Fill-undocumented:</u></b> CLAYEY SAND, grayish brown and gray, dry, loose, fine to medium grained.
	2.0 – 16.0		<b><u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u></b> Red, dry, soft, coarse grained, large Biotite crystals, highly weathered. @ 4.0 ft. light gray and yellowish brown, moderately hard, moderately weathered. @ 12.0 ft. hard, slow digging. @ 15.0 ft. Blueish gray, very hard, very slow digging.  TOTAL DEPTH 16.0 FT./PRACTICAL REFUSAL NO WATER, NO CAVING



**LOG OF TEST PITS**

**Project No.** 111446-001  
**CLIENT:** Victoria Grove

**LOGGED BY:** PC  
**DATE:** 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-46	0-5				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, moist, medium dense, silty, fine SAND and GRAVEL; scattered pebbles <3 mm in diameter, rootlets, porous
	5-6				SM	Red-brown, damp, medium dense to dense, silty, fine SAND; scattered pebbles <3 mm in diameter, micaceous
	6-7					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense to very dense, weathered BEDROCK; friable, breaks to medium to coarse sand  Total Depth 7', No Groundwater, No Caving, Backfilled 12/22/04
T-65	0-2				SM	<b>Topsoil-</b> Red-brown, damp to moist, loose, silty, fine SAND; scattered pebbles <3mm in diameter, dense root system throughout, pinhole pores very common
	2-6				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to moist, medium dense, silty, fine SAND and GRAVEL; subrounded pebbles between 2mm and 20 mm in diameter, rootlets throughout, pinhole pores very common
	6-7					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense, weathered BEDROCK; friable, breaks into medium to coarse sand  Total Depth 7', No Groundwater, No Caving, Backfilled 12/27/04
T-66	0-4				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to moist, loose to medium dense, silty, fine SAND; scattered pebbles <3mm in diameter, rootlets
	4-7.5				SM	Red-brown, damp to moist, medium dense, silty, fine SAND and GRAVEL; subrounded pebbles between 2mm and 20 mm in diameter, rootlets throughout, pinhole pores very common
	7.5-8					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense, weathered BEDROCK; friable, breaks into medium to coarse sand  Total Depth 8', No Groundwater, No Caving, Backfilled 12/27/04

**LOG OF TEST PITS**

**Project No.** 111446-001  
**CLIENT:** Victoria Grove

**LOGGED BY:** PC  
**DATE:** 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-67	0-1				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to moist, loose to medium dense, silty, fine SAND; scattered pebbles <3mm in diameter, rootlets throughout
	1-2.5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp to moist, dense, weathered BEDROCK; friable, breaks into medium to coarse sand, mafic 80%, felsic 20%
Total Depth 2.5', No Groundwater, No Caving, Backfilled 12/27/04						
T-68	0-3				SM	<b>Undocumented Artificial Fill (Afu)</b> – Red-brown, damp to moist, loose to medium dense, silty, fine SAND; scattered rootlets, few large roots
	2-3				SM	<b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to moist, medium dense, silty, fine SAND and GRAVEL; subrounded pebbles between 2mm and 20 mm in diameter, rootlets throughout, pinhole pores very common
	3-3.5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, dense to very dense, weathered BEDROCK; friable, breaks into medium to coarse sand
Total Depth 3.5', No Groundwater, No Caving, Backfilled 12/27/04						
T-69	0-5				SM	<b>Undocumented Artificial Fill (Afu)</b> – Yellow-red-brown, damp to moist, loose to medium dense, silty, fine to coarse SAND and GRAVEL; scattered pebbles <3mm in diameter
	5-6.5				SM	<b>Quaternary Colluvium (Qcol)</b> – Dark red-brown, damp to slightly moist, medium dense to dense, silty, fine SAND and GRAVEL; subrounded to subangular pebbles between <20 mm in diameter
	6.5-7.5					<b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Dark red-brown, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand
Total Depth 7.5', No Groundwater, No Caving, Backfilled 12/27/04						

**LOG OF TEST PITS**

**Project No.** 111446-001  
**CLIENT:** Victoria Grove

**LOGGED BY:** PC  
**DATE:** 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-79	0-10				SM	<p><b>Quaternary Colluvium (Qcol)</b> – Light brown, damp, medium dense, silty, fine SAND; scattered pebbles &lt;3mm in diameter, rootlets throughout, pinhole pores very common, calcium carbonate stringers common, sand fines upwards</p> <p>Total Depth 10', No Groundwater, No Caving, Backfilled 12/27/04</p>
T-80	0-4.5 4.5-6				SM	<p><b>Quaternary Colluvium (Qcol)</b> – Red-brown, damp to moist, medium dense, silty, fine to coarse SAND; scattered pebbles &lt;4mm in diameter, very porous, rootlets throughout</p> <p><b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Blue-brown, damp, very dense, weathered BEDROCK; slightly friable, breaks into medium to coarse sand and gravel</p> <p>Total Depth 6', No Groundwater, No Caving, Backfilled 12/27/04</p>
T-81	0-3 3-8				SM SM	<p><b>Topsoil</b> – Red-brown, moist, loose, silty, fine SAND; scattered pebbles, porous, rootlets common</p> <p><b>Quaternary Alluvium Older (Qalo)</b> – Dark red-brown, damp, dense, silty, fine SAND; scattered pebbles, porous, calcium carbonate stringers common</p> <p>Total Depth 8', No Groundwater, No Caving, Backfilled 12/27/04</p>
T-82	0-3.5 3.5-4				SM	<p><b>Topsoil</b> – Red-brown, damp to moist, medium dense, silty, fine SAND; scattered pebbles &lt;3mm in diameter, porous, rootlets common</p> <p><b>Cretaceous-Aged Granitic Bedrock (Kgr)</b> – Red-brown, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand</p> <p>Total Depth 4', No Groundwater, No Caving, Backfilled 12/27/04</p>

# GEOTECHNICAL BORING LOG LB-2

Date 1-24-05 Sheet 1 of 1  
 Project Victoria Grove East Project No. 111446-001  
 Drilling Co. Layne Christiansen Type of Rig \_\_\_\_\_  
 Hole Diameter 8" Drive Weight 140 lbs Drop 30"  
 Elevation Top of Hole +/- 1290' Location See Map

Elevation Feet	Depth Feet	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
1290	0	N S							Logged By <u>PC</u> Sampled By <u>PC</u>	
									TOPSOIL QUATERNARY ALLUVIUM OLDER (Qal <sub>o</sub> )	
				R1	73	111.2	14.9	ML	@ 2.5': Light to medium brown, moist, very stiff, sandy SILT; pinhole pores, rootlets common, blocky texture	RDS
1285	5			R2	46	111.4	4.4		@ 5': Medium brown, damp to moist, very stiff, sandy SILT; pinhole pores common, calcium carbonate stringers common, blocky texture	HCO, -200, EI
				R3	34			SM	@ 7.5': Light to medium brown, damp to moist, medium dense, silty, fine SAND; pinhole to 2mm diameter hole pores common, calcium carbonate stringers common, blocky texture	
1280	10			R4	63	117.1	8.0		@ 10': Medium to red-brown, damp to moist, dense, silty, fine SAND; pinhole pores common, calcium carbonate stringers very common, blocky texture	HCO, EI
				R5	81	132.9	7.8		@ 12.5': Dark red-brown, moist, dense, silty, fine to medium SAND; few rock fragments, micaceous	HCO, -200, EI
1275	15			R6	19				@ 15': Dark red-brown, moist, medium dense, silty, fine to medium SAND; few rock fragments, micaceous	
				R7	24	112.9	17.2		@ 17.5': Red-brown, damp to moist, medium dense, silty, fine to medium SAND; calcium carbonate stringers very common, micaceous	-200
1270	20			R8	20				@ 20': Red-brown, damp to moist, medium dense, silty, fine to medium SAND; pebbles common, very micaceous	
				R9	63	123.8	2.5		CRETACEOUS AGED GRANITIC BEDROCK (Kgr) @ 22.5': Red-brown, damp to moist, dense, weathered BEDROCK; friable, breaks into coarse sand and gravel, very micaceous	
1265	25			S10	50/5"				@ 25': Gray-brown, damp, very dense, weathered BEDROCK; friable, breaks into coarse sand and gravel	
									Total Depth 25.9' No Groundwater Encountered Backfilled with Spoils 1/24/05	
1260	30									

**SAMPLE TYPES:**  
 S SPT  
 R RING SAMPLE  
 B BULK SAMPLE  
 T TUBE SAMPLE

G GRAB SAMPLE  
 C CORE SAMPLE

**TYPE OF TESTS:**  
 SU SULFATE  
 DS DIRECT SHEAR  
 MD MAXIMUM DENSITY  
 CN CONSOLIDATION  
 CR CORROSION

HCO HYDROCOLLAPSE  
 HD HYDROMETER  
 SA SIEVE ANALYSIS  
 AL ATTERBERG LIMITS  
 EI EXPANSION INDEX  
 RV R-VALUE

CS CORROSION SUITE  
 MC MOISTURE CONTENT  
 SE SAND EQUIVALENT  
 -200 200 WASH  
 RDS Remolded DS

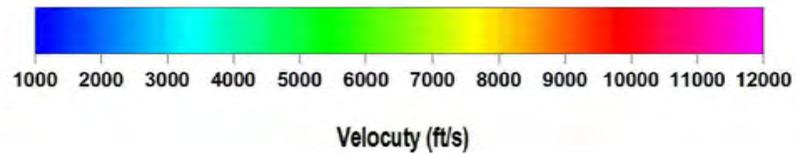
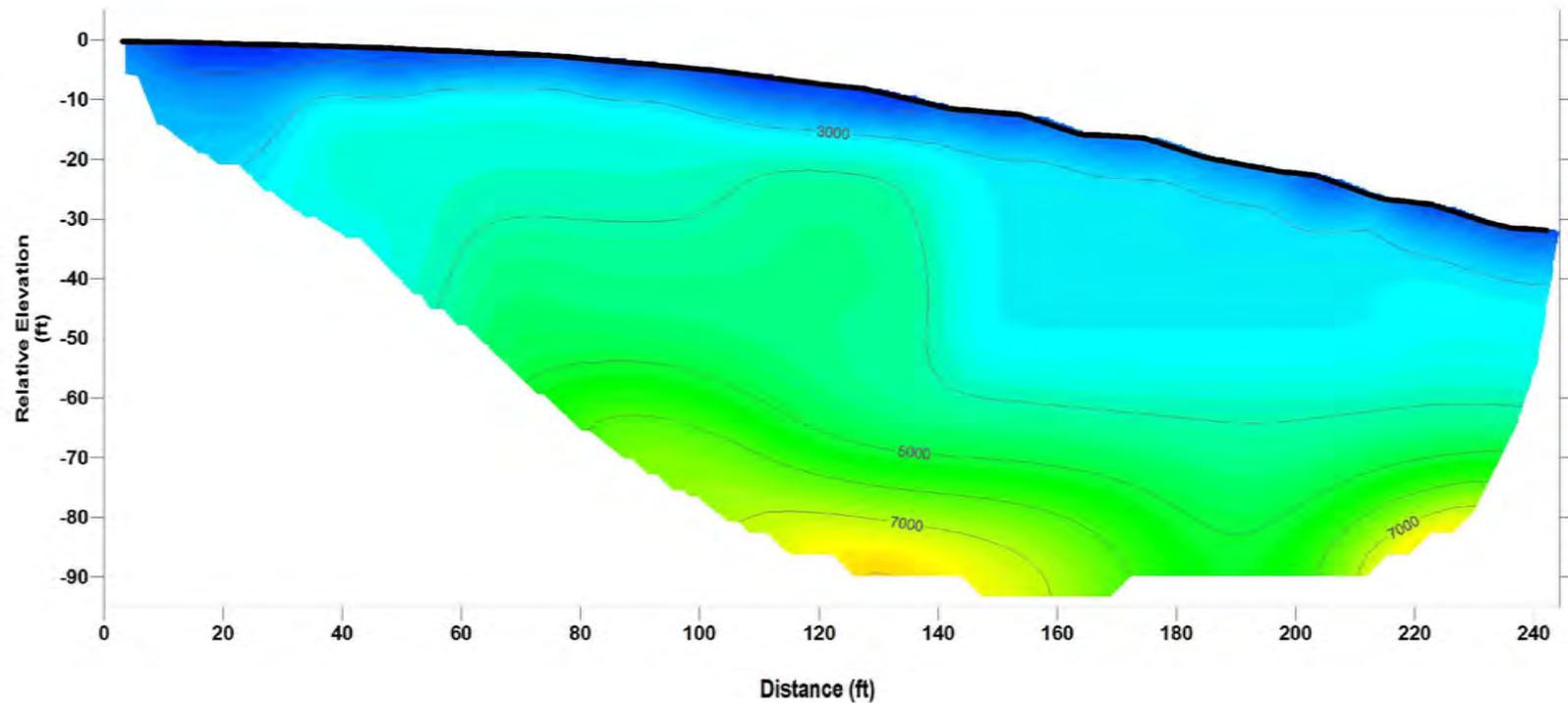


## LEIGHTON

APPENDIX A-3

SEISMIC REFRACTION SURVEY (PREVIOUS STUDY)

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-1**

Green Tree Ranch  
Riverside, California

Project No.: 118142

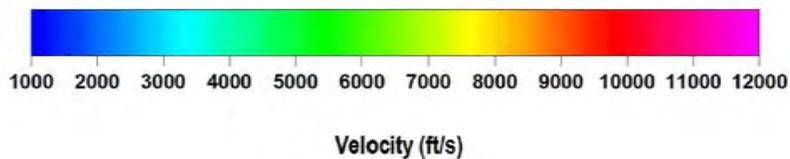
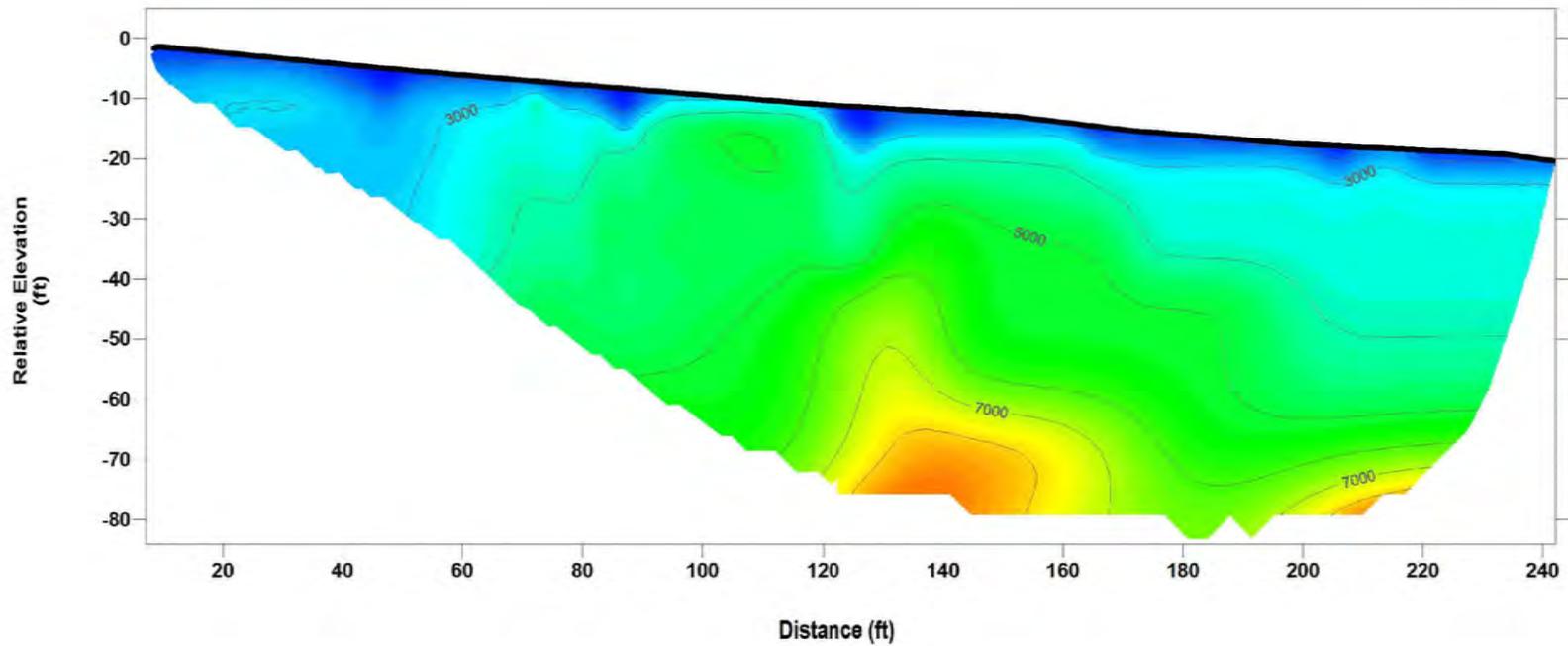
Date: 04/18



Figure 4a

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-2**

Green Tree Ranch  
Riverside, California

Project No.: 118142

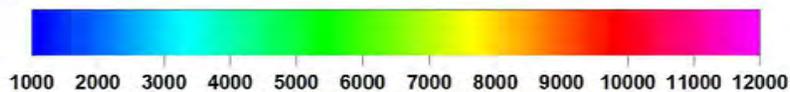
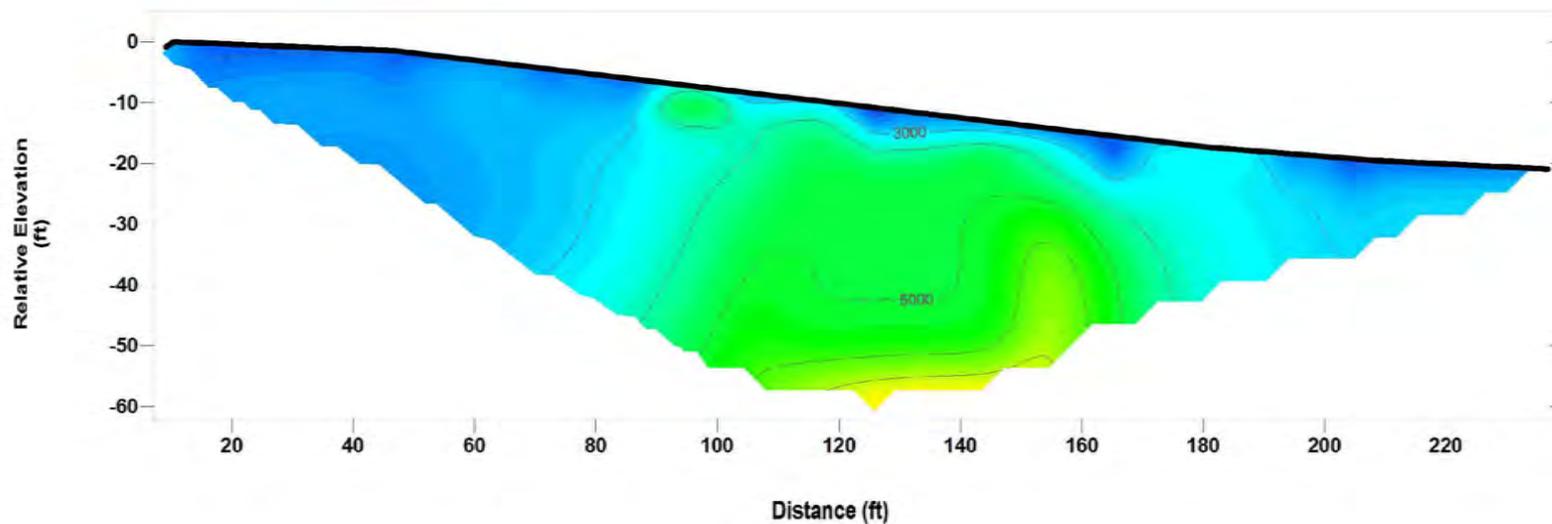
Date: 04/18



Figure 4b

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



Velocity (ft/s)

**P-WAVE PROFILE  
SL-3**

Green Tree Ranch  
Riverside, California

Project No.: 118142

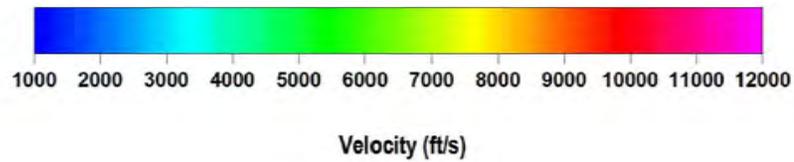
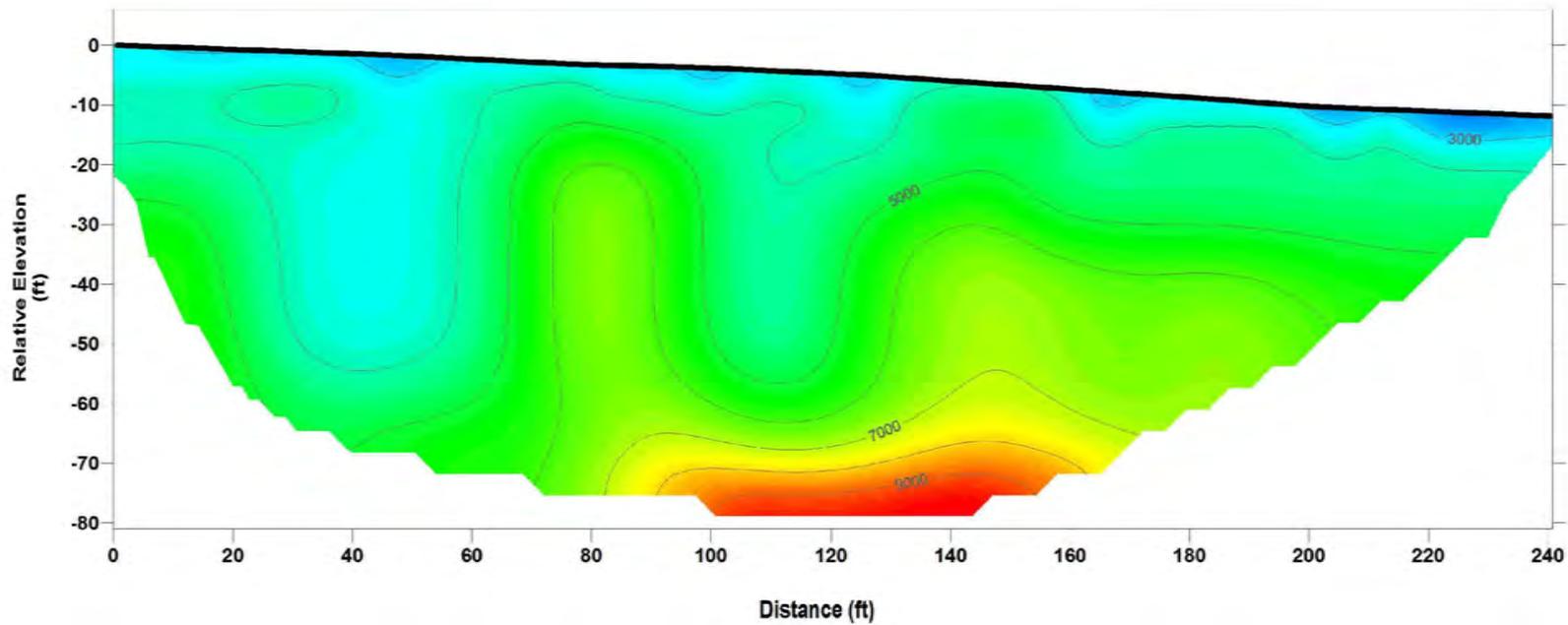
Date: 04/18



Figure 4c

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-4**

Green Tree Ranch  
Riverside, California

Project No.: 118142

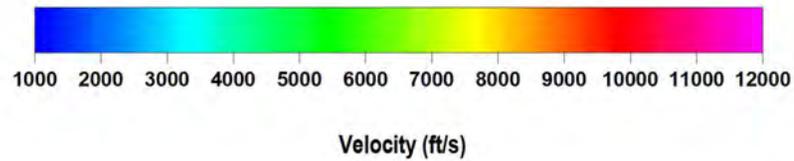
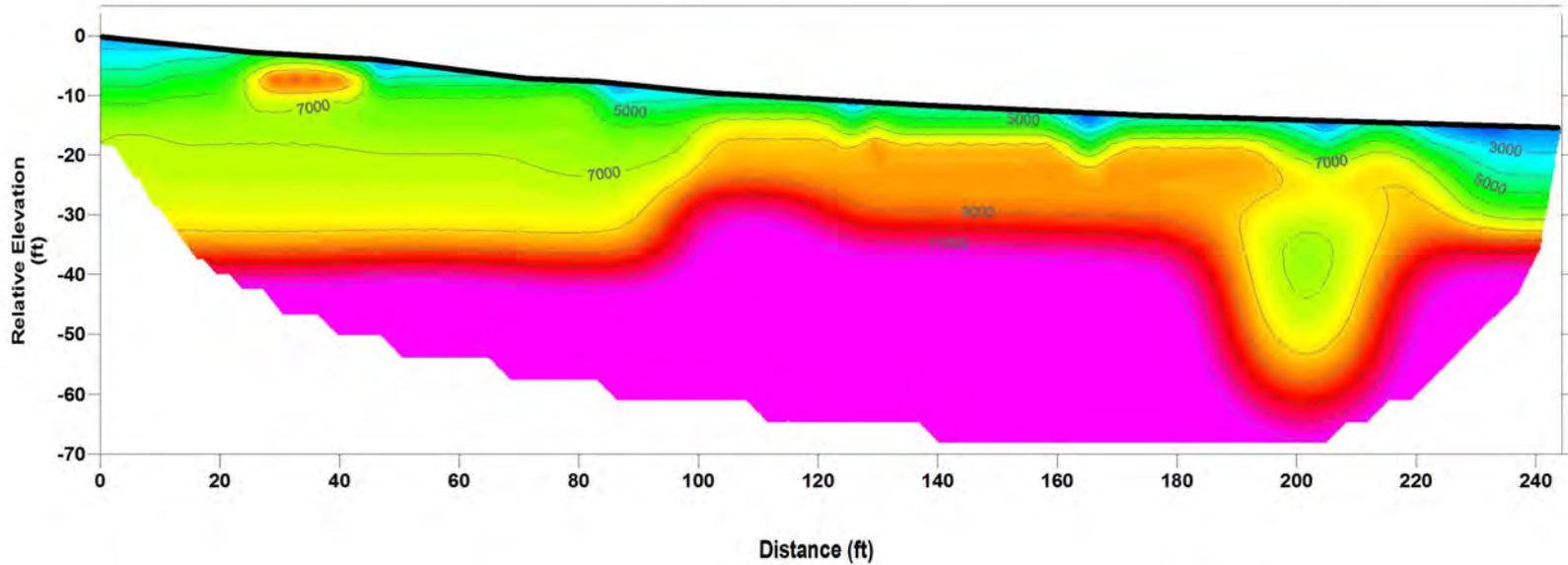
Date: 04/18



Figure 4d

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-5**

Green Tree Ranch  
Riverside, California

Project No.: 118142

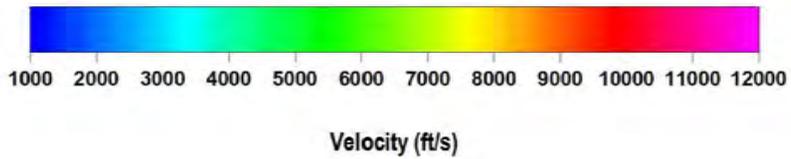
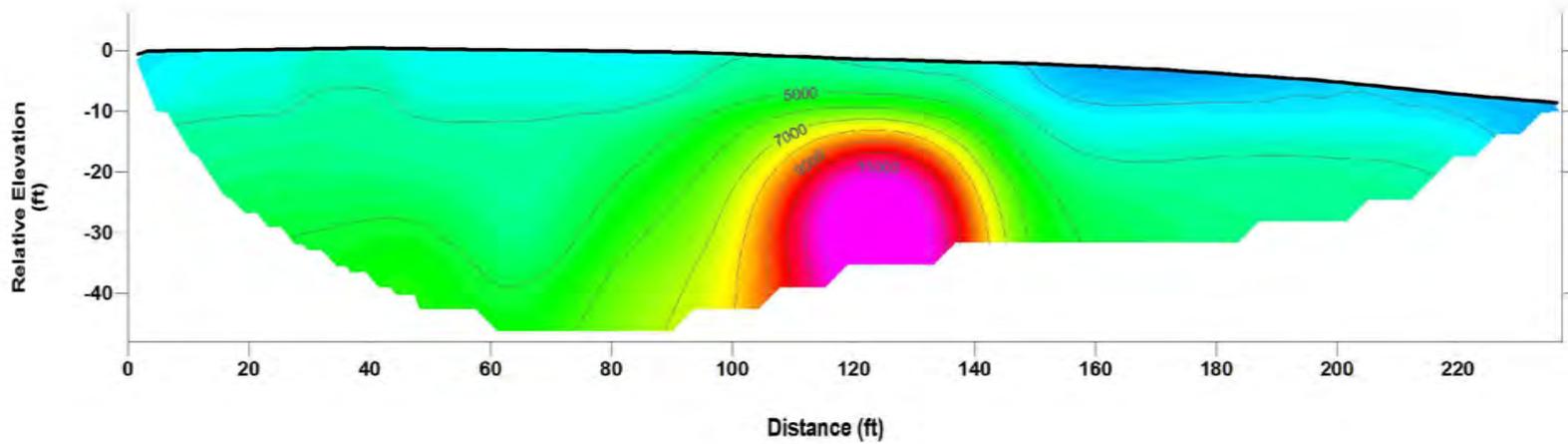
Date: 04/18



Figure 4e

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-6**

Green Tree Ranch  
Riverside, California

Project No.: 118142

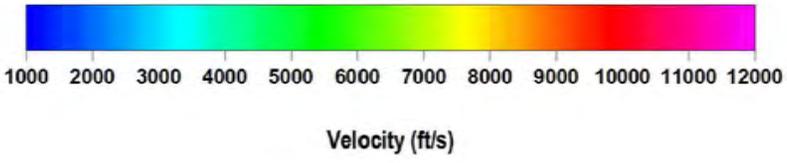
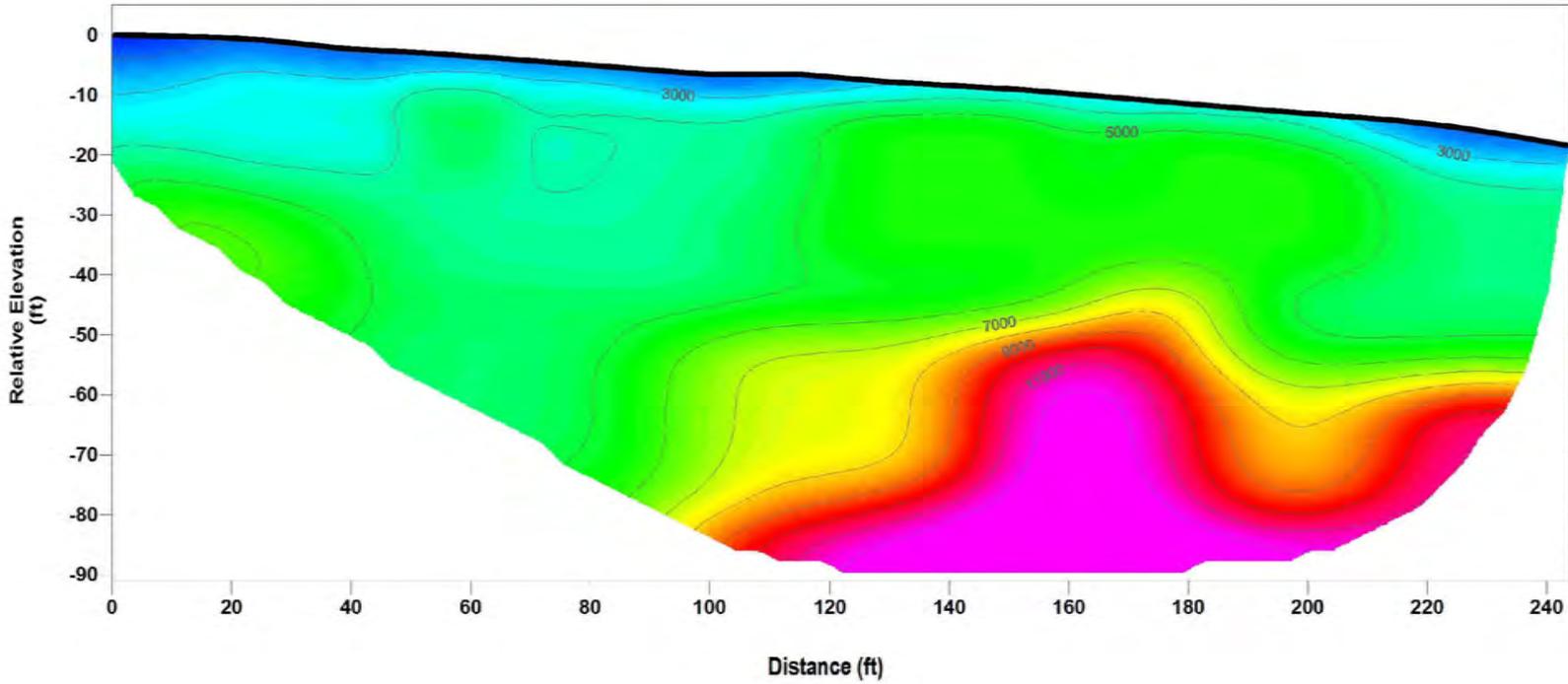
Date: 04/18



Figure 4f

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-7**

Green Tree Ranch  
Riverside, California

Project No.: 118142

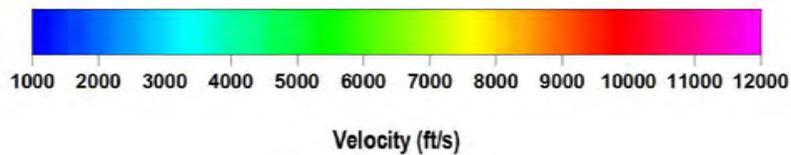
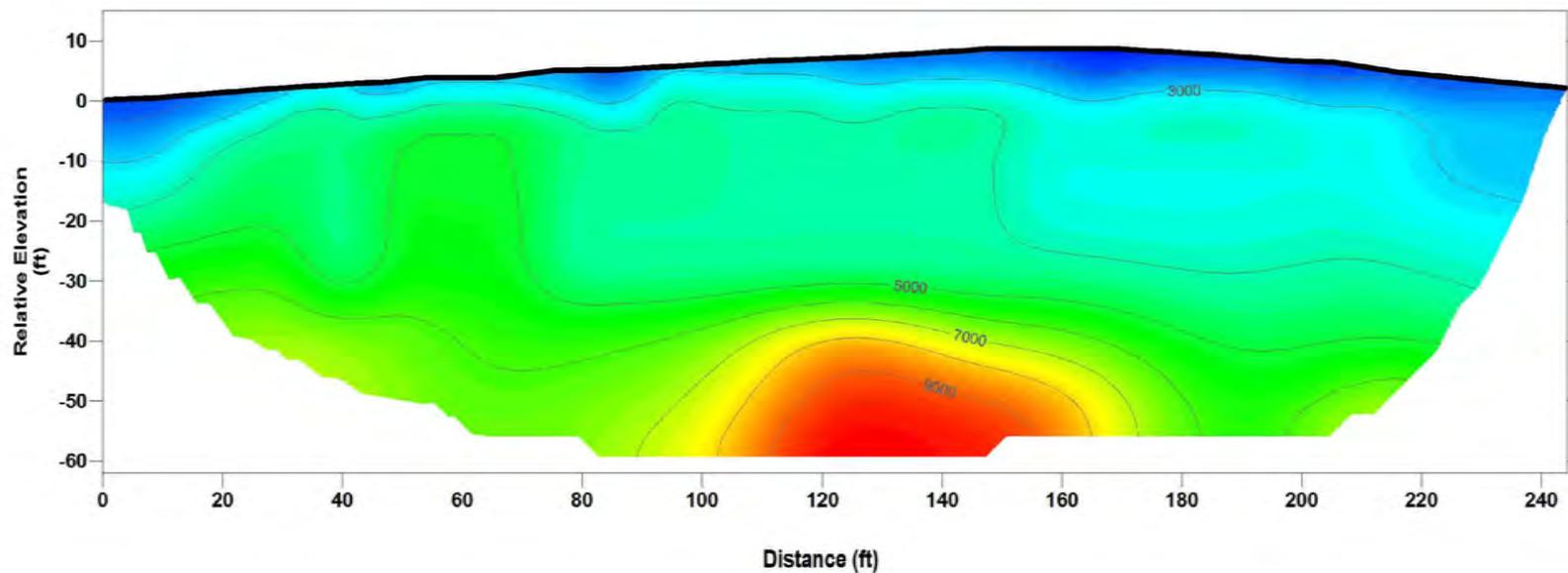
Date: 04/18



Figure 4g

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-8**

Green Tree Ranch  
Riverside, California

Project No.: 118142

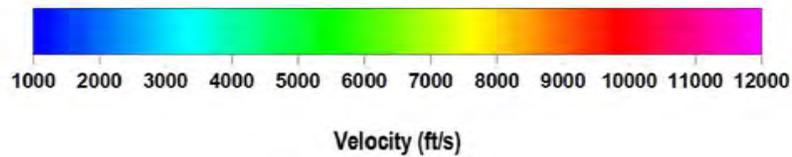
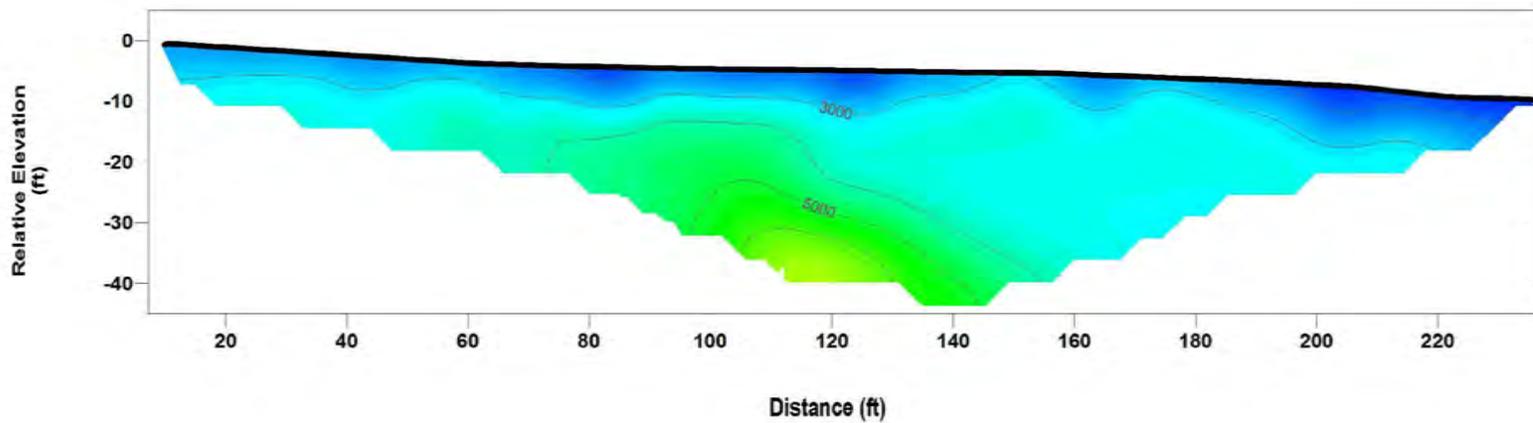
Date: 04/18



Figure 4h

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-9**

Green Tree Ranch  
Riverside, California

Project No.: 118142

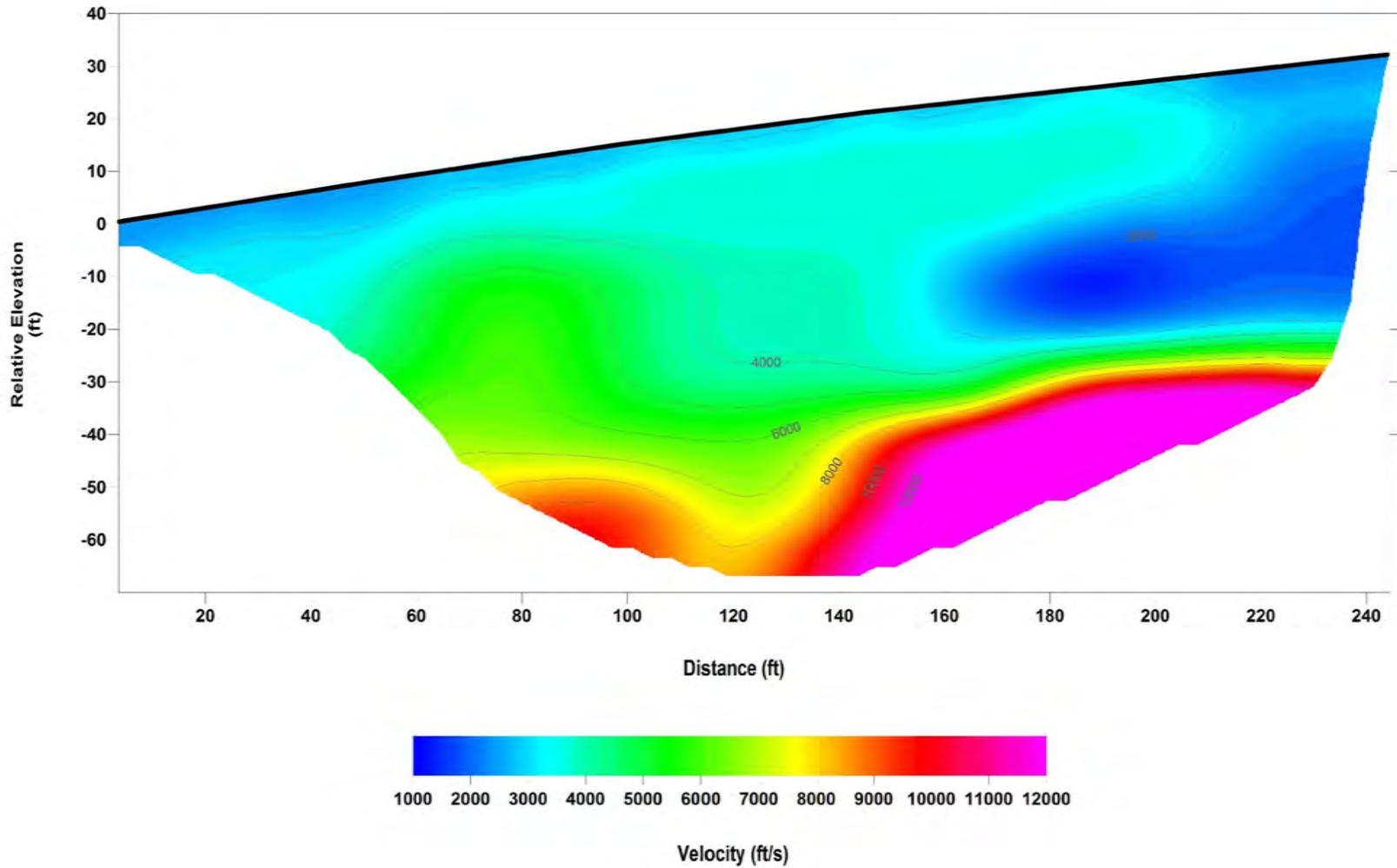
Date: 04/18



Figure 4i

Note: Contour Interval = 1,000 feet per second

# TOMOGRAPHY MODEL



**P-WAVE PROFILE  
SL-10**

Green Tree Ranch  
Riverside, California

Project No.: 118142

Date: 04/18



Figure 4j

Note: Contour Interval = 1,000 feet per second

APPENDIX A-4

AIRTRACK LOGS (PREVIOUS STUDY)

# Drilling Report

## E.C.M.

EarthConstructionMining

Rotary Percussion Test Drilling Penetration Rates

**Job Name** VICTORIA HEIGHTS PHASE 1  
**Location**  
**Job Number** 1387.00  
**For** ALBUS- KEEFE

**Drill Date(s)** 15-Jan-05

3½": ———● 4": .....◆

**Field Tech(s)**

**Drill Model** 841- ECM 370

### Disclaimer:

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.



1387.00 VICTORIA HEIGHTS PHASE 1  
0

**Test Drilling Graphs**

Graphs	Hole Number	Number of Feet with 3½" Bit	Number of Feet with 4" Bit	Total Feet
1	1		31	31
2	2		42	42
3	3		27	27
4	4		40	40
5	5		30	30
6	6		30	30
7	7		30	30
8	8		49	49
9	9		45	45
10	10		40	40
11	11		40	40
12	12		30	30
13	13		43	43
14	14		33	33
15				0
16				0
17				0
18				0
19				0
20				0
21				0
22				0
23				0
24				0
25				0
26				0
27				0
28				0
29				0
30				0
31				0
32				0
33				0
34				0
35				0
36				0
37				0
38				0
39				0
40				0
41				0
42				0
43				0
44				0
45				0

**TOTAL FEET 510**  
**TOTAL HOURS**



E.C.M.

0

Date 0-Jan-00

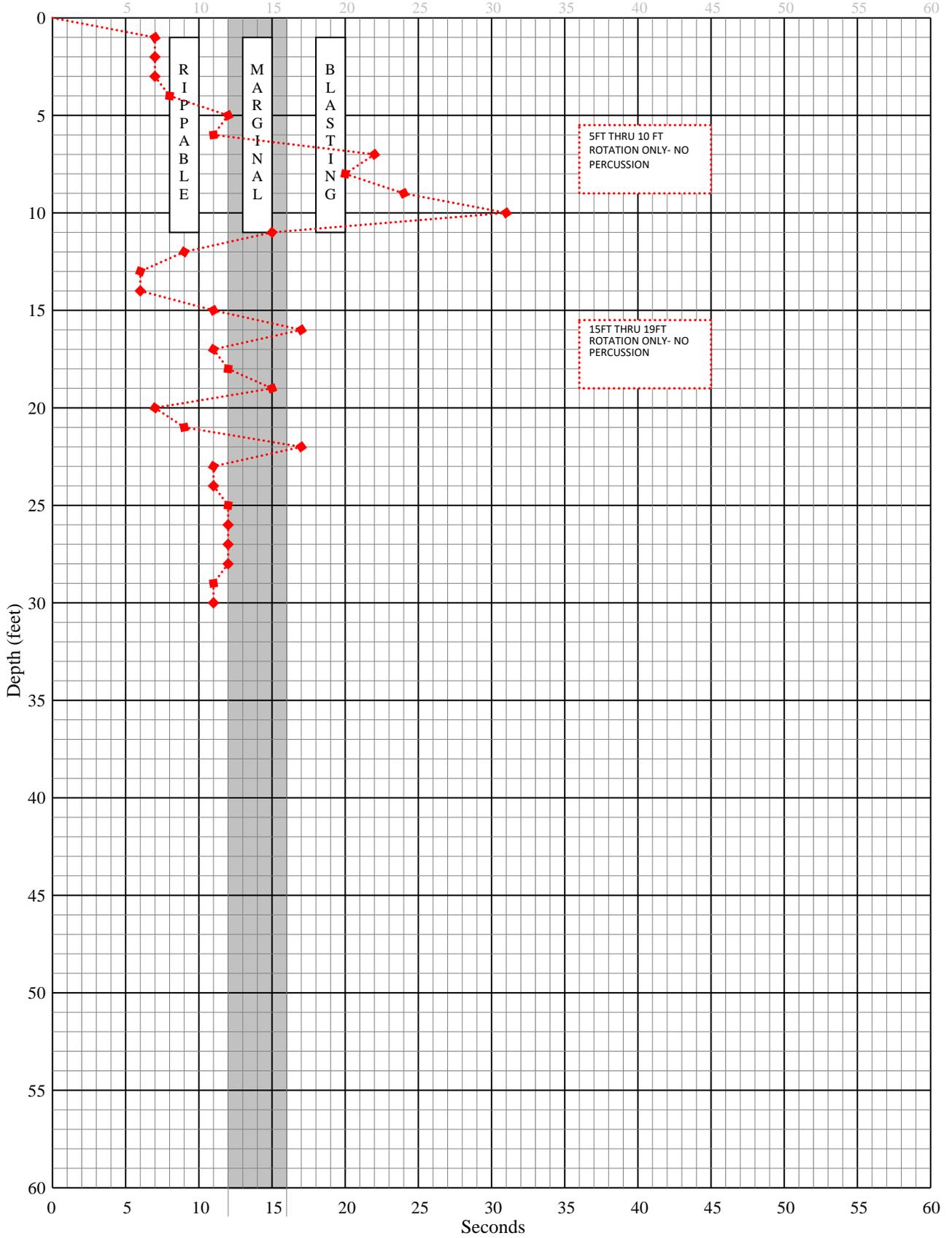
3 1/2": —●—

Job #: 1387.00

Date 15-Jan-05

4": .....◆.....

Hole # 7



E.C.M.

0

Date 0-Jan-00

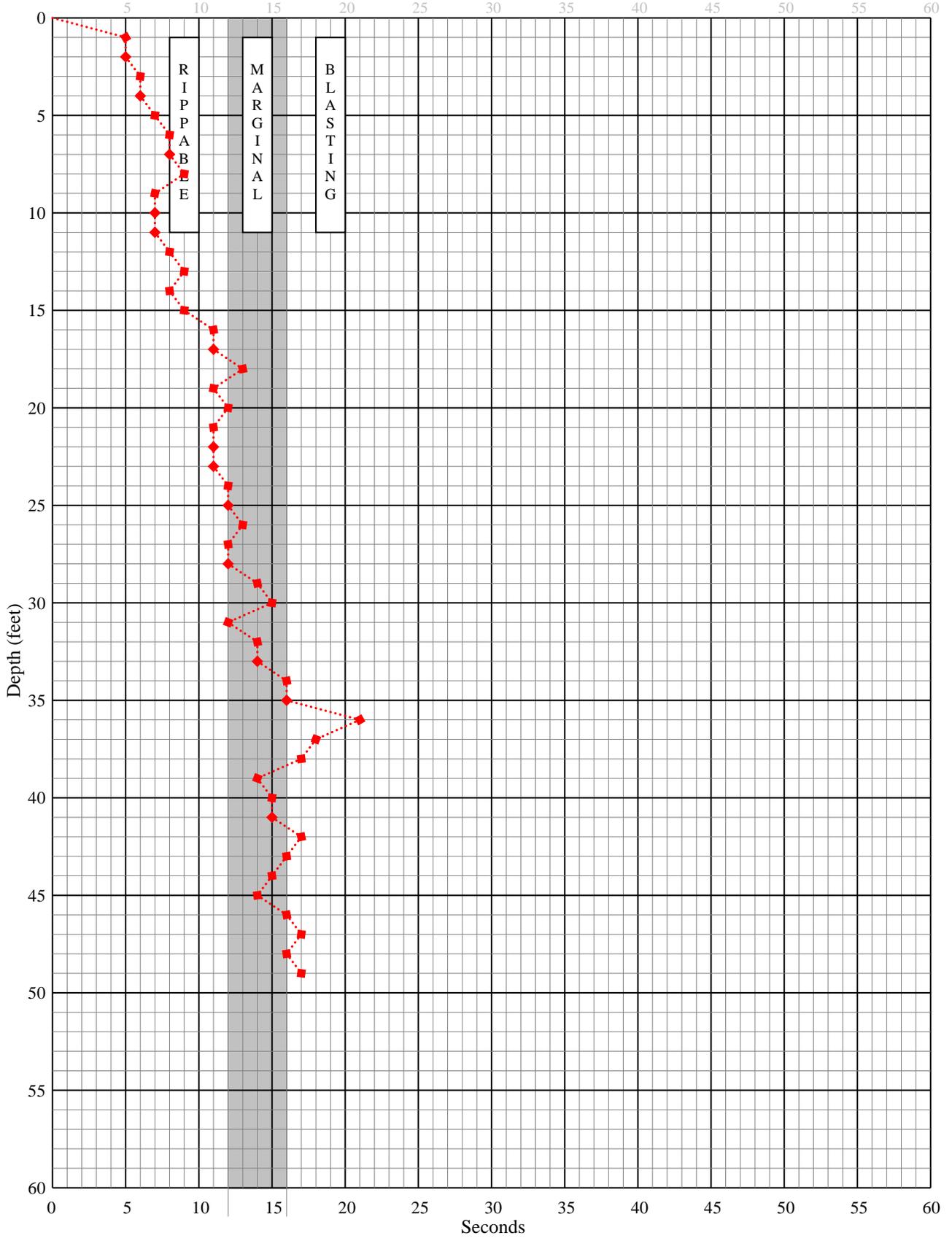
3½": —●—

Job #: 1387.00

Date 15-Jan-05

4": .....◆.....

Hole # 8



E.C.M.

0

Date 0-Jan-00

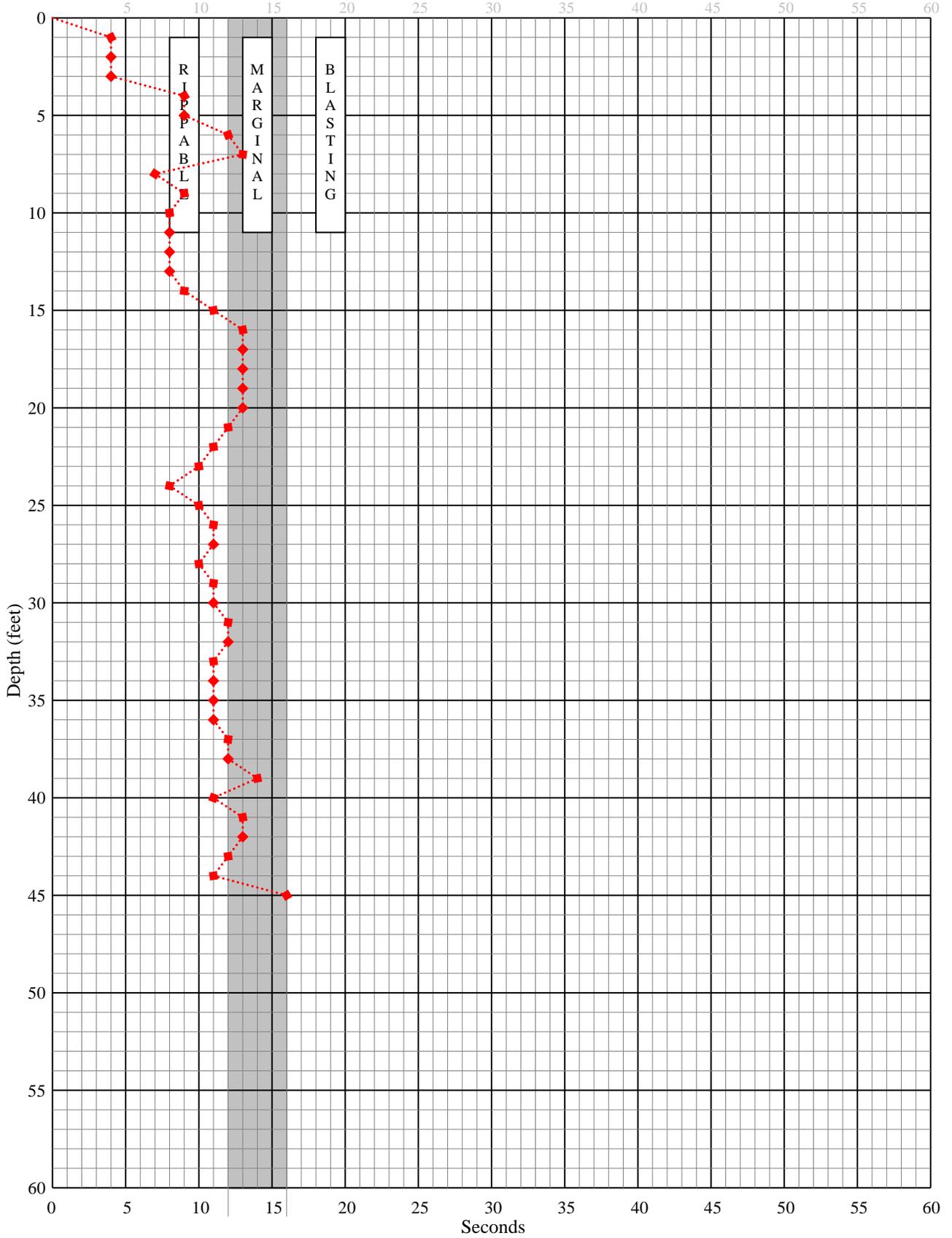
3½": —●—

Job #: 1387.00

Date 15-Jan-05

4": .....◆.....

Hole # 9



## APPENDIX B

### GEOTECHNICAL LABORATORY TEST RESULTS (THIS AND PREVIOUS STUDIES)



**PARTICLE-SIZE DISTRIBUTION (GRADATION)  
of SOILS USING SIEVE ANALYSIS  
ASTM D 6913**

Project Name: Pulte/Highland Grove 3/Geo DD  
 Project No.: 13979.001  
 Boring No.: TP-4  
 Sample No.: B-1

Tested By: MRV      Date: 08/31/23  
 Checked By: MRV      Date: 09/01/23  
 Depth (feet): 0 - 4.0

Soil Identification: Well-Graded Sand with Silt (SW-SM), Reddish Brown.

Calculation of Dry Weights	Whole Sample	Sample Passing #4	Moisture Contents	Whole Sample	Sample passing #4
Container No.:	P	P	Wt. of Air-Dry Soil + Cont.(g)	1622.6	624.7
Wt. Air-Dried Soil + Cont.(g)	1622.6	624.7	Wt. of Dry Soil + Cont. (g)	1573.6	624.7
Wt. of Container (g)	278.8	279.3	Wt. of Container No. (g)	278.8	279.3
Dry Wt. of Soil (g)	1294.6	345.4	Moisture Content (%)	3.8	0.0

Passing #4 Material After Wet Sieve	Container No.	A
	Wt. of Dry Soil + Container (g)	607.8
	Wt. of Container (g)	279.3
	Dry Wt. of Soil Retained on # 200 Sieve (g)	328.5

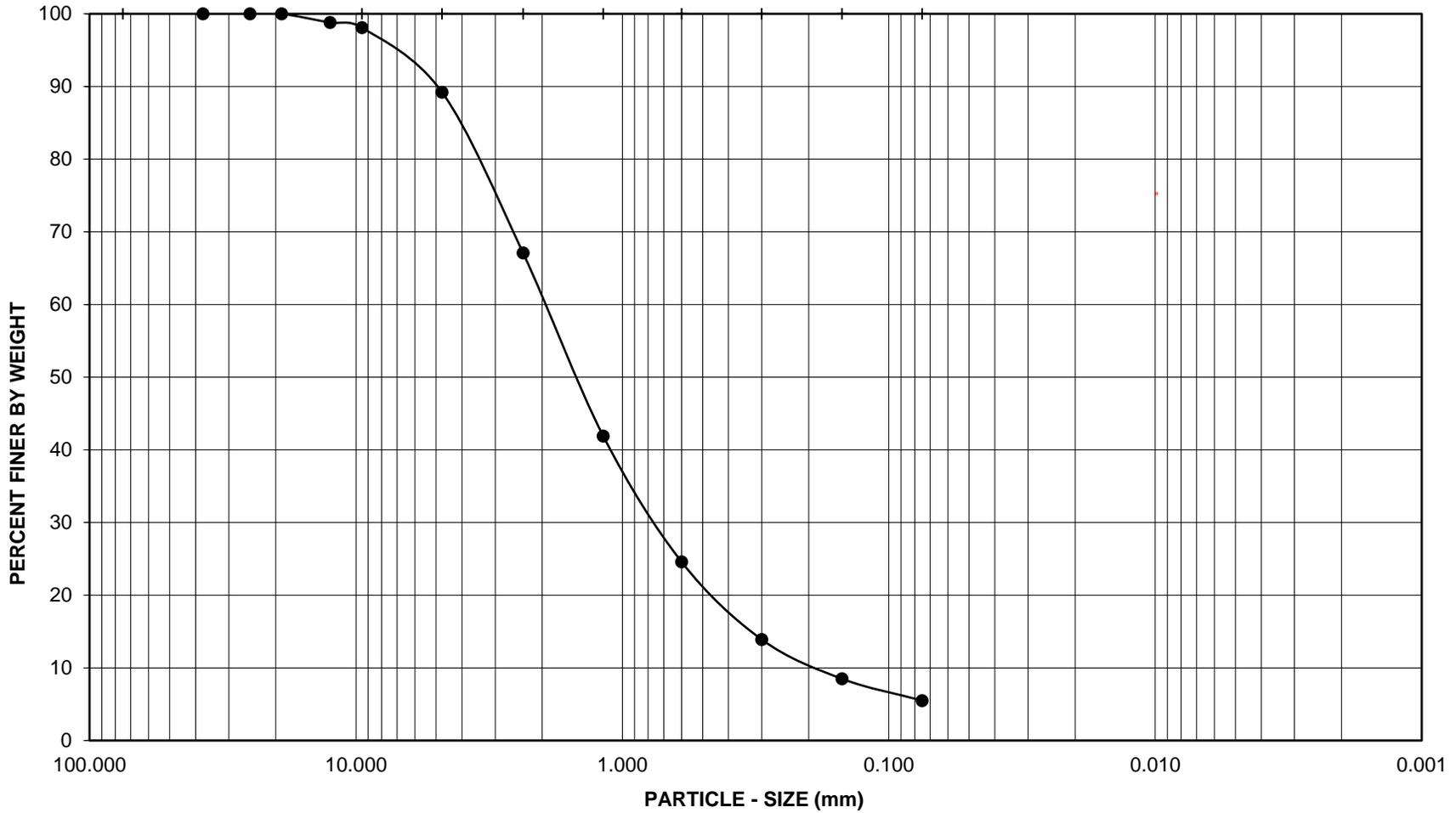
U. S. Sieve Size		Cumulative Weight of Dry Soil Retained (g)		Percent Passing (%)
	(mm.)	Whole Sample	Sample Passing #4	
1 1/2"	37.500			100.0
1"	25.000			100.0
3/4"	19.000	0.0		100.0
1/2"	12.500	15.2		98.8
3/8"	9.500	24.6		98.1
#4	4.750	139.2		89.2
#8	2.360		85.6	67.1
#16	1.180		183.0	41.9
#30	0.600		250.0	24.6
#50	0.300		291.4	13.9
#100	0.150		312.4	8.5
#200	0.075		324.2	5.5
PAN				

GRAVEL: **11 %**  
 SAND: **83 %**  
 FINES: **6 %**  
 GROUP SYMBOL: **SW-SM**

$C_u = D_{60}/D_{10} = \underline{10.00}$   
 $C_c = (D_{30})^2/(D_{60} \cdot D_{10}) = \underline{1.60}$

Remarks: \_\_\_\_\_

GRAVEL			SAND					FINES				
COARSE		FINE	COARSE	MEDIUM	FINE		SILT	CLAY				
U.S. STANDARD SIEVE OPENING			U.S. STANDARD SIEVE NUMBER					HYDROMETER				
3.0"	1 1/2"	3/4"	3/8"	#4	#8	#16	#30	#50	#100	#200		



Project Name: Pulte/Highland Grove 3/Geo DD

Project No.: 13979.001

Boring No.: TP-4

Sample No.: B-1

Depth (feet): 0 - 4.0

Soil Type : SW-SM

Soil Identification: Well-Graded Sand with Silt (SW-SM), Reddish Brown.

**GR:SA:FI : (%)      11 : 83 : 6**



**PARTICLE - SIZE  
DISTRIBUTION  
ASTM D 6913**

Sep-23



**PARTICLE-SIZE DISTRIBUTION (GRADATION)  
of SOILS USING SIEVE ANALYSIS  
ASTM D 6913**

Project Name: Pulte/Highland Grove 3/Geo DD  
 Project No.: 13979.001  
 Boring No.: TP-8  
 Sample No.: B-1  
 Soil Identification: Silty Sand (SM), Grayish Brown.

Tested By: MRV Date: 08/31/23  
 Checked By: MRV Date: 09/01/23  
 Depth (feet): 0 - 4.0

Calculation of Dry Weights	Whole Sample	Sample Passing #4	Moisture Contents	Whole Sample	Sample passing #4
Container No.:	B	M	Wt. of Air-Dry Soil + Cont.(g)	1893.7	619.7
Wt. Air-Dried Soil + Cont.(g)	1893.7	619.7	Wt. of Dry Soil + Cont. (g)	1859.1	619.7
Wt. of Container (g)	278.1	277.5	Wt. of Container No. (g)	278.1	277.5
Dry Wt. of Soil (g)	1580.8	342.2	Moisture Content (%)	2.2	0.0

Passing #4 Material After Wet Sieve	Container No.	M
	Wt. of Dry Soil + Container (g)	547.5
	Wt. of Container (g)	277.5
	Dry Wt. of Soil Retained on # 200 Sieve (g)	270.0

U. S. Sieve Size		Cumulative Weight of Dry Soil Retained (g)		Percent Passing (%)
	(mm.)	Whole Sample	Sample Passing #4	
1 1/2"	37.500			100.0
1"	25.000			100.0
3/4"	19.000	0.0		100.0
1/2"	12.500	23.8		98.5
3/8"	9.500	33.2		97.9
#4	4.750	54.0		96.6
#8	2.360		18.2	91.5
#16	1.180		67.6	77.5
#30	0.600		117.4	63.5
#50	0.300		161.8	50.9
#100	0.150		209.2	37.5
#200	0.075		257.7	23.9
PAN				

GRAVEL: **3 %**  
 SAND: **73 %**  
 FINES: **24 %**  
 GROUP SYMBOL: **SM**

Cu = D60/D10 = N/A  
 Cc = (D30)<sup>2</sup>/(D60\*D10) = N/A

Remarks: \_\_\_\_\_

GRAVEL			SAND				FINES	
COARSE	FINE		COARSE	MEDIUM	FINE		SILT	CLAY

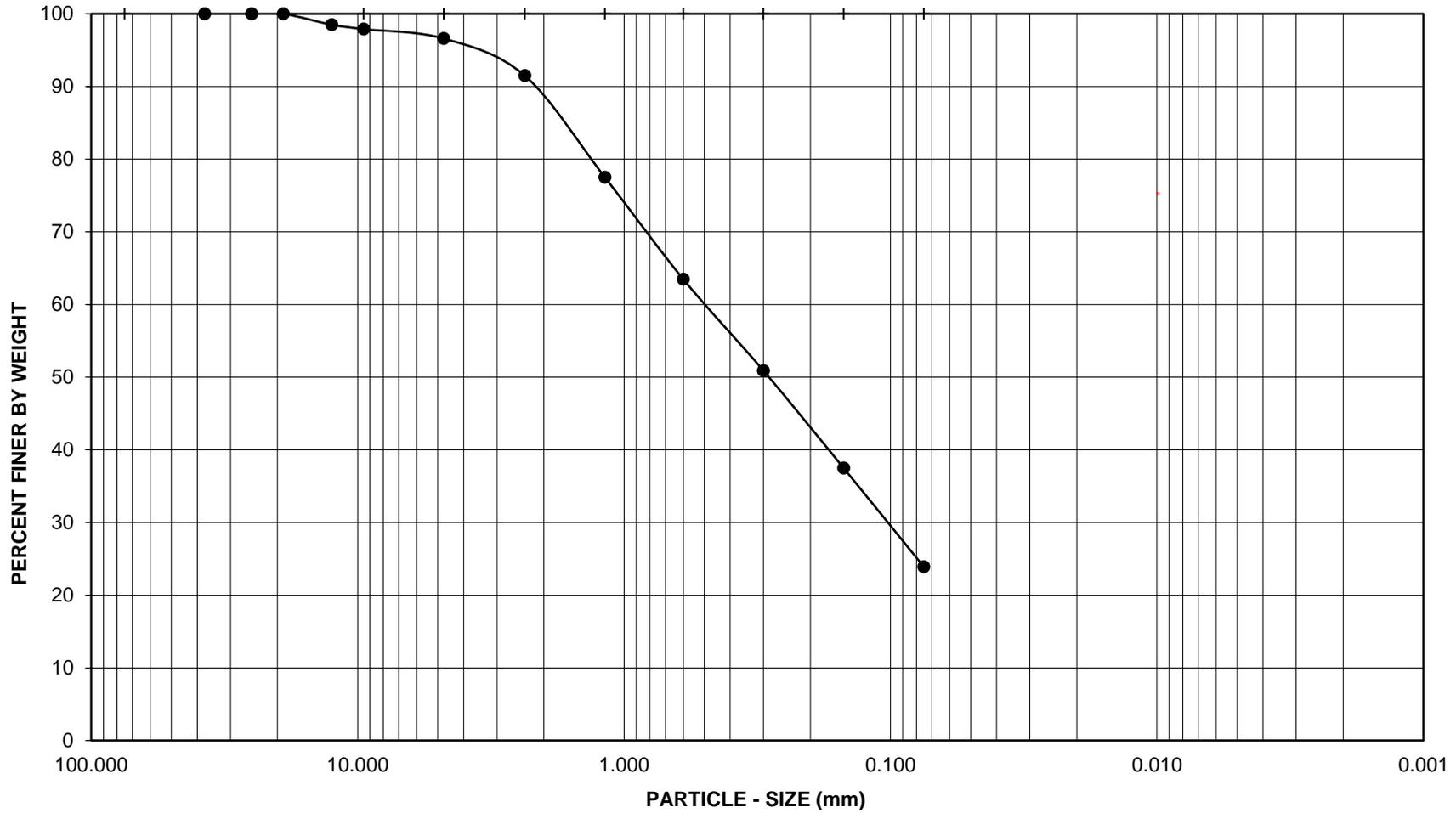
U.S. STANDARD SIEVE OPENING

3.0" 1 1/2" 3/4" 3/8" #4

U.S. STANDARD SIEVE NUMBER

#8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: Pulte/Highland Grove 3/Geo DD

Project No.: 13979.001

Boring No.: TP-8

Sample No.: B-1

Depth (feet): 0 - 4.0

Soil Type : SM

Soil Identification: Silty Sand (SM), Grayish Brown.

**GR:SA:FI : (%)      3 : 73 : 24**



**PARTICLE - SIZE  
DISTRIBUTION  
ASTM D 6913**

Sep-23



**EXPANSION INDEX of SOILS**  
ASTM D 4829

Project Name:	<u>Pulte/Highland Grove 3/Geo DD</u>	Tested By:	<u>M. Vinet</u>	Date:	<u>8/31/23</u>
Project No. :	<u>13979.001</u>	Checked By:	<u>M. Vinet</u>	Date:	<u>9/1/23</u>
Boring No.:	<u>TP-3</u>	Depth:	<u>0 - 4.0</u>		
Sample No. :	<u>B-1</u>	Location:	<u>N/A</u>		
Sample Description:	<u>Well-Graded Sand with Silt (SW-SM), Reddish Brown.</u>				

Dry Wt. of Soil + Cont. (gm.)	2632.2
Wt. of Container No. (gm.)	0.0
Dry Wt. of Soil (gm.)	2632.2
Weight Soil Retained on #4 Sieve	25.2
Percent Passing # 4	99.0

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	0.9945
Wt. Comp. Soil + Mold (gm.)	585.0	609.2
Wt. of Mold (gm.)	178.0	178.0
Specific Gravity (Assumed)	2.70	2.70
Container No.	7	7
Wet Wt. of Soil + Cont. (gm.)	337.3	609.2
Dry Wt. of Soil + Cont. (gm.)	312.5	373.4
Wt. of Container (gm.)	37.3	178.0
Moisture Content (%)	9.0	15.5
Wet Density (pcf)	122.8	130.8
Dry Density (pcf)	112.6	113.3
Void Ratio	0.497	0.489
Total Porosity	0.332	0.328
Pore Volume (cc)	68.7	67.6
Degree of Saturation (%) [ S meas]	<b>48.9</b>	<b>85.6</b>

**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.)
8/31/23	12:00	1.0	0	0.5000
8/31/23	12:10	1.0	10	0.5000
Add Distilled Water to the Specimen				
9/1/23	8:00	1.0	1190	0.4945
9/1/23	9:00	1.0	1250	0.4945

Expansion Index (EI meas) = ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	<b>-5.5</b>
Expansion Index ( Report ) = Nearest Whole Number or Zero (0) if Initial Height is > than Final Height	<b>0</b>



**EXPANSION INDEX of SOILS**  
ASTM D 4829

Project Name:	<u>Pulte/Highland Grove 3/Geo DD</u>	Tested By:	<u>M. Vinet</u>	Date:	<u>8/31/23</u>
Project No. :	<u>13979.001</u>	Checked By:	<u>M. Vinet</u>	Date:	<u>9/1/23</u>
Boring No.:	<u>TP-7</u>	Depth:	<u>0 - 4.0</u>		
Sample No. :	<u>B-1</u>	Location:	<u>N/A</u>		
Sample Description:	<u>Well-Graded Sand with Silt (SW-SM), Yellowish Brown.</u>				

Dry Wt. of Soil + Cont. (gm.)	2688.2
Wt. of Container No. (gm.)	0.0
Dry Wt. of Soil (gm.)	2688.2
Weight Soil Retained on #4 Sieve	61.2
Percent Passing # 4	97.7

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	0.9963
Wt. Comp. Soil + Mold (gm.)	605.2	621.5
Wt. of Mold (gm.)	200.0	200.0
Specific Gravity (Assumed)	2.70	2.70
Container No.	8	8
Wet Wt. of Soil + Cont. (gm.)	337.1	621.5
Dry Wt. of Soil + Cont. (gm.)	311.1	370.0
Wt. of Container (gm.)	37.1	200.0
Moisture Content (%)	9.5	13.9
Wet Density (pcf)	122.2	127.6
Dry Density (pcf)	111.6	112.0
Void Ratio	0.510	0.505
Total Porosity	0.338	0.335
Pore Volume (cc)	69.9	69.2
Degree of Saturation (%) [ S meas]	<b>50.3</b>	<b>74.4</b>

**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.)
8/31/23	12:15	1.0	0	0.5000
8/31/23	12:25	1.0	10	0.5000
Add Distilled Water to the Specimen				
9/1/23	8:00	1.0	1175	0.4963
9/1/23	9:00	1.0	1235	0.4963

Expansion Index (EI meas) = ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	<b>-3.7</b>
Expansion Index ( Report ) = Nearest Whole Number or Zero (0) if Initial Height is > than Final Height	<b>0</b>



**EXPANSION INDEX of SOILS**  
ASTM D 4829

Project Name:	<u>Pulte/Highland Grove 3/Geo DD</u>	Tested By:	<u>M. Vinet</u>	Date:	<u>8/31/23</u>
Project No. :	<u>13979.001</u>	Checked By:	<u>M. Vinet</u>	Date:	<u>9/1/23</u>
Boring No.:	<u>TP-9</u>	Depth:	<u>0 - 4.0</u>		
Sample No. :	<u>B-1</u>	Location:	<u>N/A</u>		
Sample Description:	<u>Silty Sand (SM), Dark Brown.</u>				

Dry Wt. of Soil + Cont. (gm.)	2412.3
Wt. of Container No. (gm.)	0.0
Dry Wt. of Soil (gm.)	2412.3
Weight Soil Retained on #4 Sieve	12.2
Percent Passing # 4	99.5

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	0.9985
Wt. Comp. Soil + Mold (gm.)	601.1	619.2
Wt. of Mold (gm.)	199.1	199.1
Specific Gravity (Assumed)	2.70	2.70
Container No.	9	9
Wet Wt. of Soil + Cont. (gm.)	349.8	619.2
Dry Wt. of Soil + Cont. (gm.)	323.8	367.1
Wt. of Container (gm.)	49.8	199.1
Moisture Content (%)	9.5	14.4
Wet Density (pcf)	121.3	126.9
Dry Density (pcf)	110.7	110.9
Void Ratio	0.522	0.520
Total Porosity	0.343	0.342
Pore Volume (cc)	71.0	70.7
Degree of Saturation (%) [ S meas]	<b>49.1</b>	<b>74.9</b>

**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.)
8/31/23	12:45	1.0	0	0.5000
8/31/23	12:55	1.0	10	0.5000
Add Distilled Water to the Specimen				
9/1/23	8:00	1.0	1145	0.4985
9/1/23	9:00	1.0	1205	0.4985

Expansion Index (EI meas) = ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	<b>-1.5</b>
Expansion Index ( Report ) = Nearest Whole Number or Zero (0) if Initial Height is > than Final Height	<b>0</b>



## R-VALUE TEST RESULTS

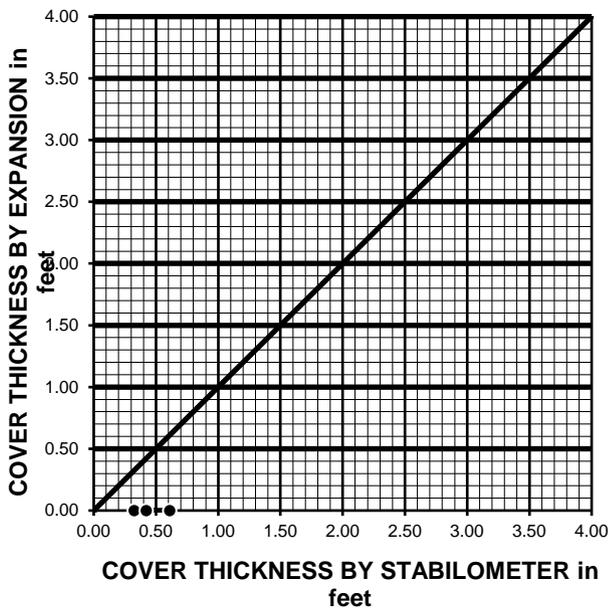
### ASTM D 2844

Project Name:	Pulte/Highland Grove 3/Geo DD	Date:	8/31/23
Project Number:	13979.001	Technician:	M. Vinet
Boring Number:	TP-4	Depth (ft.):	0 - 4.0
Sample Number:	B-1		
Sample Description:	Well-Graded Sand with Silt (SW-SM), Reddish		Sample Location: N/A

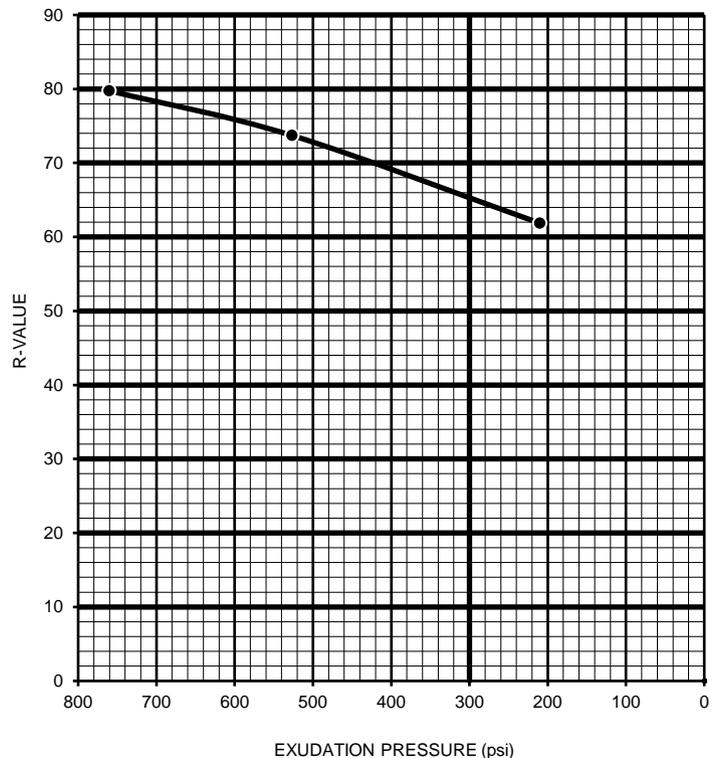
TEST SPECIMEN	A	B	C
MOISTURE AT COMPACTION %	8.8	9.4	10.4
HEIGHT OF SAMPLE, Inches	2.52	2.54	2.51
DRY DENSITY, pcf	116.6	117.8	117.0
COMPACTOR AIR PRESSURE, psi	350	350	275
EXUDATION PRESSURE, psi	761	527	210
EXPANSION, Inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	19	24	36
TURNS DISPLACEMENT	4.71	5.05	5.31
R-VALUE UNCORRECTED	80	74	62
R-VALUE CORRECTED	80	74	62

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.	0.32	0.42	0.61
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION:	N/A
R-VALUE BY EXUDATION:	65
EQUILIBRIUM R-VALUE:	65



**TESTS for SULFATE CONTENT  
CHLORIDE CONTENT and pH of SOILS**

Project Name: Pulte/Highland Grove 3/Geo DD  
Project No. : 13979.001

Tested By : M. Vinet Date: 09/01/23  
Data Input By: M. Vinet Date: 09/01/23

Boring No.	TP-8			
Sample No.	B-1			
Sample Depth (ft)	0 - 5.0			
Soil Identification:	Silty Sand (SM)			
Wet Weight of Soil + Container (g)	100.00			
Dry Weight of Soil + Container (g)	100.00			
Weight of Container (g)	0.00			
Moisture Content (%)	0.00			
Weight of Soaked Soil (g)	100.00			

**SULFATE CONTENT, DOT California Test 417, Part II**

Beaker No.	1			
Crucible No.	1			
Furnace Temperature (°C)	850			
Time In / Time Out	Timer			
Duration of Combustion (min)	45			
Wt. of Crucible + Residue (g)	25.0407			
Wt. of Crucible (g)	25.0362			
Wt. of Residue (g) (A)	0.0045			
PPM of Sulfate (A) x 41150	185.18			
<b>PPM of Sulfate, Dry Weight Basis</b>	<b>185</b>			

**CHLORIDE CONTENT, DOT California Test 422**

ml of Extract For Titration (B)	30			
ml of AgNO <sub>3</sub> Soln. Used in Titration (C)	0.8			
PPM of Chloride (C -0.2) * 100 * 30 / B	60			
<b>PPM of Chloride, Dry Wt. Basis</b>	<b>60</b>			

**pH TEST, DOT California Test 643**

<b>pH Value</b>	<b>7.30</b>			
<b>Temperature °C</b>	<b>21.0</b>			

## SOIL RESISTIVITY TEST

### DOT CA TEST 643

Project Name: Pulte/Highland Grove 3/Geo DD

Tested By : M. Vinet Date: 09/01/23

Project No. : 13979.001

Data Input By: M. Vinet Date: 09/01/23

Boring No.: TP-8

Depth (ft.) : 0 - 5.0

Sample No. : B-1

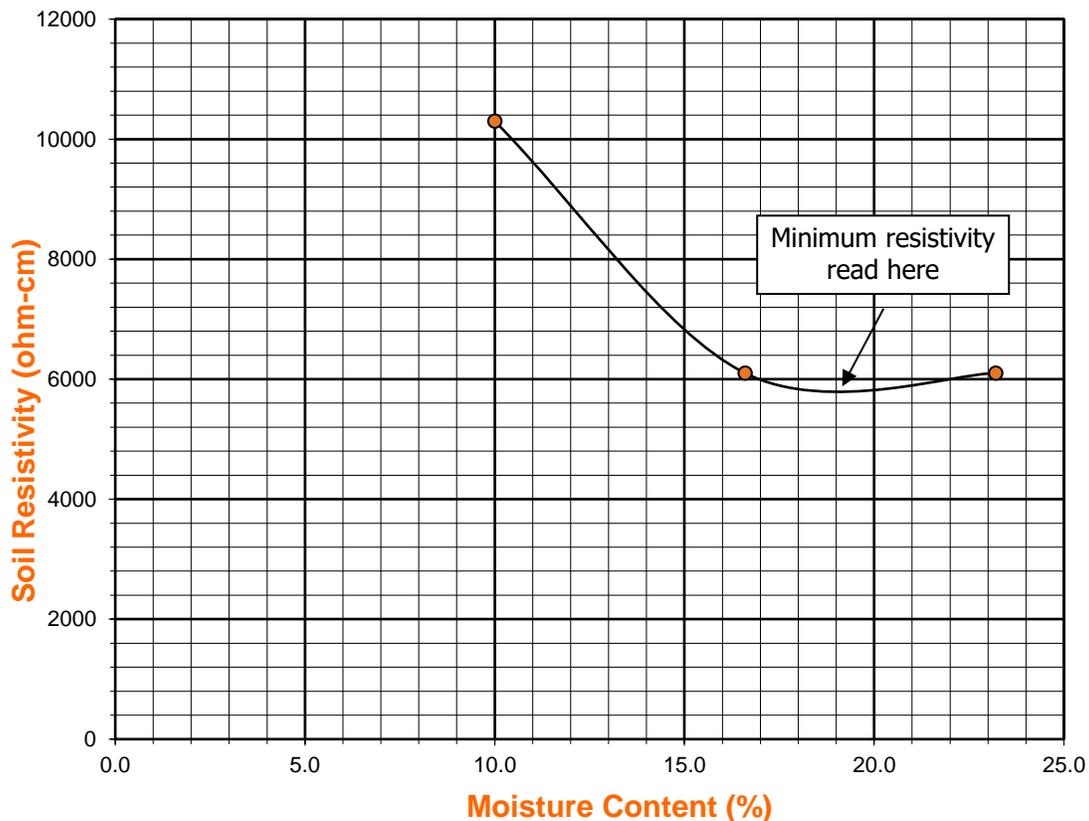
Soil Identification:\* Silty Sand (SM)

\*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	50	10.00	10300	10300
2	83	16.60	6100	6100
3	116	23.20	6100	6100
4				
5				

Moisture Content (%) (Mci)	0.00
Wet Wt. of Soil + Cont. (g)	100.00
Dry Wt. of Soil + Cont. (g)	100.00
Wt. of Container (g)	0.00
Container No.	A
Initial Soil Wt. (g) (Wt)	500.00
Box Constant	1.000
$MC = (((1 + M_{ci}/100) \times (W_a/W_t + 1)) - 1) \times 100$	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		DOT CA Test 417 Part II		DOT CA Test 643	
<b>5800</b>	<b>19.0</b>	<b>185</b>	<b>60</b>	<b>7.30</b>	<b>21.0</b>



Boring No.	LB-2	LB-2	LB-2					
Sample No.	R-2	R-5	R-7					
Depth (ft.)	5	12.5	17.5					
Sample Type	RING	RING	RING					
Visual Soil Classification	ML	SM	SM					
<b>Moisture Correction</b>								
Wet Weight of Soil + Container (gm.)	401.6	401.4	402.5					
Dry Weight of Soil + Container (gm.)	392.5	385.8	381.9					
Weight of Container (gm)	216.5	220.1	219.2					
Moisture Content (%)	5.2	9.4	12.7					
Container No.:	QR	IJ	ST					
<b>Sample Dry Weight Determination</b>								
Weight of Sample + Container (gm.)	401.6	401.4	402.5					
Weight of Container (gm.)	216.5	220.1	219.2					
Weight of Dry Sample (gm.)	176.0	165.7	162.7					
Container No.:	QR	IJ	ST					
<b>After Wash</b>								
Dry Weight of Sample + Container (gm)	258.3	318.0	320.3					
Weight of Container (gm)	216.5	220.1	219.2					
Dry Weight of Sample (gm)	41.8	97.9	101.1					
<b>% Passing No. 200 Sieve</b>	<b>76</b>	<b>41</b>	<b>38</b>					
<b>% Retained No. 200 Sieve</b>	24	59	62					
<b>PERCENT PASSING No. 200 SIEVE ASTM D 1140</b>				Project Name: VICTORIA GROVE				
 <b>Leighton and Associates, Inc.</b>				Project No.: 111446-001				
				Client Name: _____				
				Tested By: JMD		Date: 2/7/05		



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

Project Name: VICTORIA GROVE  
Project No.: 111446-001  
Boring No.: LB-2  
Sample No.: R-2  
Sample Description: ML, BROWN SANDY SILT

Tested By: JMD Date: 2/3/05  
Checked By: PRC Date: 2/7/05  
Sample Type: IN SITU  
Depth (ft.): 5

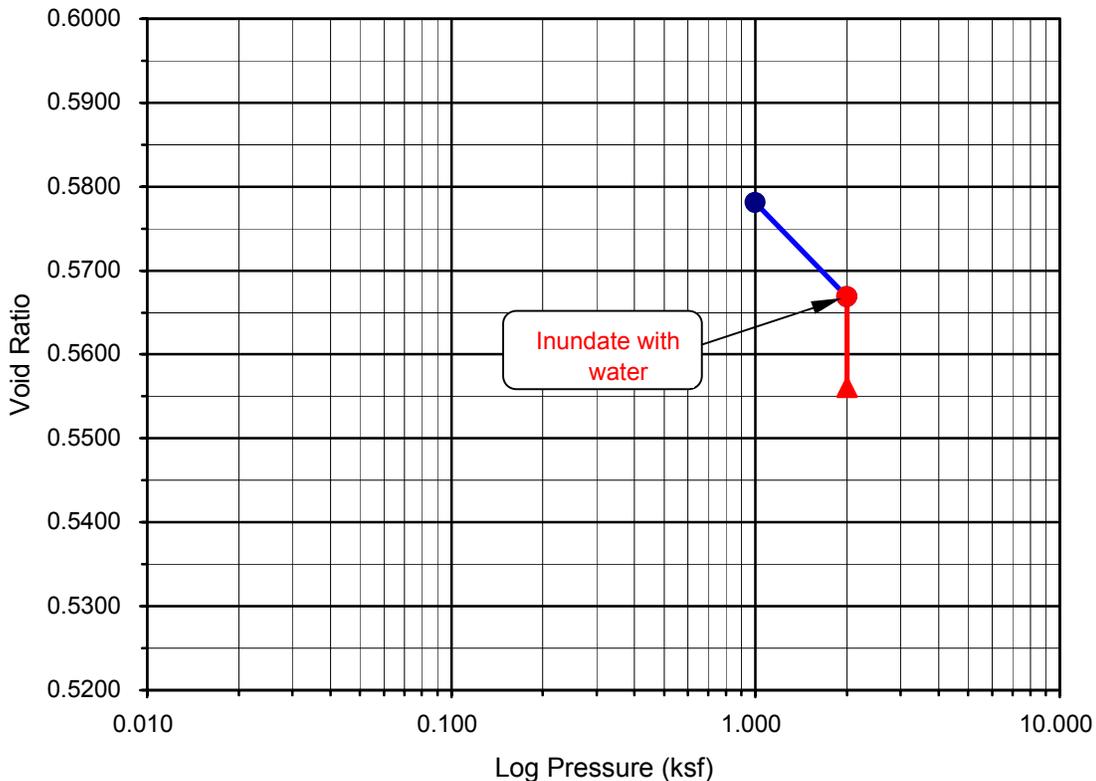
Initial Dry Density (pcf):	106.5
Initial Moisture (%):	5.6
Initial Length (in.):	1.0000
Initial Dial Reading:	0.0500
Diameter(in):	2.416

Final Dry Density (pcf):	108.3
Final Moisture (%):	19.8
Initial Void ratio:	0.5835
Specific Gravity(assumed):	2.70
Initial Saturation (%):	26.0

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
1.000	0.0534	0.9966	0.00	-0.34	0.5781	-0.34
2.000	0.0605	0.9895	0.00	-1.05	0.5668	-1.05
H2O	0.0673	0.9827	0.00	-1.73	0.5561	-1.73

**Percent Swell / Settlement After Inundation = -0.69**

**Void Ratio - Log Pressure Curve**





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

Project Name: VICTORIA GROVE  
Project No.: 111446-001  
Boring No.: LB-2  
Sample No.: R-4  
Sample Description: SM, BROWN SILTY SAND

Tested By: JMD Date: 2/3/05  
Checked By: PRC Date: 2/7/05  
Sample Type: IN SITU  
Depth (ft.): 10

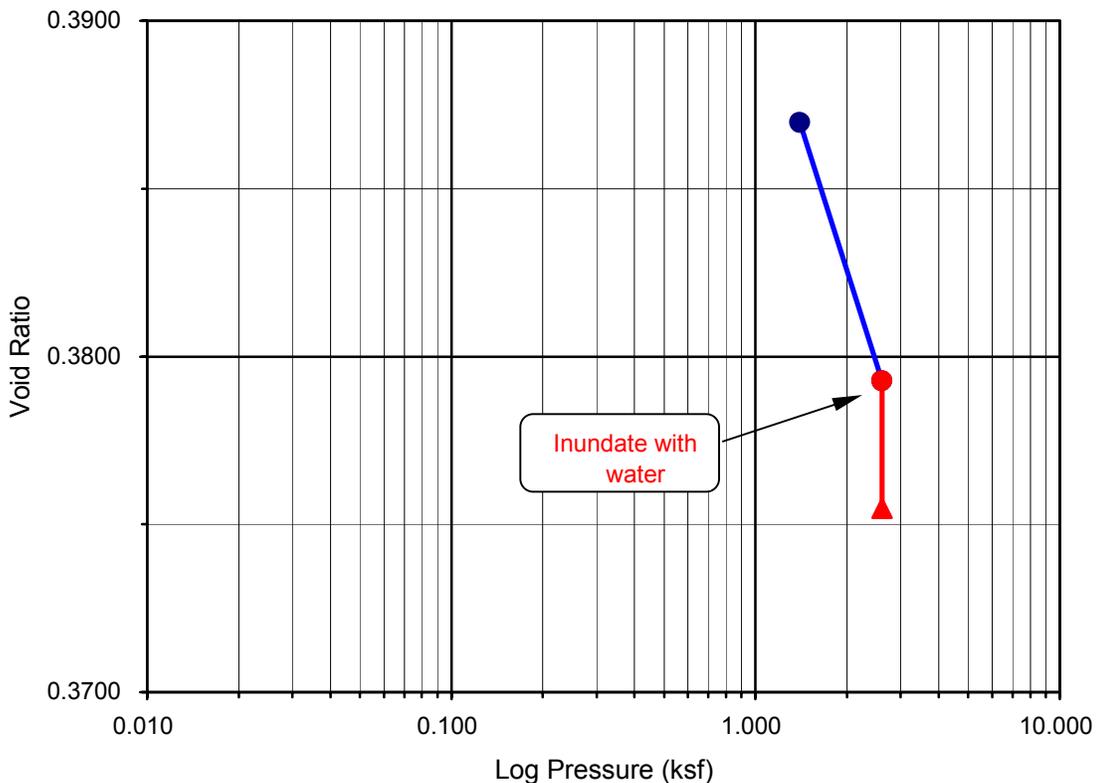
Initial Dry Density (pcf):	120.3
Initial Moisture (%):	10.5
Initial Length (in.):	1.0000
Initial Dial Reading:	0.0500
Diameter(in):	2.416

Final Dry Density (pcf):	122.5
Final Moisture (%):	14.6
Initial Void ratio:	0.4008
Specific Gravity(assumed):	2.70
Initial Saturation (%):	70.7

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
1.400	0.0599	0.9901	0.00	-0.99	0.3870	-0.99
2.600	0.0654	0.9846	0.00	-1.54	0.3793	-1.54
H2O	0.0681	0.9819	0.00	-1.81	0.3755	-1.81

**Percent Swell / Settlement After Inundation = -0.27**

**Void Ratio - Log Pressure Curve**





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

Project Name: VICTORIA GROVE  
Project No.: 111446-001  
Boring No.: LB-2  
Sample No.: R-5  
Sample Description: SM, BROWN SILTY SAND

Tested By: JMD Date: 2/3/05  
Checked By: PRC Date: 2/7/05  
Sample Type: IN SITU  
Depth (ft.): 12.5

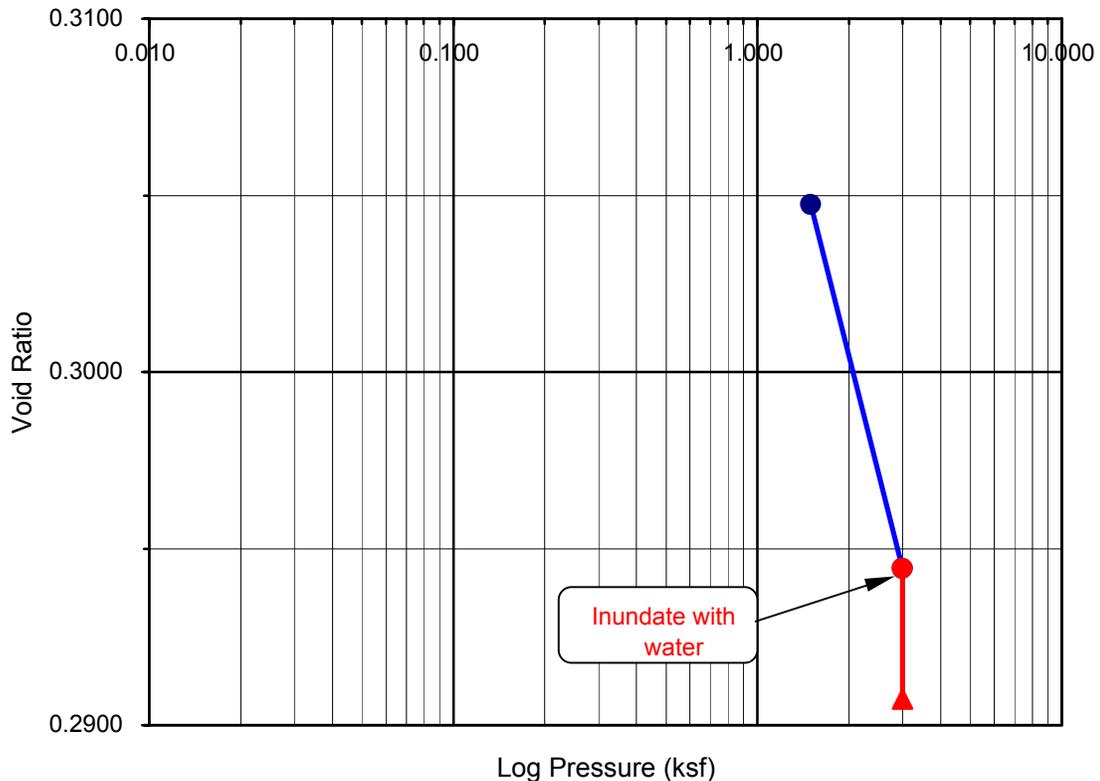
Initial Dry Density (pcf):	127.6
Initial Moisture (%):	10.7
Initial Length (in.):	1.0000
Initial Dial Reading:	0.0500
Diameter(in):	2.416

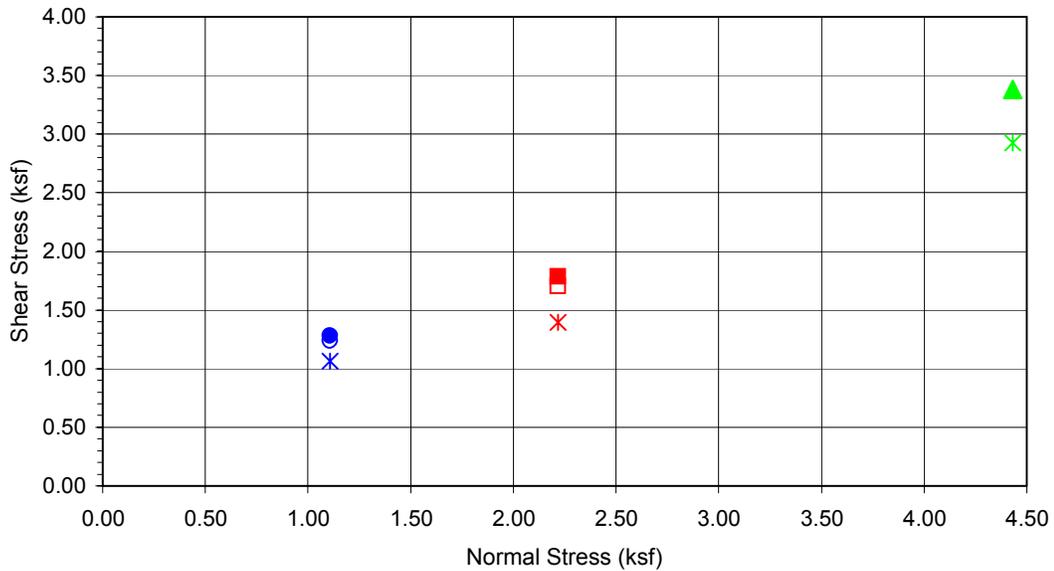
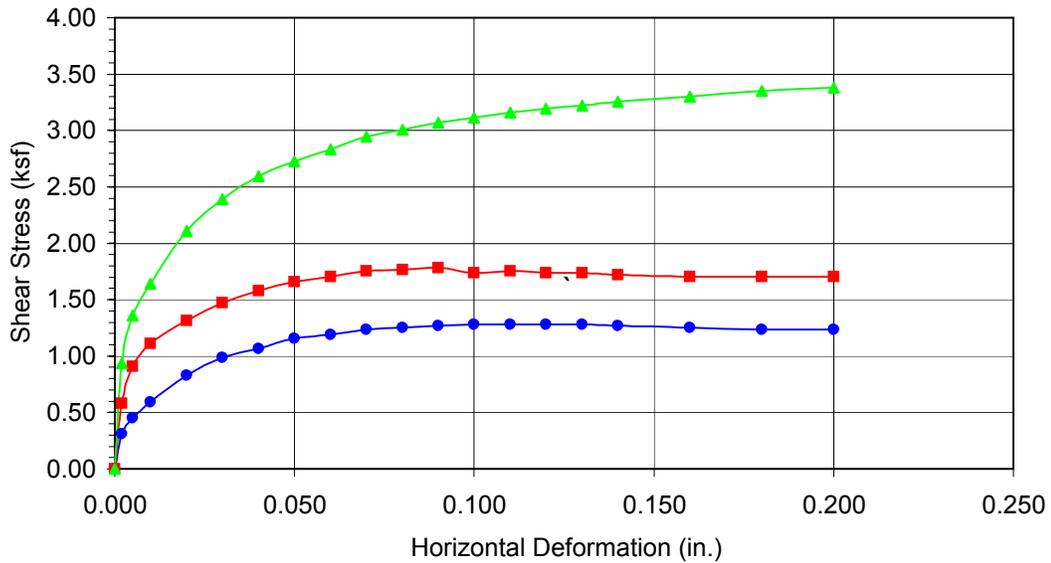
Final Dry Density (pcf):	130.6
Final Moisture (%):	13.2
Initial Void ratio:	0.3206
Specific Gravity(assumed):	2.70
Initial Saturation (%):	89.9

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
1.500	0.0620	0.9880	0.00	-1.20	0.3047	-1.20
3.000	0.0698	0.9802	0.00	-1.98	0.2944	-1.98
H2O	0.0726	0.9774	0.00	-2.26	0.2907	-2.26

**Percent Swell / Settlement After Inundation = -0.29**

**Void Ratio - Log Pressure Curve**





Normal Stress (kip/ft <sup>2</sup> )	1.108	2.216	4.432
Peak Shear Stress (kip/ft <sup>2</sup> )	● 1.283	■ 1.784	▲ 3.380
Shear Stress @ End of Test (ksf)	○ 1.236	□ 1.706	△ 3.380
Relaxed Value (ksf)	× 1.064	× 1.393	× 2.927
Deformation Rate (in./min.)	0.010	0.010	0.010
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.416	2.416	2.416
Initial Moisture Content (%)	9.0	9.0	9.0
Dry Density (pcf)	119.1	119.1	119.1
Saturation (%)	58.5	58.5	58.5
Soil Height Before Shearing (in.)	N/A	N/A	N/A
Final Moisture Content (%)	21.6	19.7	20.8

### DIRECT SHEAR TEST RESULTS

Consolidated Drained - ASTM D 3080  
Sample Remolded to 92% Relative Compaction

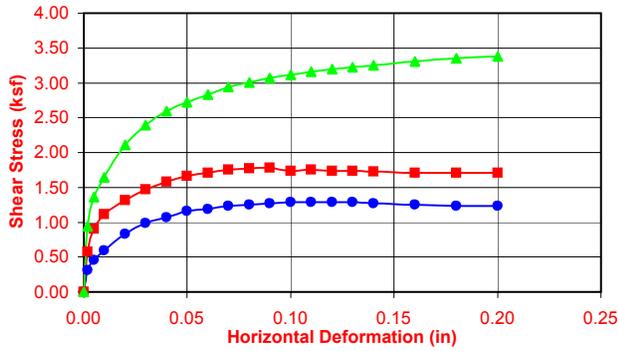
Boring No.: LB-2  
Sample No.: R-1  
Depth (ft): 2.5  
Soil Description: ML, BROWN SANDY SILT

Project No.: 111446-001

VICTORIA GROVE



Leighton and Associates, Inc.



	Load 1	Load 2	Load 3
Normal Stress (kg)	16	32	64
Normal Stress (psf)	1108	2216	4432
Load Factor:	15.65	15.65	15.65
Max. Stress (ksf)	1.28	1.78	3.38
Stress @ end of Test	1.24	1.71	3.38
Shear Rate (in/min)	0.01	0.01	0.01

Load 1		
Horiz. Displacement (in.)	Proving Ring Dial Rdg.	Proving Ring Dial Rdg. (ksf)
0.000	0	0.00
0.002	20	0.31
0.005	29	0.45
0.010	38	0.59
0.020	53	0.83
0.030	63	0.99
0.040	68	1.06
0.050	74	1.16
0.060	76	1.19
0.070	79	1.24
0.080	80	1.25
0.090	81	1.27
0.100	82	1.28
0.110	82	1.28
0.120	82	1.28
0.130	82	1.28
0.140	81	1.27
0.160	80	1.25
0.180	79	1.24
0.200	79	1.24
0.200	68	1.06

RELAXED

Load 2	
Proving Ring Dial Rdg.	Proving Ring Dial Rdg. (ksf)
0	0.00
37	0.58
58	0.91
71	1.11
84	1.31
94	1.47
101	1.58
106	1.66
109	1.71
112	1.75
113	1.77
114	1.78
111	1.74
112	1.75
111	1.74
111	1.74
110	1.72
109	1.71
109	1.71
109	1.71
89	1.39

RELAXED

Load 3	
Proving Ring Dial Rdg.	Proving Ring Dial Rdg. (ksf)
0	0.00
60	0.94
87	1.36
105	1.64
135	2.11
153	2.39
166	2.60
174	2.72
181	2.83
188	2.94
192	3.00
196	3.07
199	3.11
202	3.16
204	3.19
206	3.22
208	3.26
211	3.30
214	3.35
216	3.38
187	2.93

## DIRECT SHEAR TEST

ASTM D 3080

Project Name: <u>VICTORIA GROVE</u>	Tested By: <u>RGO</u>	Date: <u>2/3/05</u>
Project No.: <u>111446-001</u>	Checked By: <u>PRC</u>	Date: <u>2/7/05</u>
Boring No.: <u>LB-2</u>	Sample Type: <u>REMOLDED</u>	
Sample No.: <u>R-1</u>	Depth (ft.): <u>2.5</u>	
Sample Description: <u>ML, BROWN SANDY SILT</u>		

Sample Diameter(in):	2.416	2.416	2.416
Sample Thickness(in.):	1.000	1.000	1.000
Weight of Sample + ring(gm):	201.7	199.9	203.0
Weight of Ring(gm):	45.5	43.7	46.8
<b>Before Shearing</b>			
Weight of Wet Sample+Cont.(gm):	201.7	199.9	203.0
Weight of Dry Sample+Cont.(gm):	188.8	187.0	190.1
Weight of Container(gm):	45.5	43.7	46.8
Vertical Rdg.(in): Initial	No measurements of height change is being done during consolidation of sample		
Vertical Rdg.(in): Final			
<b>After Shearing</b>			
Weight of Wet Sample+Cont.(gm):	219.8	215.2	219.9
Weight of Dry Sample+Cont.(gm):	188.8	187.0	190.1
Weight of Container(gm):	45.5	43.7	46.8
Specific Gravity (Assumed):	2.70	2.70	2.70
Water Density(pcf):	62.43	62.43	62.43

Rev. 08-04

### REMOLD DATA

MAX DENS.	OPTIMUM %	% REM.	RING WTS.	CAN MOIST.
129.5	9.0	92	45.5	13.0
		= 119.14	43.7	
			46.8	

CONV. FACTOR	DRY SOIL	ADD TO 500 g	GRAMS PER RING
1.203	143.3	-17.7	156.2

## APPENDIX C

### EARTHWORK AND GRADING SPECIFICATIONS

LEIGHTON AND ASSOCIATES, INC.  
GENERAL EARTHWORK AND GRADING SPECIFICATIONS FOR ROUGH GRADING

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Standard Details

A - Keying and Benching	Rear of Text
B - Oversize Rock Disposal	Rear of Text
C - Canyon Subdrains	Rear of Text
D - Buttress or Replacement Fill Subdrains	Rear of Text
E - Transition Lot Fills and Side Hill Fills	Rear of Text
Retaining Wall	Rear of Text

## 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. 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).

### 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). 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.

#### 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. 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 OSHA and Cal/OSHA requirements for safety of trench excavations.

### 7.2 Bedding and Backfill

All bedding and backfill of utility trenches shall be performed 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 relative compaction 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.

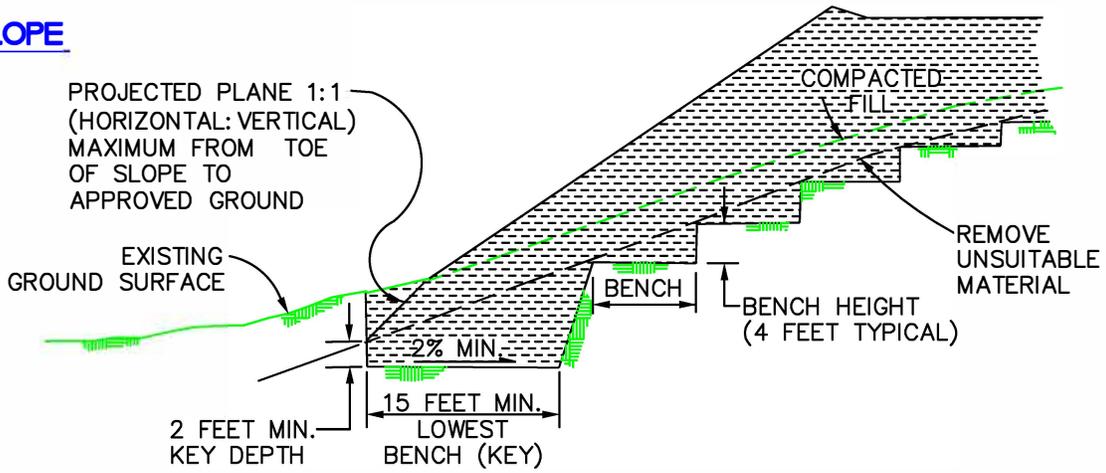
### 7.3 Lift Thickness

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.

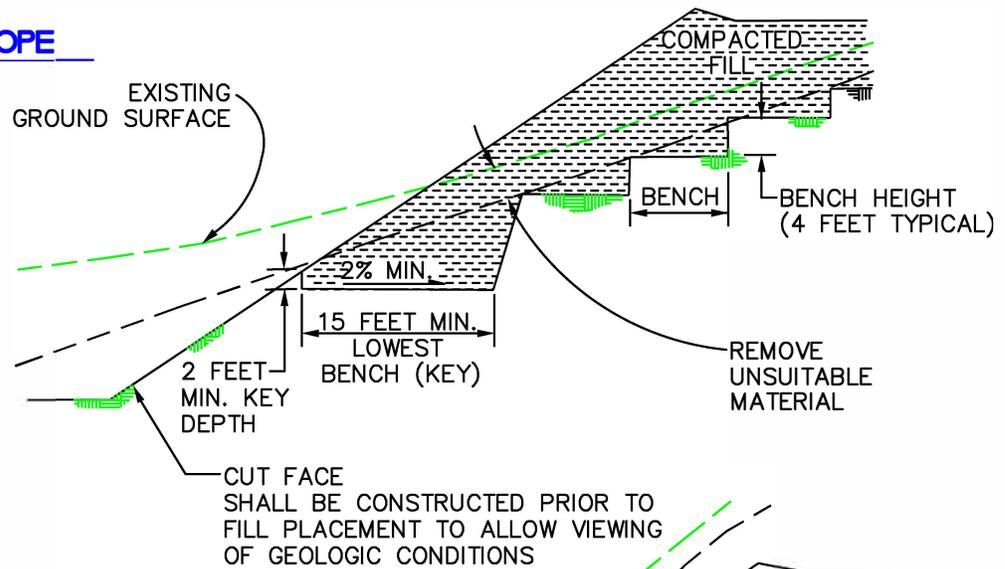
### 7.4 Observation and Testing

The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

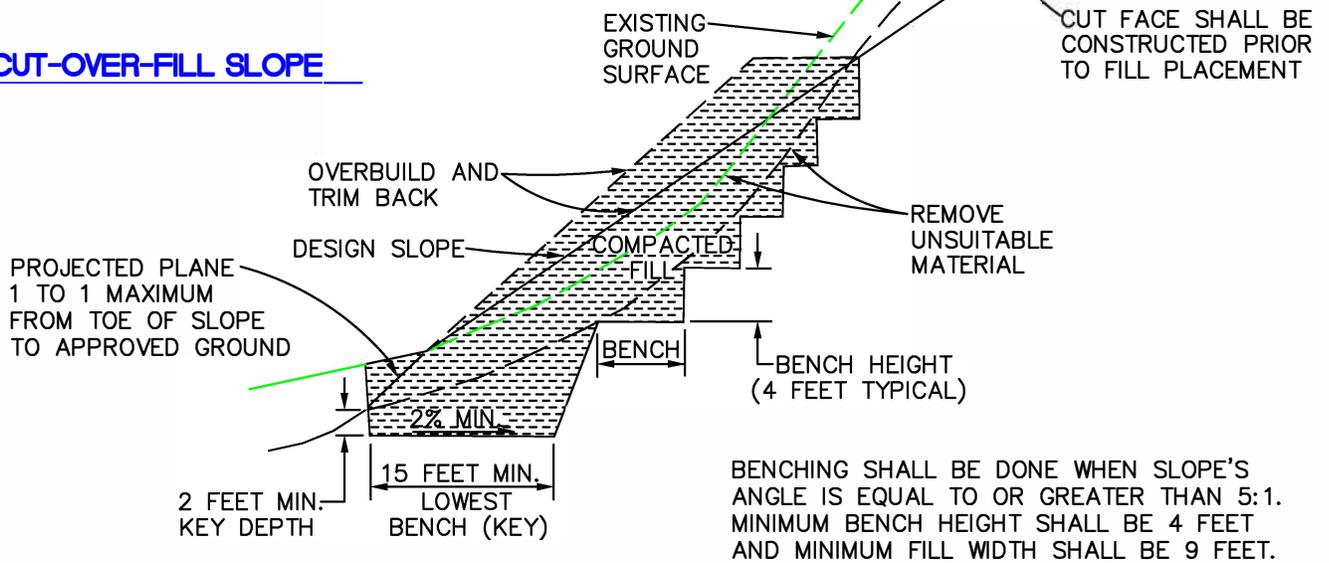
**FILL SLOPE**

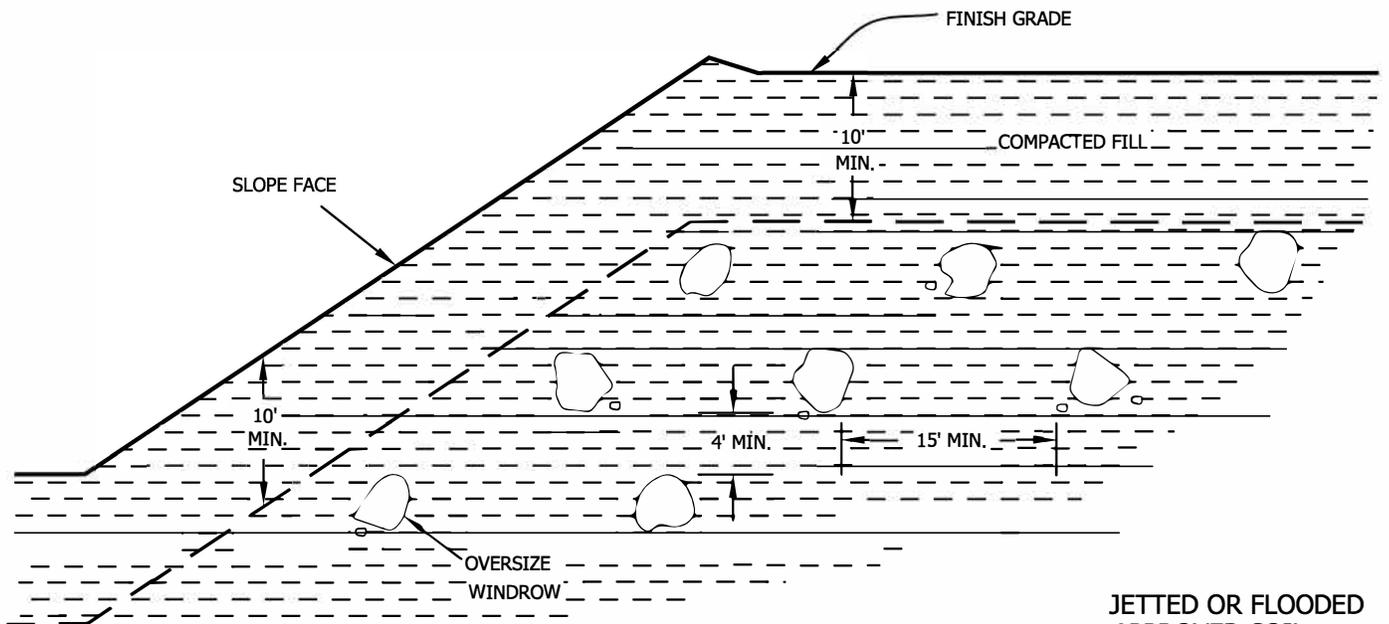


**FILL-OVER-CUT SLOPE**

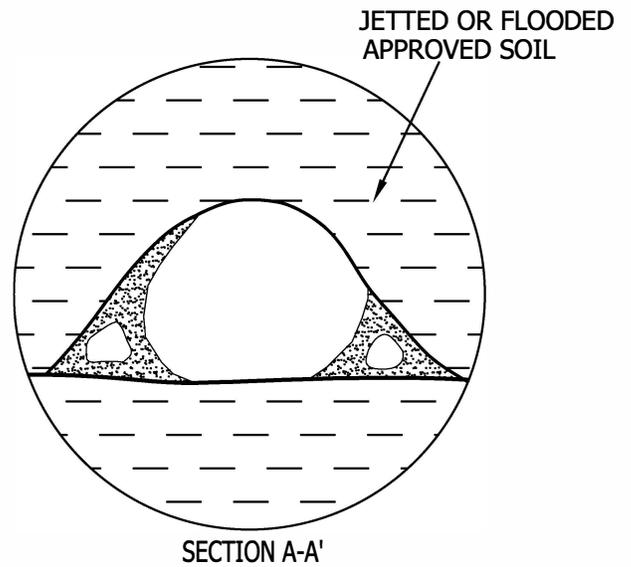


**CUT-OVER-FILL SLOPE**

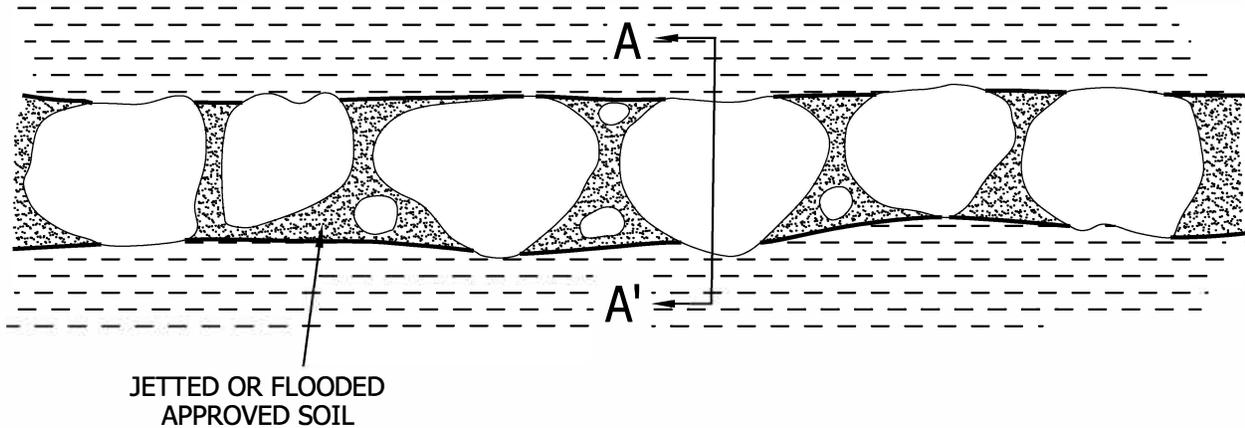




- Oversize rock is larger than 8 inches in largest dimension.
- Backfill with approved soil jetted or flooded in place to fill all the voids.
- Do not bury rock within 10 feet of finish grade.
- Windrow of buried rock shall be parallel to the finished slope face.



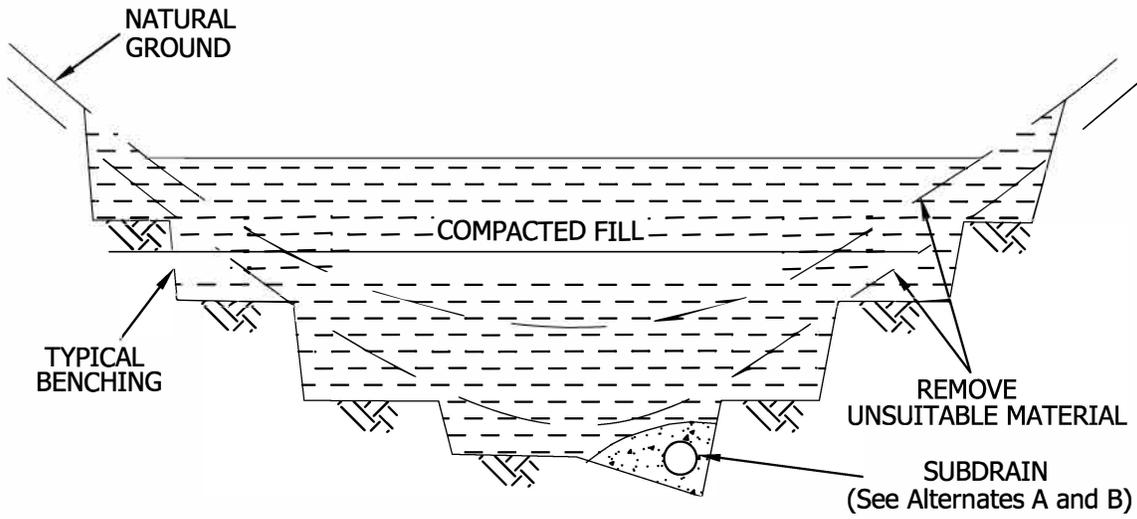
PROFILE ALONG WINDROW



**OVERSIZE ROCK DISPOSAL**

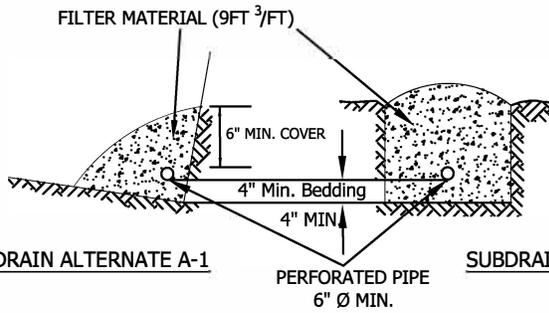
GENERAL EARTHWORK AND GRADING  
SPECIFICATIONS  
STANDARD DETAILS B





**SUBDRAIN ALTERNATE A**

PERFORATED PIPE SURROUNDED WITH FILTER MATERIAL

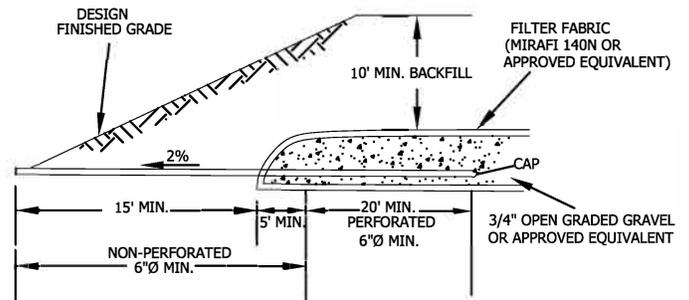
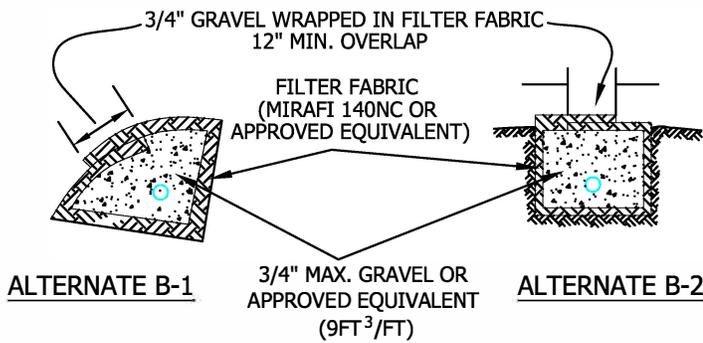


**FILTER MATERIAL**  
 FILTER MATERIAL SHALL BE CLASS 2 PERMEABLE MATERIAL PER STATE OF CALIFORNIA STANDARD SPECIFICATION, OR APPROVED ALTERNATE. CLASS 2 GRADING AS FOLLOWS:

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

**SUBDRAIN ALTERNATE B**

**DETAIL OF CANYON SUBDRAIN TERMINAL**

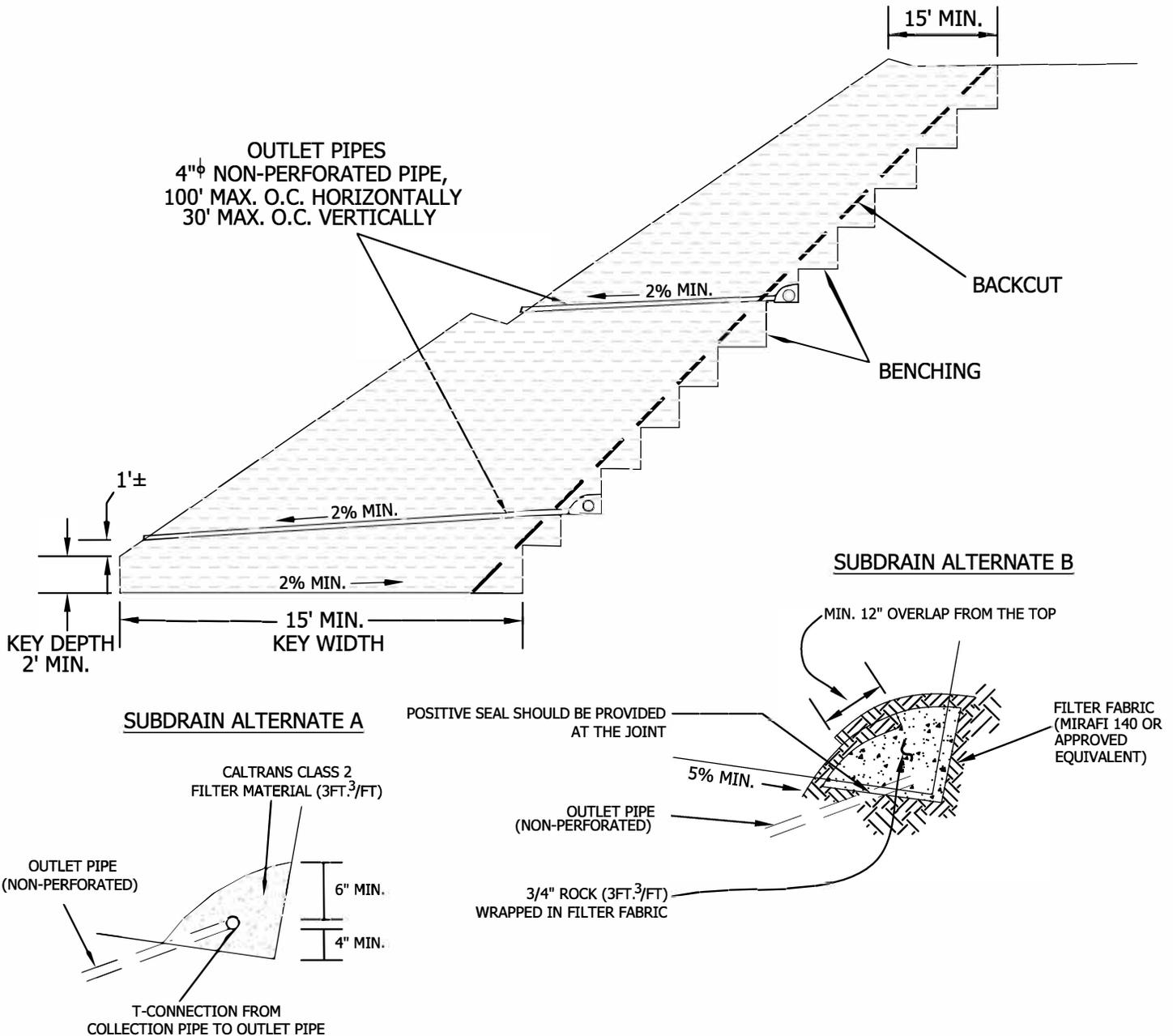


○ PERFORATED PIPE IS OPTIONAL PER GOVERNING AGENCY'S REQUIREMENTS

CANYON  
SUBDRAIN

GENERAL EARTHWORK AND GRADING  
SPECIFICATIONS  
STANDARD DETAILS C





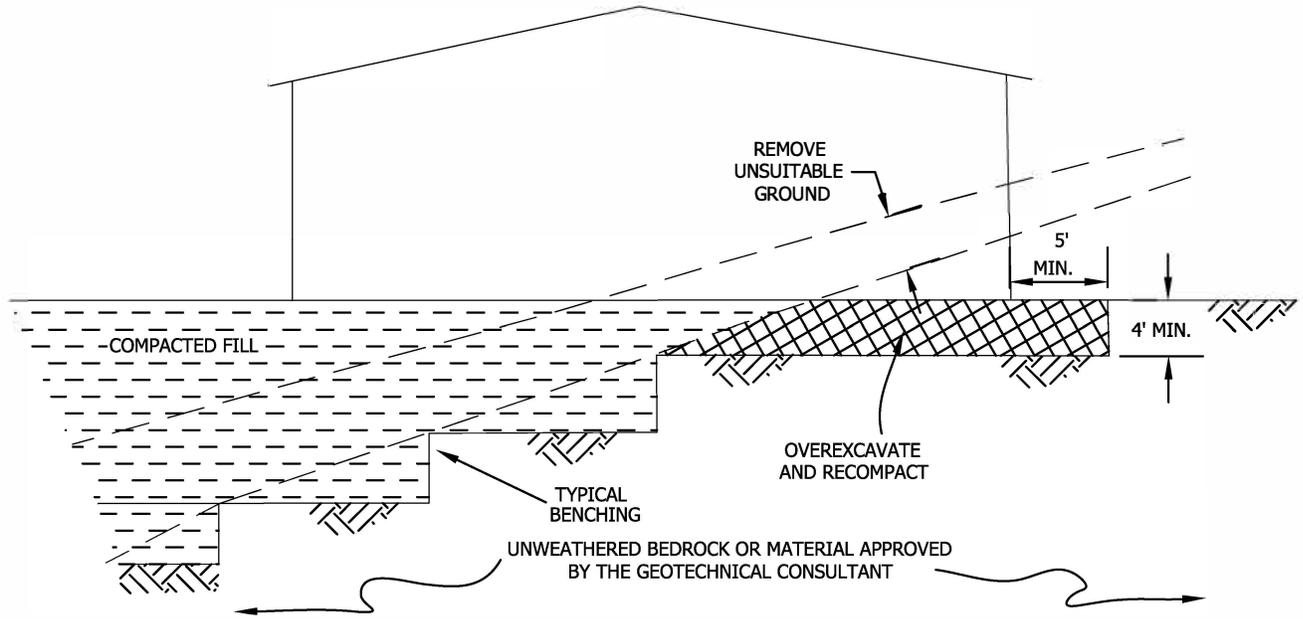
- **SUBDRAIN INSTALLATION** - Subdrain collector pipe shall be installed with perforations down or, unless otherwise designated by the geotechnical consultant. Outlet pipes shall be non-perforated pipe. The subdrain pipe shall have at least 8 perforations uniformly spaced per foot. Perforation shall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

**BUTTRESS OR  
REPLACEMENT FILL  
SUBDRAINS**

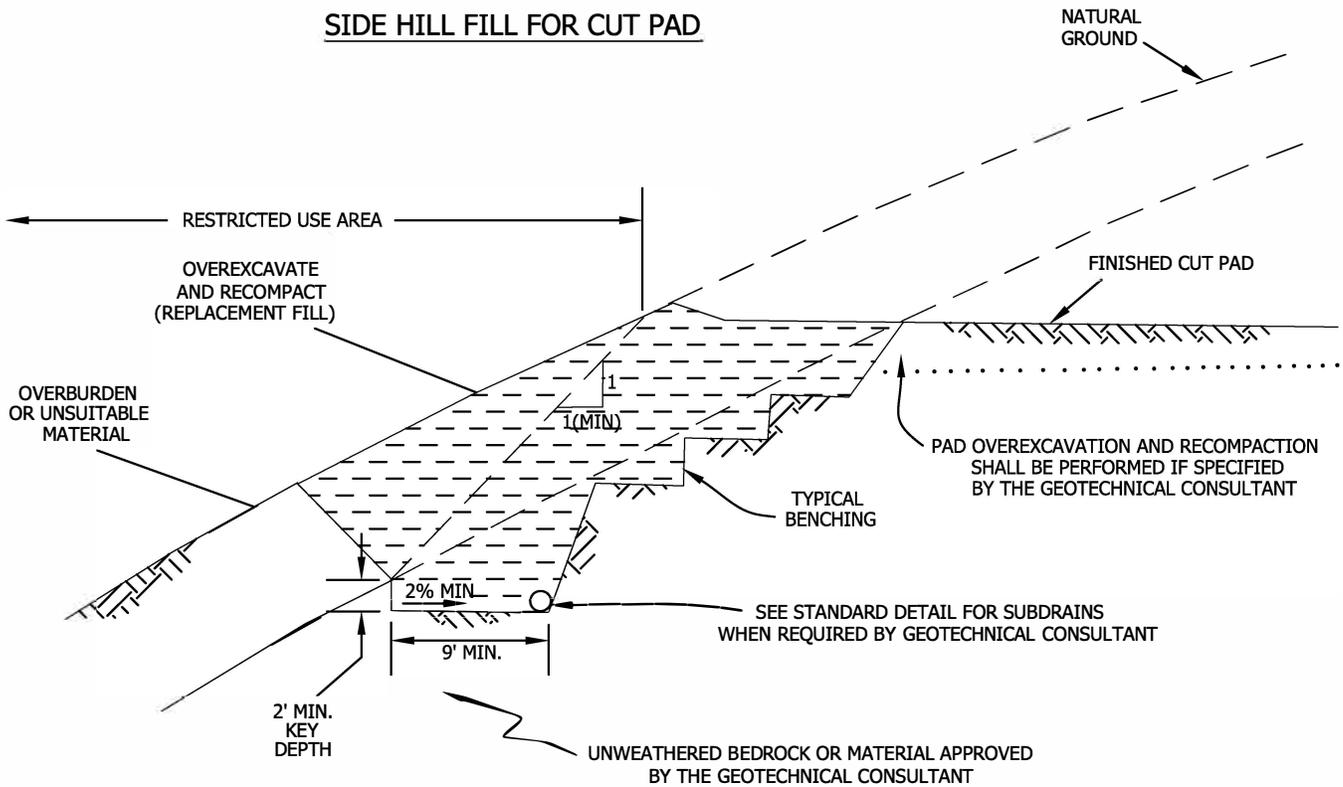
**GENERAL EARTHWORK AND GRADING  
SPECIFICATIONS  
STANDARD DETAILS D**



**CUT-FILL TRANSITION LOT OVEREXCAVATION**



**SIDE HILL FILL FOR CUT PAD**

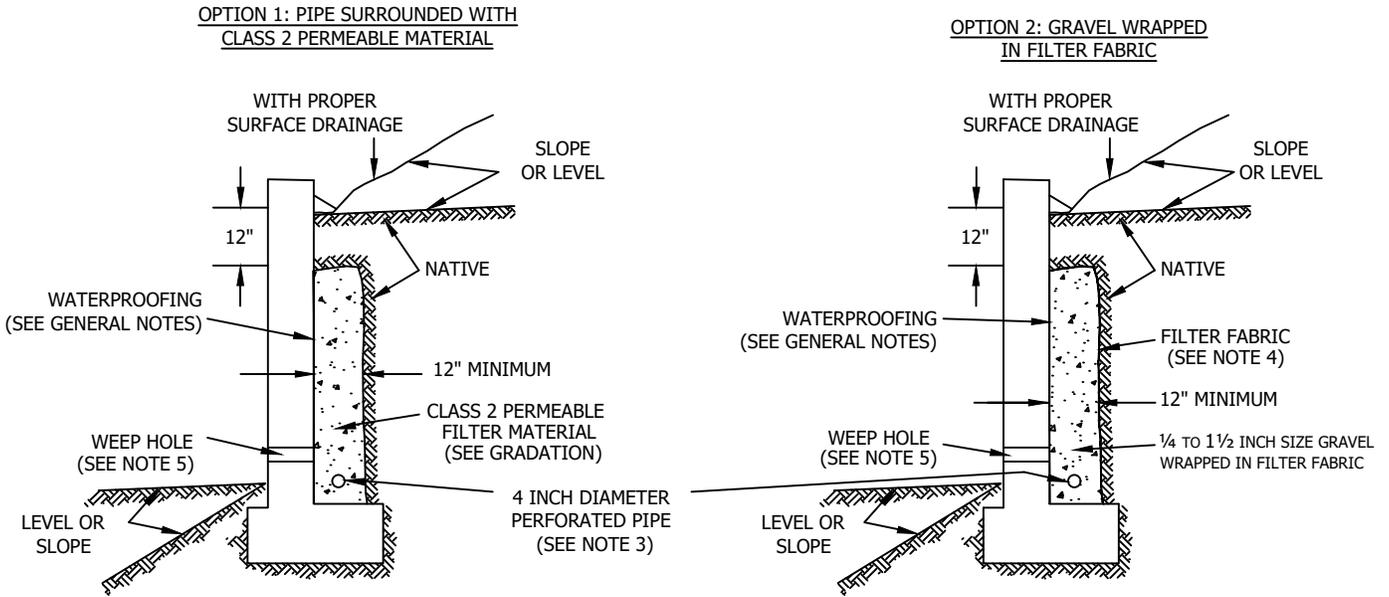


**TRANSITION LOT FILLS  
AND SIDE HILL FILLS**

**GENERAL EARTHWORK AND GRADING  
SPECIFICATIONS  
STANDARD DETAILS E**



**SUBDRAIN OPTIONS AND BACKFILL WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF  $\leq 50$**



Class 2 Filter Permeable Material Gradation  
Per Caltrans Specifications

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

**GENERAL NOTES:**

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

**Notes:**

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

**RETAINING WALL BACKFILL AND SUBDRAIN DETAIL  
FOR WALLS 6 FEET OR LESS IN HEIGHT  
WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF  $\leq 50$**



V:\DRAFTING\TEMP\ATES\STANDARD-FIGURES\STANDARD-FIGURES.DWG (04.02.21 10:55AM) Plotted by: bham

## APPENDIX D

### GBA IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL ENGINEERING REPORT

# Important Information about This

# Geotechnical-Engineering Report

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

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

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

## Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

## Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer

will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

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

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

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

## Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

## You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

### Most of the “Findings” Related in This Report Are Professional Opinions

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

### This Report’s Recommendations Are Confirmation-Dependent

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

### This Report Could Be Misinterpreted

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

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals’ plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

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

### Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note*

*conspicuously that you’ve included the material for information purposes only.* To avoid misunderstanding, you may also want to note that “informational purposes” means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

### Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled “limitations,” many of these provisions indicate where geotechnical engineers’ responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

### Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a “phase-one” or “phase-two” environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

### Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer’s services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer’s recommendations will not of itself be sufficient to prevent moisture infiltration.* **Confront the risk of moisture infiltration** by including building-envelope or mold specialists on the design team. **Geotechnical engineers are not building-envelope or mold specialists.**



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# Appendix 4: Historical Site Conditions

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

*Not Applicable*

# Appendix 5: LID Infeasibility

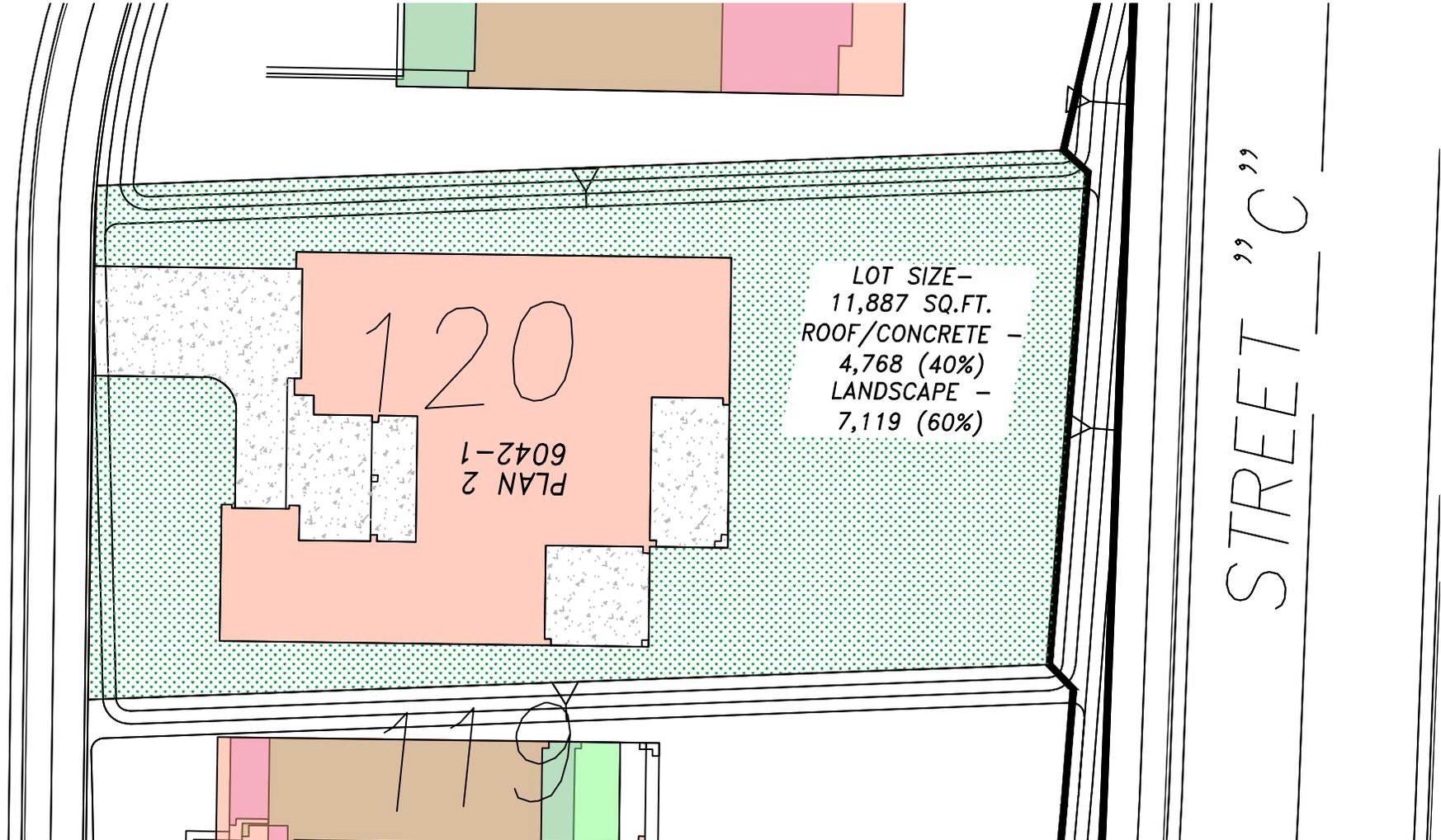
*LID Technical Infeasibility Analysis*

*Not Applicable*

# Appendix 6: BMP Design Details

*BMP Sizing, Design Details and other Supporting Documentation*

# AVERAGE LOT SIZE





<b>Extended Detention Basin Design Procedure</b>	BMP Subarea No. <b>EDB1</b>	Legend:	Required Entries
			Calculated Cells

Company Name:	<b>ADKAN ENGINEERS</b>	Date:	<b>4-15-24'</b>
Designed by:	<b>ALEX YE</b>	County/City Case No.:	

**Design Volume**

Tributary Area (BMP Subarea)  $A_T = 26.87$  acres

Enter  $V_{BMP}$ , determined from Section 2.1 of this Handbook  $V_{BMP} = 29,048$  ft<sup>3</sup>

**Basin Footprint**

**Overall Geometry**

Length at Basin Bottom Surface Length = 296 ft

Width at Basin Bottom Surface Width = 191 ft

Meets 1.5 : 1 requirement?

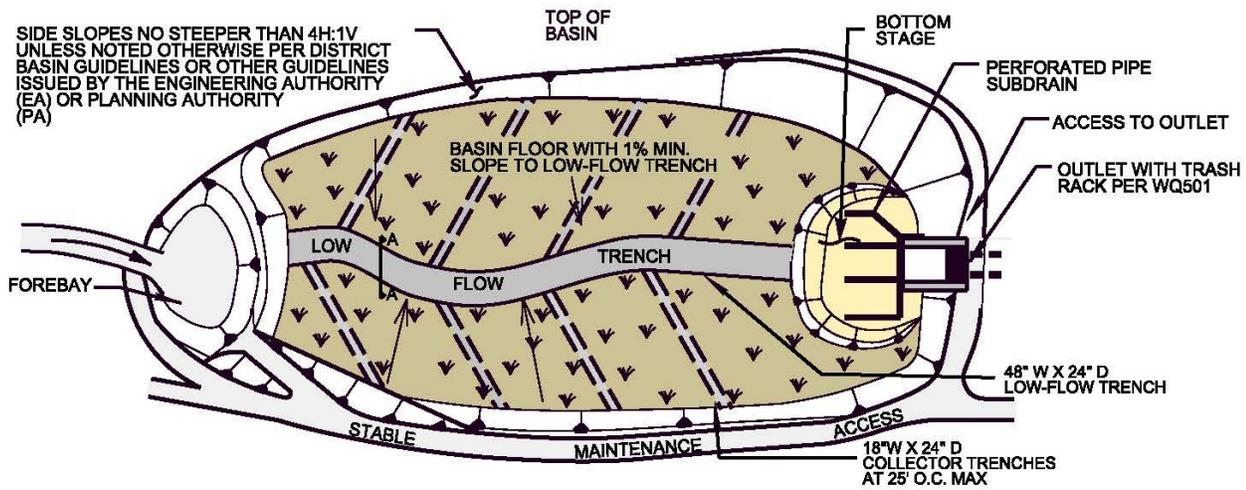
Side Slopes per "Basin Guidelines", Sect. 1.2  $z = 4$  :1

Proposed Basin Depth (with no freeboard)  $D_B = 3.00$  ft

Depth of freeboard (if used)  $D_{FB} = 0.50$  ft

Minimum Required Allowance for Total Depth (including proposed basin depth, freeboard, minimum depth of bottom stage ( $D_{BS}=0.33'$ ) and minimum filter depth ( $D_{FD}=2.33'$ ))  $D_{REQ} = 6.2$  ft

Depth from design water surface elevation to lowest orifice  $D_O = 3.0$  ft



## Basin Design

### Basin Design

Proposed Total Basin Depth (proposed depth plus freeboard)

$$D_{TOT} = 3.50 \text{ ft}$$

Basin Invert Longitudinal Slope

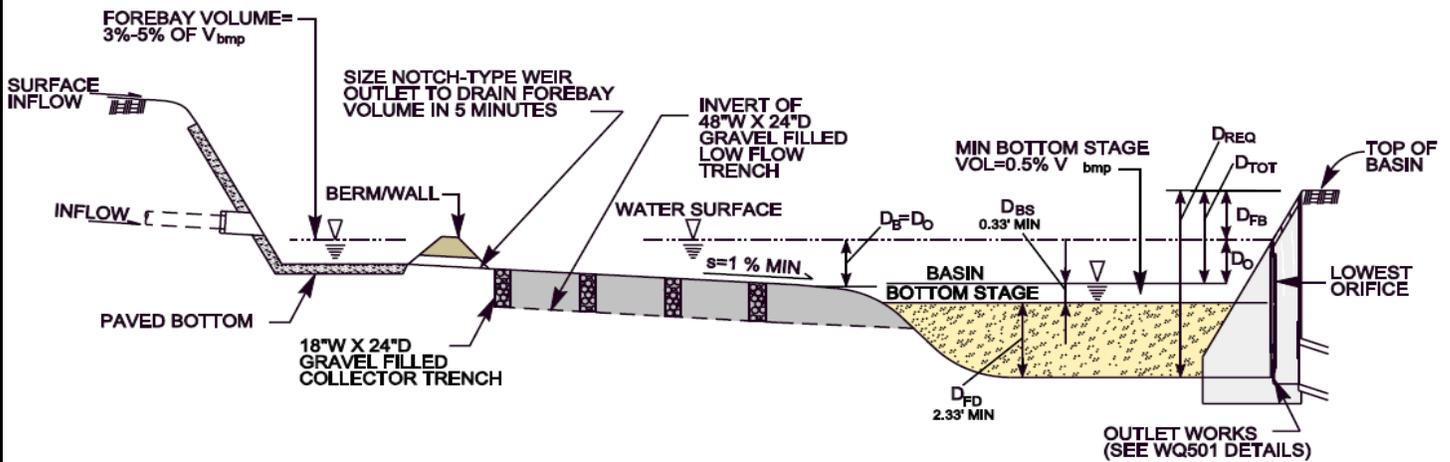
$$\text{Slope} = 1.00 \%$$

Basin Invert Transverse Slope (1% min)

$$\text{Slope} = 1 \%$$

Basin Volume

$$V_{Basin} = 106966 \text{ ft}^3$$



## Forebay Design

Forebay Volume (3 - 5%  $V_{BMP}$ )

$$V_{FB} = 1452 \text{ ft}^3$$

Forebay Depth (height of berm)

$$D_{FBY} = 1 \text{ ft}$$

Minimum Forebay Surface Area

$$A_{FB} = 1452 \text{ ft}^2$$

Rectangular weir (notch)

$$W = 18.00 \text{ in}$$

**Low-Flow Trench** (see graphic below)

Depth (24 inches minimum, gravel filled)

Depth =  24 inches

Width (48 inches minimum)

Width =  48 inches

Trench Invert Longitudinal Slope

Slope =  1 %

**Collector Trenches** (see graphic below)

Depth (24 inches minimum)

Depth =  24 inches

Width (18 inches minimum)

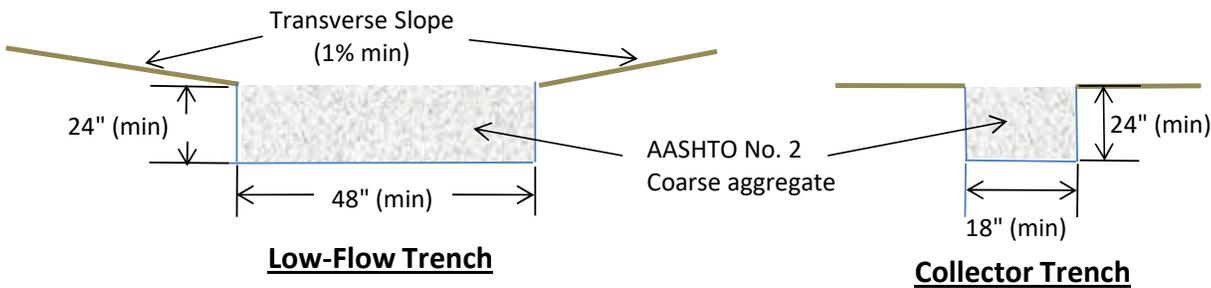
Width =  18 inches

Trench Invert Longitudinal Slope

Slope =  1 %

Spacing (25 feet on center maximum)

S =  25 feet



**Bottom Stage (Sand Filter) Design**

Depth of the Bottom Stage (4" minimum ponding)

$D_{BS} =$   4 in

Surface Area of Bottom Stage

$A_{BS} =$   30759 ft<sup>2</sup>

Dry Weather Poned Volume (above sand layer)

$V_{BS} =$   10253 ft<sup>3</sup>

Is  $V_{BS}$  no less than 0.5%  $V_{BMP}$ ? **OK**

Depth of ASTM-C33 sand (18 inch minimum)

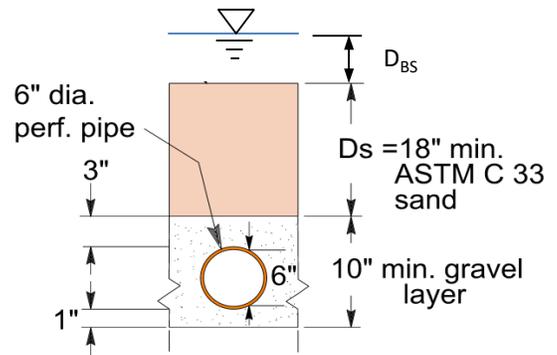
$D_s =$   18 inches

Diameter of Subdrains

$\phi =$   6 in

Subdrain Spacing

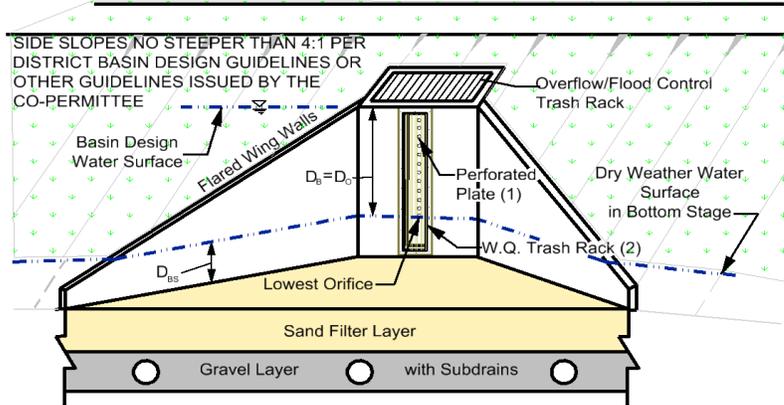
$s =$   6 ft. on center



## Basin Outlet Design

### Outlet Design

Assume an orifice area. Based on the information provided above, the spreadsheet provides discharge vs. stage data. Enter the volume vs. stage data for each interval. This information is used to route the volume through the basin. The size of the orifice is acceptable when the data shows that less than 50% of  $V_{BMP}$  has drained in 24 hours, and that 100% drawdown occurs within 72 hours.



### Flow Rate, Q (cfs)

$$Q = CA[2g(H-H_o)]^{0.5}$$

Discharge Coefficient,

Default, C = 0.66

Other, C = 0.66

### Orifice Area (ft<sup>2</sup>)

Orifice Diameter, d; number of orifices per row, n; and number of orifice rows, N (from the bottom up).

d = 2.97 inches

n = 1 per row

N = 1 rows

A<sub>eff</sub> = 0.048 ft<sup>2</sup> per row

or

A<sub>eff</sub> = 6.924 in<sup>2</sup> per row

From outflow hydrograph, the time where 50% of  $V_{BMP}$  has drained from the basin (24 hour minimum):

Time (50%) = 24.07 hrs

OK

From outflow hydrograph, the time where 100%  $V_{BMP}$  has drained from the basin (within 72 hours):

Time (100 %) = 70.92 hrs

OK

Headwater Elev. / Stage (ft)	Discharge (cfs)	Volume (acre-ft)	Δt (hrs.)
0	0.0000	0.0000	
0.33	0.1470	0.250	41.16
0.67	0.2080	0.500	17.04
1.00	0.2547	0.743	12.71
1.33	0.2941	1.020	
1.67	0.3288	1.290	
2.00	0.3602	1.561	
2.33	0.3890	1.861	
2.67	0.4159	2.161	
3.00	0.4411	2.456	
3.33			
3.67			
4.00			
4.33			
4.67			
5.00			
5.33			
5.67			
6.00			
6.33			
6.67			
7.00			
7.33			
7.67			
8.00			
8.33			
8.67			
9.00			
9.33			
9.67			
10.00			
Σ =			70.92

Notes:



<b>Extended Detention Basin Design Procedure</b>		BMP Subarea No. <b>EDB2</b>	Legend:	Required Entries
Company Name: <b>ADKAN ENGINEERS</b>				Calculated Cells
Designed by: <b>ALEX YE</b>				Date: <b>4-26-24'</b>
				County/City Case No.:

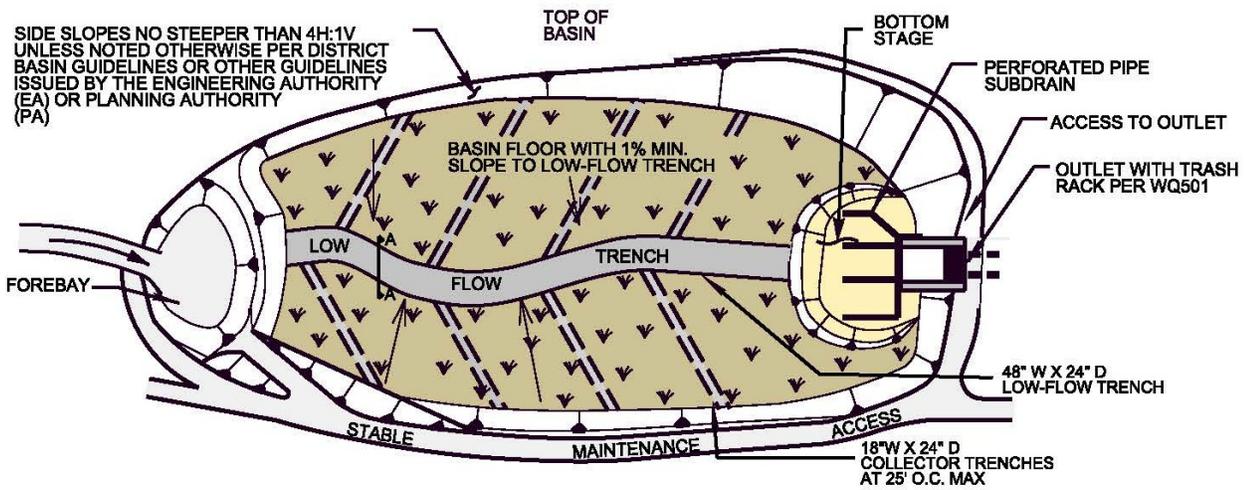
**Design Volume**

Tributary Area (BMP Subarea) A<sub>T</sub> = **51.92** acres  
 Enter V<sub>BMP</sub>, determined from Section 2.1 of this Handbook V<sub>BMP</sub> = **47,760** ft<sup>3</sup>

**Basin Footprint**

**Overall Geometry**

Length at Basin Bottom Surface Length = **203** ft  
 Width at Basin Bottom Surface Width = **96** ft  
Meets 1.5 : 1 requirement?   
 Side Slopes per "Basin Guidelines", Sect. 1.2 z = **4** :1  
 Proposed Basin Depth (with no freeboard) D<sub>B</sub> = **3.00** ft  
 Depth of freeboard (if used) D<sub>FB</sub> = **0.50** ft  
 Minimum Required Allowance for Total Depth (including proposed basin depth, freeboard, minimum depth of bottom stage (D<sub>BS</sub>=0.33') and minimum filter depth (D<sub>FD</sub>=2.33')) D<sub>REQ</sub> = **6.2** ft  
 Depth from design water surface elevation to lowest orifice D<sub>O</sub> = **3.0** ft



## Basin Design

### Basin Design

Proposed Total Basin Depth (proposed depth plus freeboard)

$$D_{TOT} = 3.50 \text{ ft}$$

Basin Invert Longitudinal Slope

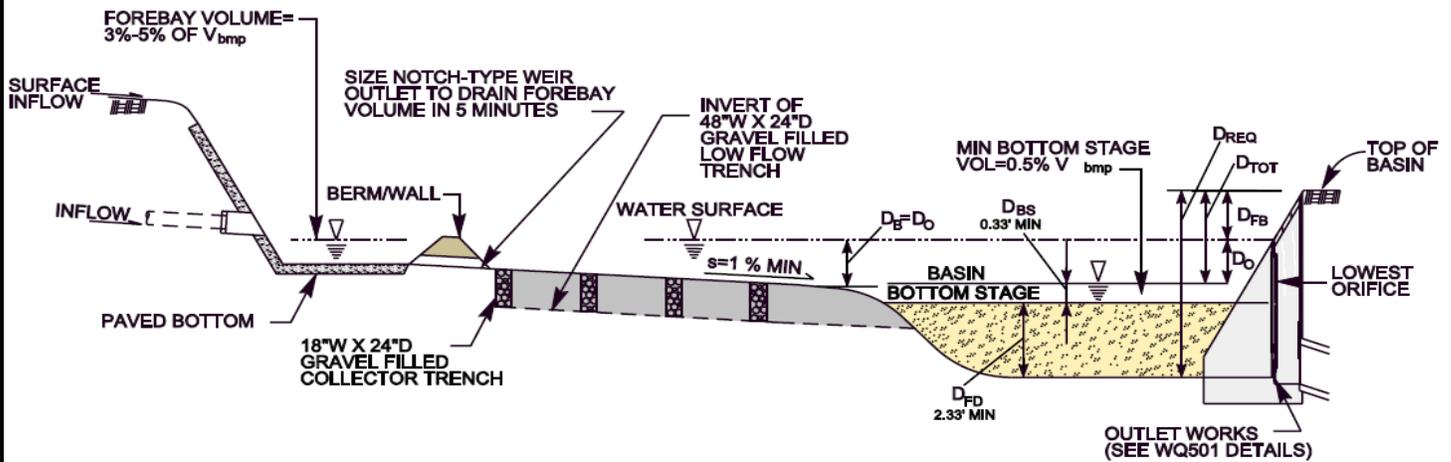
$$\text{Slope} = 1.00 \%$$

Basin Invert Transverse Slope (1% min)

$$\text{Slope} = 1 \%$$

Basin Volume

$$V_{Basin} = 118029 \text{ ft}^3$$



## Forebay Design

Forebay Volume (3 - 5%  $V_{BMP}$ )

$$V_{FB} = 2388 \text{ ft}^3$$

Forebay Depth (height of berm)

$$D_{FBY} = 1 \text{ ft}$$

Minimum Forebay Surface Area

$$A_{FB} = 2388 \text{ ft}^2$$

Rectangular weir (notch)

$$W = 18.00 \text{ in}$$

## Dry Weather and Low-Flow Management

### Low-Flow Trench (see graphic below)

Depth (24 inches minimum, gravel filled)

Depth =  24 inches

Width (48 inches minimum)

Width =  48 inches

Trench Invert Longitudinal Slope

Slope =  1 %

### Collector Trenches (see graphic below)

Depth (24 inches minimum)

Depth =  24 inches

Width (18 inches minimum)

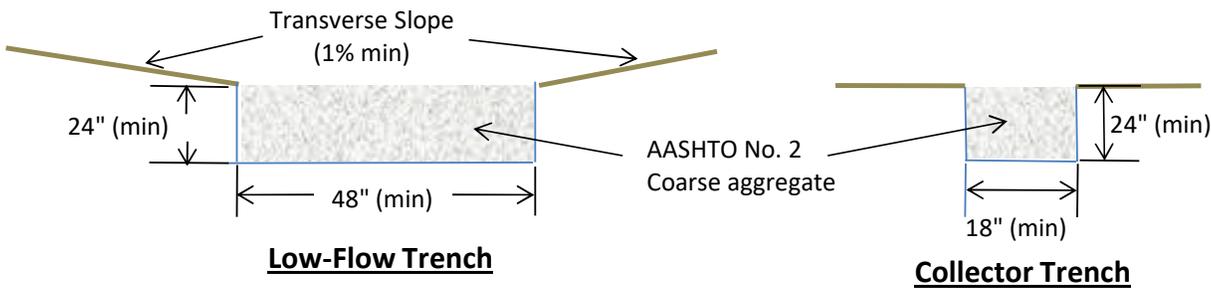
Width =  18 inches

Trench Invert Longitudinal Slope

Slope =  1 %

Spacing (25 feet on center maximum)

S =  25 feet



### Bottom Stage (Sand Filter) Design

Depth of the Bottom Stage (4" minimum ponding)

$D_{BS} =$   4 in

Surface Area of Bottom Stage

$A_{BS} =$   17097 ft<sup>2</sup>

Dry Weather Poned Volume (above sand layer)

$V_{BS} =$   5699 ft<sup>3</sup>

Is  $V_{BS}$  no less than 0.5%  $V_{BMP}$ ? **OK**

Depth of ASTM-C33 sand (18 inch minimum)

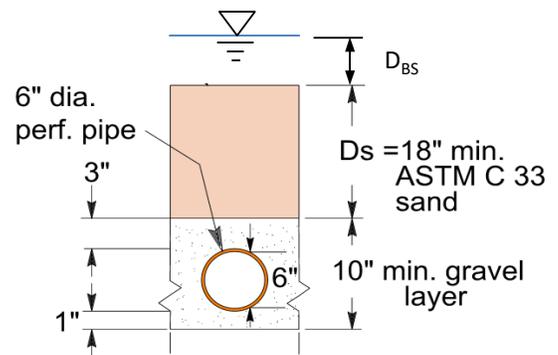
$D_s =$   18 inches

Diameter of Subdrains

$\phi =$   6 in

Subdrain Spacing

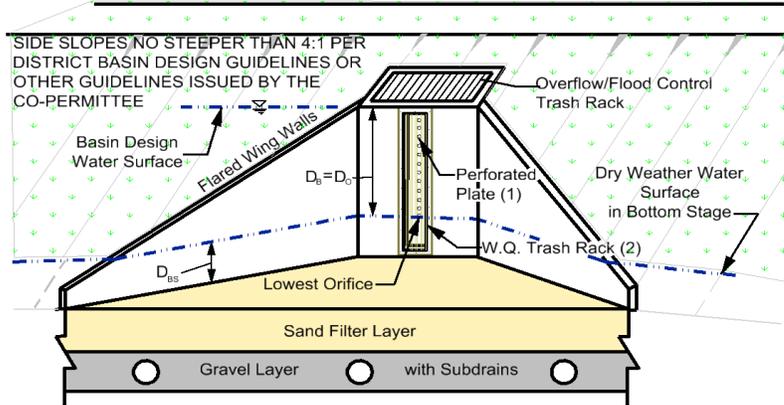
$s =$   6 ft. on center



## Basin Outlet Design

### Outlet Design

Assume an orifice area. Based on the information provided above, the spreadsheet provides discharge vs. stage data. Enter the volume vs. stage data for each interval. This information is used to route the volume through the basin. The size of the orifice is acceptable when the data shows that less than 50% of  $V_{BMP}$  has drained in 24 hours, and that 100% drawdown occurs within 72 hours.



### Flow Rate, Q (cfs)

$$Q = CA[2g(H-H_o)]^{0.5}$$

Discharge Coefficient,

Default, C = 0.66

Other, C = 0.66

### Orifice Area (ft<sup>2</sup>)

Orifice Diameter, d; number of orifices per row, n; and number of orifice rows, N (from the bottom up).

d = 3 inches

n = 1 per row

N = 1 rows

A<sub>eff</sub> = 0.049 ft<sup>2</sup> per row

or

A<sub>eff</sub> = 7.065 in<sup>2</sup> per row

From outflow hydrograph, the time where 50% of  $V_{BMP}$  has drained from the basin (24 hour minimum):

Time (50%) = 24.51 hrs

OK

From outflow hydrograph, the time where 100%  $V_{BMP}$  has drained from the basin (within 72 hours):

Time (100 %) = 69.65 hrs

OK

Headwater Elev. / Stage (ft)	Discharge (cfs)	Volume (acre-ft)	Δt (hrs.)
0	0.0000	0.0000	
0.33	0.1500	0.143	23.08
0.67	0.2122	0.287	9.62
1.00	0.2599	0.431	7.38
1.33	0.3000	0.592	6.96
1.67	0.3355	0.753	6.13
2.00	0.3675	0.914	5.54
2.33	0.3969	1.093	5.67
2.67	0.4244	1.272	5.27
3.00	0.4501	1.451	
3.33			
3.67			
4.00			
4.33			
4.67			
5.00			
5.33			
5.67			
6.00			
6.33			
6.67			
7.00			
7.33			
7.67			
8.00			
8.33			
8.67			
9.00			
9.33			
9.67			
10.00			
		Σ =	69.65

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 ADKAN ENGINEERS Date 6/3/2024  
 Designed by JOSE CONTRERAS Case No    
 Company Project Number/Name WADDELL

**BMP Identification**

BMP NAME / ID Basin 3  
*Must match Name/ID used on BMP Design Calculation Sheet*

**Design Rainfall Depth**

85th Percentile, 24-hour Rainfall Depth,  $D_{85} =$  0.55 inches  
 from the Isohyetal Map in Handbook Appendix E

**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 3.1	101,880.00	Concrete or Asphalt	1	0.89	90877			
D 3.2	67,690.00	Roofs	1	0.89	60379.5			
D 3.2	101,536	Ornamental Landscaping	0.1	0.11	11215.5			
D 3.3	68,151	Ornamental Landscaping	0.1	0.11	7527.8			
D 3.4	14013	Natural (C Soil)	0.3	0.23	3155.3			
<b>353270</b>		<b>Total</b>		<b>173155.1</b>	<b>0.55</b>			

Notes:

<b>Extended Detention Basin Design Procedure</b>		BMP Subarea No. EDB3	Legend:	Required Entries
Company Name: ADKAN ENGINEERS				Calculated Cells
Designed by: ALEX YE				Date: 4-26-24'
				County/City Case No.:

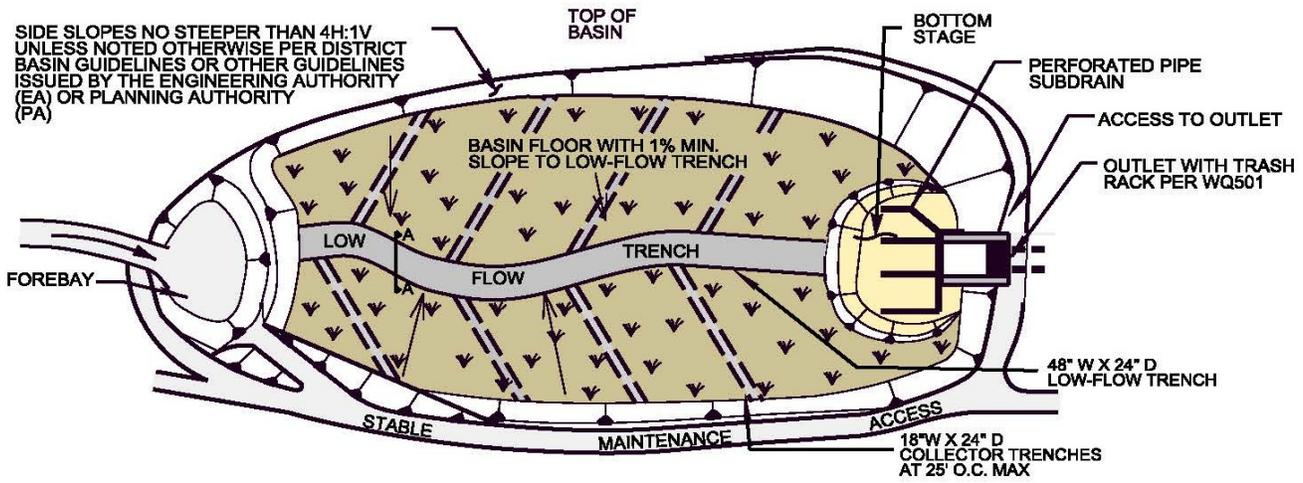
**Design Volume**

Tributary Area (BMP Subarea)	$A_T = 8.11$ acres
Enter $V_{BMP}$ , determined from Section 2.1 of this Handbook	$V_{BMP} = 7,936$ ft <sup>3</sup>

**Basin Footprint**

**Overall Geometry**

Length at Basin Bottom Surface	Length = 213 ft
Width at Basin Bottom Surface	Width = 74 ft
Meets 1.5 : 1 requirement?	<input checked="" type="checkbox"/>
Side Slopes per "Basin Guidelines", Sect. 1.2	$z = 4 : 1$
Proposed Basin Depth (with no freeboard)	$D_B = 2.00$ ft
Depth of freeboard (if used)	$D_{FB} = 0.50$ ft
Minimum Required Allowance for Total Depth (including proposed basin depth, freeboard, minimum depth of bottom stage ( $D_{BS}=0.33'$ ) and minimum filter depth ( $D_{FD}=2.33'$ ))	$D_{REQ} = 5.2$ ft
Depth from design water surface elevation to lowest orifice	$D_O = 2.0$ ft



## Basin Design

### Basin Design

Proposed Total Basin Depth (proposed depth plus freeboard)

$D_{TOT} = 2.50$  ft

Basin Invert Longitudinal Slope

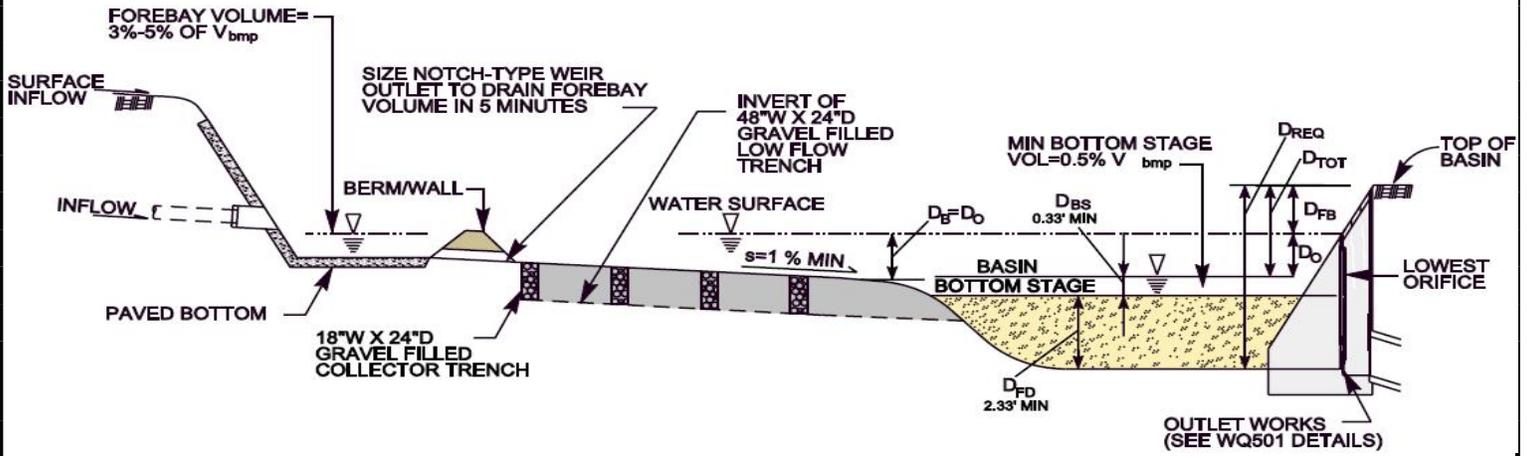
Slope = 1.00 %

Basin Invert Transverse Slope (1% min)

Slope = 1 %

Basin Volume

$V_{Basin} = 29764$  ft<sup>3</sup>



## Forebay Design

Forebay Volume (3 - 5%  $V_{BMP}$ )

$V_{FB} = 363$  ft<sup>3</sup>

Forebay Depth (height of berm)

$D_{FBY} = 1$  ft

Minimum Forebay Surface Area

$A_{FB} = 363$  ft<sup>2</sup>

Rectangular weir (notch)

$W = 18.00$  in

## Dry Weather and Low-Flow Management

### Low-Flow Trench (see graphic below)

Depth (24 inches minimum, gravel filled)

Depth =  24 inches

Width (48 inches minimum)

Width =  48 inches

Trench Invert Longitudinal Slope

Slope =  1 %

### Collector Trenches (see graphic below)

Depth (24 inches minimum)

Depth =  24 inches

Width (18 inches minimum)

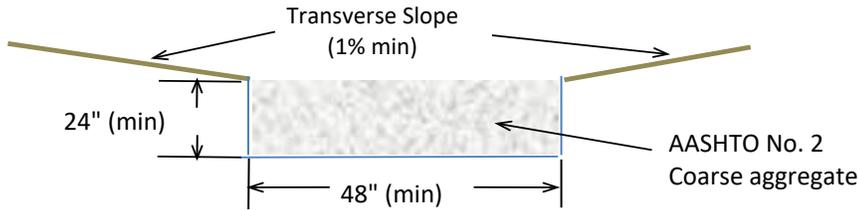
Width =  18 inches

Trench Invert Longitudinal Slope

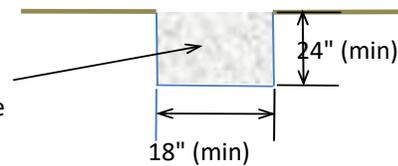
Slope =  1 %

Spacing (25 feet on center maximum)

S =  25 feet



**Low-Flow Trench**



**Collector Trench**

### Bottom Stage (Sand Filter) Design

Depth of the Bottom Stage (4" minimum ponding)

$D_{BS}$  =  4 in

Surface Area of Bottom Stage

$A_{BS}$  =  12107 ft<sup>2</sup>

Dry Weather Poned Volume (above sand layer)

$V_{BS}$  =  4036 ft<sup>3</sup>

Is  $V_{BS}$  no less than 0.5%  $V_{BMP}$ ? **OK**

Depth of ASTM-C33 sand (18 inch minimum)

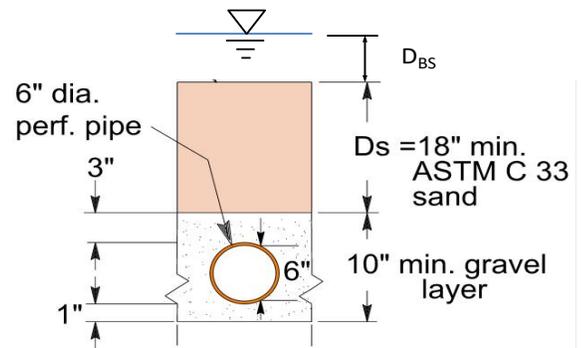
$D_s$  =  18 inches

Diameter of Subdrains

$\phi$  =  6 in

Subdrain Spacing

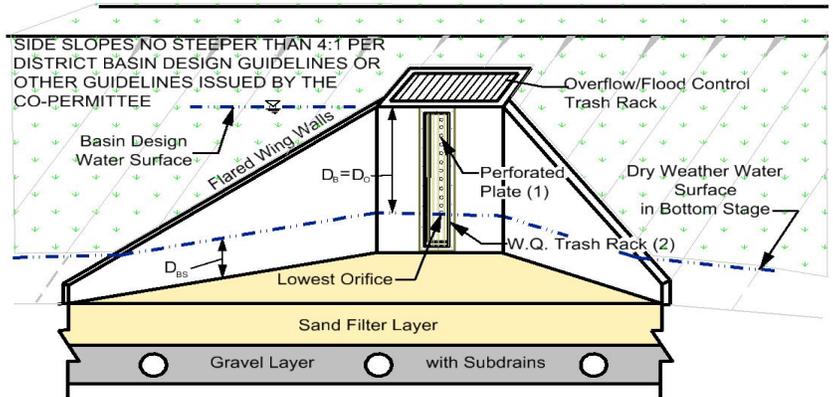
$s$  =  6 ft. on center



## Basin Outlet Design

### Outlet Design

Assume an orifice area. Based on the information provided above, the spreadsheet provides discharge vs. stage data. Enter the volume vs. stage data for each interval. This information is used to route the volume through the basin. The size of the orifice is acceptable when the data shows that less than 50% of  $V_{BMP}$  has drained in 24 hours, and that 100% drawdown occurs within 72 hours.



### Flow Rate, Q (cfs)

$$Q = CA[2g(H-H_o)]^{0.5}$$

Discharge Coefficient,

Default, C = 0.66

Other, C = 0.66

### Orifice Area (ft<sup>2</sup>)

Orifice Diameter, d; number of orifices per row, n; and number of orifice rows, N (from the bottom up).

d = 1.7 inches

n = 1 per row

N = 1 rows

A<sub>eff</sub> = 0.016 ft<sup>2</sup> per row

or

A<sub>eff</sub> = 2.269 in<sup>2</sup> per row

From outflow hydrograph, the time where 50% of  $V_{BMP}$  has drained from the basin (24 hour minimum):

Time (50%) = 25.28 hrs

OK

From outflow hydrograph, the time where 100%  $V_{BMP}$  has drained from the basin (within 72 hours):

Time (100 %) = 71.07 hrs

OK

Headwater Elev. / Stage (ft)	Discharge (cfs)	Volume (acre-ft)	Δt (hrs.)
0	0.0000	0.0000	
0.33	0.0482	0.100	50.26
0.67	0.0681	0.200	20.81
1.00	0.0834	0.304	
1.33	0.0963	0.430	
1.67	0.1077	0.560	
2.00	0.1180	0.683	
2.33			
2.67			
3.00			
3.33			
3.67			
4.00			
4.33			
4.67			
5.00			
5.33			
5.67			
6.00			
6.33			
6.67			
7.00			
7.33			
7.67			
8.00			
8.33			
8.67			
9.00			
9.33			
9.67			
10.00			
Σ =			71.07

Notes:

# Appendix 7: Hydromodification

*Supporting Detail Relating to Hydrologic Conditions of Concern*

Basin Routing Summary Table (2 Year – 24 Hour)<sup>1</sup>

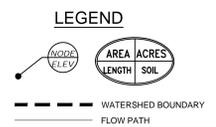
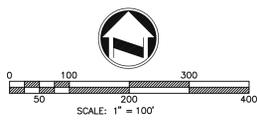
Table 7-1 Tract 38605– Extended Detention Basin No. 1 Outflow Comparison								
Storm Event	Pre-Developed		Post-Developed		Post-Developed with Basin			Pre vs. Post Percent Difference (10% Max)
	Flow (cfs)	Volume (ac.ft.)	Flow (cfs)	Volume (ac.ft.)	Routed Basin Out Flow (cfs)	Storage Volume (ac.ft.)	Depth (ft)	
2 Year - 24 Hour	0.883	0.4084	3.455	2.0108	0.665	1.556	1.99	-24.7%

Table 7-2 Tract 38605– Extended Detention Basin No. 2 Outflow Comparison								
Storm Event	Pre-Developed		Post-Developed		Post-Developed with Basin			Pre vs. Post Percent Difference (10% Max)
	Flow (cfs)	Volume (ac.ft.)	Flow (cfs)	Volume (ac.ft.)	Routed Basin Out Flow (cfs)	Storage Volume (ac.ft.)	Depth (ft)	
2 Year - 24 Hour	1.661	0.7911	6.393	3.8846	1.728	2.705	4.99	4.0%

Table 3-3 Tract 38605– Extended Detention Basin No. 3 Outflow Comparison								
Storm Event	Pre-Developed		Post-Developed		Post-Developed with Basin			Pre vs. Post Percent Difference (10% Max)
	Flow (cfs)	Volume (ac.ft.)	Flow (cfs)	Volume (ac.ft.)	Routed Basin Out Flow (cfs)	Storage Volume (ac.ft.)	Depth (ft)	
2 Year - 24 Hour	0.256	0.1190	0.961	0.5842	0.207	0.453	1.39	-19.1%

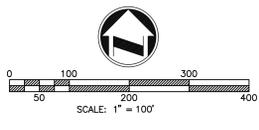
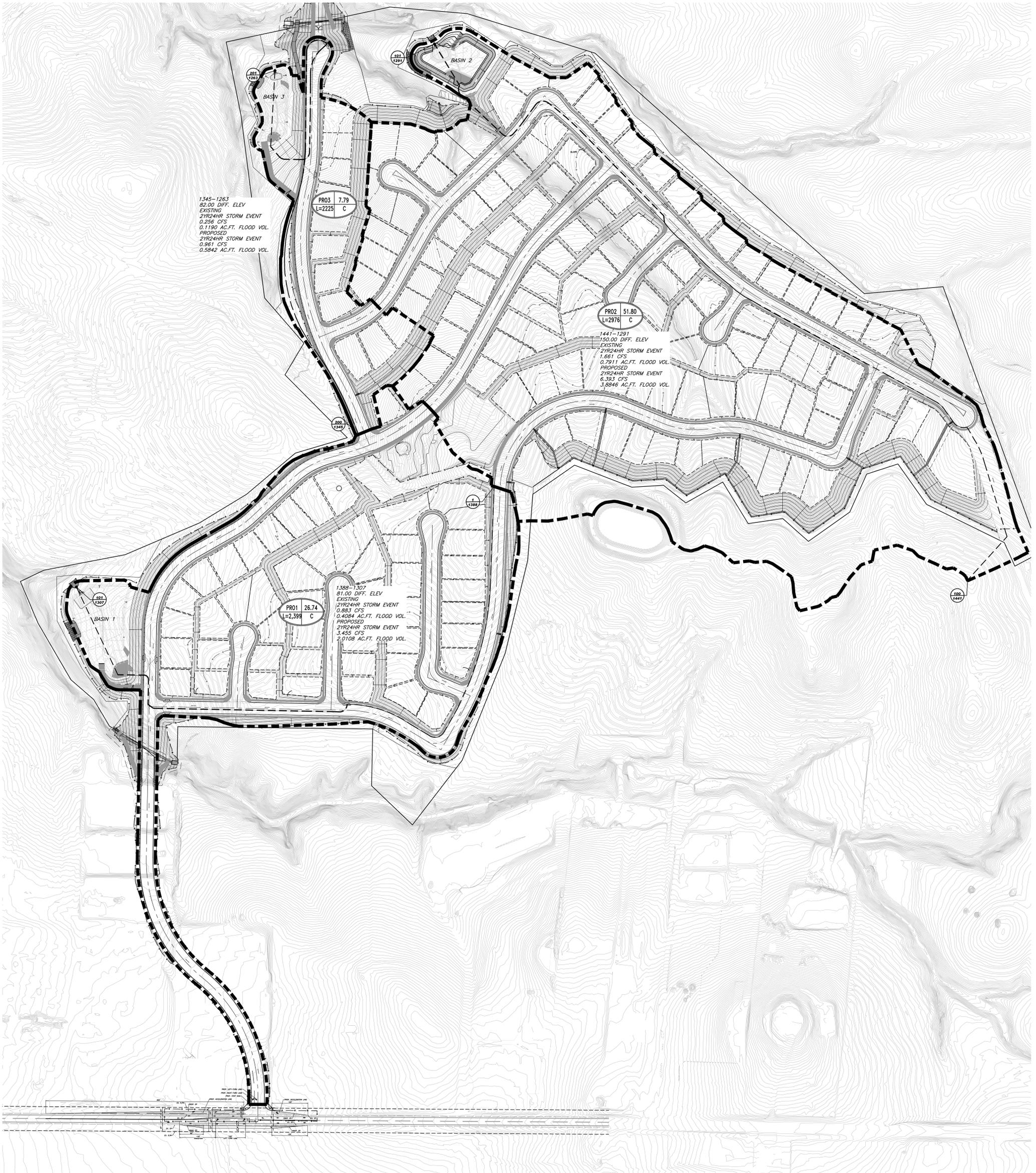
<sup>1</sup>See project specific Hydrology Analysis prepared by Adkan Engineers for the 2-, 5-, 10-, and 100-year frequency storm events for the 1-, 3-, 6-, and 24-hour durations not tabled herein.

# EXISTING UNIT HYDROGRAPH MAP



EXISTING UNIT HYDROGRAPH MAP  
PREPARATION DATE: DECEMBER 2022  
REVISION DATE: FEBRUARY 2024  
adkan  
**ENGINEERS**  
Civil Engineering • Surveying • Planning  
6879 Airport Drive, Riverside, CA 92504  
Tel: (951) 688-0241 • Fax: (951) 688-0599

# PROPOSED UNIT HYDROGRAPH MAP



**LEGEND**

- NODE ELEV
- AREA ACRES  
LENGTH SOIL
- WATERSHED BOUNDARY
- FLOW PATH

PROPOSED UNIT HYDROGRAPH MAP  
 PREPARATION DATE: MAY 2024  
 PLAN PREPARED BY:  
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Section 7.1– Basin 1 – Existing 2 Year- 24 Hour Hydrograph

Unit Hydrograph Analysis

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Study date 04/22/24 File: EX12242.out

Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 5006

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

English Units used in output format

Drainage Area = 26.74(Ac.) = 0.042 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 26.74(Ac.) = 0.042 Sq. Mi.
Length along longest watercourse = 1087.00(Ft.)
Length along longest watercourse measured to centroid = 544.00(Ft.)
Length along longest watercourse = 0.206 Mi.
Length along longest watercourse measured to centroid = 0.103 Mi.
Difference in elevation = 88.30(Ft.)
Slope along watercourse = 428.9089 Ft./Mi.
Average Manning's 'N' = 0.030
Lag time = 0.053 Hr.
Lag time = 3.16 Min.
25% of lag time = 0.79 Min.
40% of lag time = 1.26 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1] Rainfall(In)[2] weighting[1\*2]
26.74 1.80 48.13

100 YEAR Area rainfall data:

Area(Ac.)[1] Rainfall(In)[2] weighting[1\*2]
26.74 5.00 133.70

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 1.800(In)
Area Averaged 100-Year Rainfall = 5.000(In)

Point rain (area averaged) = 1.800(In)
Areal adjustment factor = 99.99 %
Adjusted average point rain = 1.800(In)

Sub-Area Data:
Area(Ac.) Runoff Index Impervious %
26.740 91.00 0.000
Total Area Entered = 26.74(Ac.)

RI RI Infil. Rate Impervious Adj. Infil. Rate Area% F
AMC2 AMC-1 (In/Hr) (Dec.%) (In/Hr) (Dec.) (In/Hr)
91.0 79.8 0.246 0.000 0.246 1.000 0.246
Sum (F) = 0.246

Area averaged mean soil loss (F) (In/Hr) = 0.246
Minimum soil loss rate ((In/Hr)) = 0.123
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.900

Unit Hydrograph
VALLEY S-Curve

Unit Hydrograph Data

Unit time period Time % of lag Distribution Unit Hydrograph
(hrs) Graph % (CFS)

1	0.083	158.322	35.130	9.467
2	0.167	316.645	46.393	12.502
3	0.250	474.967	10.719	2.889
4	0.333	633.290	4.631	1.248
5	0.417	791.612	2.248	0.606
6	0.500	949.935	0.879	0.237
			Sum = 100.000	Sum= 26.949

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

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr)		Effective (In/Hr)
				Max	Low	
1	0.08	0.07	0.014	( 0.437)	0.013	0.001
2	0.17	0.07	0.014	( 0.435)	0.013	0.001
3	0.25	0.07	0.014	( 0.433)	0.013	0.001
4	0.33	0.10	0.022	( 0.432)	0.019	0.002
5	0.42	0.10	0.022	( 0.430)	0.019	0.002
6	0.50	0.10	0.022	( 0.428)	0.019	0.002
7	0.58	0.10	0.022	( 0.427)	0.019	0.002
8	0.67	0.10	0.022	( 0.425)	0.019	0.002
9	0.75	0.10	0.022	( 0.423)	0.019	0.002
10	0.83	0.13	0.029	( 0.422)	0.026	0.003
11	0.92	0.13	0.029	( 0.420)	0.026	0.003
12	1.00	0.13	0.029	( 0.418)	0.026	0.003
13	1.08	0.10	0.022	( 0.417)	0.019	0.002
14	1.17	0.10	0.022	( 0.415)	0.019	0.002
15	1.25	0.10	0.022	( 0.413)	0.019	0.002
16	1.33	0.10	0.022	( 0.412)	0.019	0.002
17	1.42	0.10	0.022	( 0.410)	0.019	0.002
18	1.50	0.10	0.022	( 0.408)	0.019	0.002
19	1.58	0.10	0.022	( 0.407)	0.019	0.002
20	1.67	0.10	0.022	( 0.405)	0.019	0.002
21	1.75	0.10	0.022	( 0.404)	0.019	0.002
22	1.83	0.13	0.029	( 0.402)	0.026	0.003
23	1.92	0.13	0.029	( 0.400)	0.026	0.003
24	2.00	0.13	0.029	( 0.399)	0.026	0.003
25	2.08	0.13	0.029	( 0.397)	0.026	0.003
26	2.17	0.13	0.029	( 0.395)	0.026	0.003
27	2.25	0.13	0.029	( 0.394)	0.026	0.003
28	2.33	0.13	0.029	( 0.392)	0.026	0.003
29	2.42	0.13	0.029	( 0.391)	0.026	0.003
30	2.50	0.13	0.029	( 0.389)	0.026	0.003
31	2.58	0.17	0.036	( 0.387)	0.032	0.004
32	2.67	0.17	0.036	( 0.386)	0.032	0.004
33	2.75	0.17	0.036	( 0.384)	0.032	0.004
34	2.83	0.17	0.036	( 0.383)	0.032	0.004
35	2.92	0.17	0.036	( 0.381)	0.032	0.004
36	3.00	0.17	0.036	( 0.380)	0.032	0.004
37	3.08	0.17	0.036	( 0.378)	0.032	0.004
38	3.17	0.17	0.036	( 0.376)	0.032	0.004
39	3.25	0.17	0.036	( 0.375)	0.032	0.004
40	3.33	0.17	0.036	( 0.373)	0.032	0.004
41	3.42	0.17	0.036	( 0.372)	0.032	0.004
42	3.50	0.17	0.036	( 0.370)	0.032	0.004
43	3.58	0.17	0.036	( 0.369)	0.032	0.004
44	3.67	0.17	0.036	( 0.367)	0.032	0.004
45	3.75	0.17	0.036	( 0.366)	0.032	0.004
46	3.83	0.20	0.043	( 0.364)	0.039	0.004
47	3.92	0.20	0.043	( 0.362)	0.039	0.004
48	4.00	0.20	0.043	( 0.361)	0.039	0.004
49	4.08	0.20	0.043	( 0.359)	0.039	0.004
50	4.17	0.20	0.043	( 0.358)	0.039	0.004
51	4.25	0.20	0.043	( 0.356)	0.039	0.004
52	4.33	0.23	0.050	( 0.355)	0.045	0.005
53	4.42	0.23	0.050	( 0.353)	0.045	0.005
54	4.50	0.23	0.050	( 0.352)	0.045	0.005
55	4.58	0.23	0.050	( 0.350)	0.045	0.005
56	4.67	0.23	0.050	( 0.349)	0.045	0.005
57	4.75	0.23	0.050	( 0.347)	0.045	0.005
58	4.83	0.27	0.058	( 0.346)	0.052	0.006
59	4.92	0.27	0.058	( 0.344)	0.052	0.006
60	5.00	0.27	0.058	( 0.343)	0.052	0.006
61	5.08	0.20	0.043	( 0.341)	0.039	0.004
62	5.17	0.20	0.043	( 0.340)	0.039	0.004
63	5.25	0.20	0.043	( 0.338)	0.039	0.004
64	5.33	0.23	0.050	( 0.337)	0.045	0.005
65	5.42	0.23	0.050	( 0.335)	0.045	0.005
66	5.50	0.23	0.050	( 0.334)	0.045	0.005
67	5.58	0.27	0.058	( 0.332)	0.052	0.006
68	5.67	0.27	0.058	( 0.331)	0.052	0.006
69	5.75	0.27	0.058	( 0.330)	0.052	0.006
70	5.83	0.27	0.058	( 0.328)	0.052	0.006

71	5.92	0.27	0.058	( 0.327)	0.052	0.006
72	6.00	0.27	0.058	( 0.325)	0.052	0.006
73	6.08	0.30	0.065	( 0.324)	0.058	0.006
74	6.17	0.30	0.065	( 0.322)	0.058	0.006
75	6.25	0.30	0.065	( 0.321)	0.058	0.006
76	6.33	0.30	0.065	( 0.319)	0.058	0.006
77	6.42	0.30	0.065	( 0.318)	0.058	0.006
78	6.50	0.30	0.065	( 0.317)	0.058	0.006
79	6.58	0.33	0.072	( 0.315)	0.065	0.007
80	6.67	0.33	0.072	( 0.314)	0.065	0.007
81	6.75	0.33	0.072	( 0.312)	0.065	0.007
82	6.83	0.33	0.072	( 0.311)	0.065	0.007
83	6.92	0.33	0.072	( 0.310)	0.065	0.007
84	7.00	0.33	0.072	( 0.308)	0.065	0.007
85	7.08	0.33	0.072	( 0.307)	0.065	0.007
86	7.17	0.33	0.072	( 0.305)	0.065	0.007
87	7.25	0.33	0.072	( 0.304)	0.065	0.007
88	7.33	0.37	0.079	( 0.303)	0.071	0.008
89	7.42	0.37	0.079	( 0.301)	0.071	0.008
90	7.50	0.37	0.079	( 0.300)	0.071	0.008
91	7.58	0.40	0.086	( 0.298)	0.078	0.009
92	7.67	0.40	0.086	( 0.297)	0.078	0.009
93	7.75	0.40	0.086	( 0.296)	0.078	0.009
94	7.83	0.43	0.094	( 0.294)	0.084	0.009
95	7.92	0.43	0.094	( 0.293)	0.084	0.009
96	8.00	0.43	0.094	( 0.292)	0.084	0.009
97	8.08	0.50	0.108	( 0.290)	0.097	0.011
98	8.17	0.50	0.108	( 0.289)	0.097	0.011
99	8.25	0.50	0.108	( 0.288)	0.097	0.011
100	8.33	0.50	0.108	( 0.286)	0.097	0.011
101	8.42	0.50	0.108	( 0.285)	0.097	0.011
102	8.50	0.50	0.108	( 0.283)	0.097	0.011
103	8.58	0.53	0.115	( 0.282)	0.104	0.012
104	8.67	0.53	0.115	( 0.281)	0.104	0.012
105	8.75	0.53	0.115	( 0.280)	0.104	0.012
106	8.83	0.57	0.122	( 0.278)	0.110	0.012
107	8.92	0.57	0.122	( 0.277)	0.110	0.012
108	9.00	0.57	0.122	( 0.276)	0.110	0.012
109	9.08	0.63	0.137	( 0.274)	0.123	0.014
110	9.17	0.63	0.137	( 0.273)	0.123	0.014
111	9.25	0.63	0.137	( 0.272)	0.123	0.014
112	9.33	0.67	0.144	( 0.270)	0.130	0.014
113	9.42	0.67	0.144	( 0.269)	0.130	0.014
114	9.50	0.67	0.144	( 0.268)	0.130	0.014
115	9.58	0.70	0.151	( 0.267)	0.136	0.015
116	9.67	0.70	0.151	( 0.265)	0.136	0.015
117	9.75	0.70	0.151	( 0.264)	0.136	0.015
118	9.83	0.73	0.158	( 0.263)	0.143	0.016
119	9.92	0.73	0.158	( 0.261)	0.143	0.016
120	10.00	0.73	0.158	( 0.260)	0.143	0.016
121	10.08	0.50	0.108	( 0.259)	0.097	0.011
122	10.17	0.50	0.108	( 0.258)	0.097	0.011
123	10.25	0.50	0.108	( 0.256)	0.097	0.011
124	10.33	0.50	0.108	( 0.255)	0.097	0.011
125	10.42	0.50	0.108	( 0.254)	0.097	0.011
126	10.50	0.50	0.108	( 0.253)	0.097	0.011
127	10.58	0.67	0.144	( 0.251)	0.130	0.014
128	10.67	0.67	0.144	( 0.250)	0.130	0.014
129	10.75	0.67	0.144	( 0.249)	0.130	0.014
130	10.83	0.67	0.144	( 0.248)	0.130	0.014
131	10.92	0.67	0.144	( 0.247)	0.130	0.014
132	11.00	0.67	0.144	( 0.245)	0.130	0.014
133	11.08	0.63	0.137	( 0.244)	0.123	0.014
134	11.17	0.63	0.137	( 0.243)	0.123	0.014
135	11.25	0.63	0.137	( 0.242)	0.123	0.014
136	11.33	0.63	0.137	( 0.241)	0.123	0.014
137	11.42	0.63	0.137	( 0.239)	0.123	0.014
138	11.50	0.63	0.137	( 0.238)	0.123	0.014
139	11.58	0.57	0.122	( 0.237)	0.110	0.012
140	11.67	0.57	0.122	( 0.236)	0.110	0.012
141	11.75	0.57	0.122	( 0.235)	0.110	0.012
142	11.83	0.60	0.130	( 0.233)	0.117	0.013
143	11.92	0.60	0.130	( 0.232)	0.117	0.013
144	12.00	0.60	0.130	( 0.231)	0.117	0.013
145	12.08	0.83	0.180	( 0.230)	0.162	0.018
146	12.17	0.83	0.180	( 0.229)	0.162	0.018
147	12.25	0.83	0.180	( 0.228)	0.162	0.018
148	12.33	0.87	0.187	( 0.227)	0.168	0.019
149	12.42	0.87	0.187	( 0.225)	0.168	0.019
150	12.50	0.87	0.187	( 0.224)	0.168	0.019
151	12.58	0.93	0.202	( 0.223)	0.181	0.020
152	12.67	0.93	0.202	( 0.222)	0.181	0.020
153	12.75	0.93	0.202	( 0.221)	0.181	0.020
154	12.83	0.97	0.209	( 0.220)	0.188	0.021
155	12.92	0.97	0.209	( 0.219)	0.188	0.021
156	13.00	0.97	0.209	( 0.218)	0.188	0.021

157	13.08	1.13	0.245	0.216	( 0.220)	0.028
158	13.17	1.13	0.245	0.215	( 0.220)	0.029
159	13.25	1.13	0.245	0.214	( 0.220)	0.031
160	13.33	1.13	0.245	0.213	( 0.220)	0.032
161	13.42	1.13	0.245	0.212	( 0.220)	0.033
162	13.50	1.13	0.245	0.211	( 0.220)	0.034
163	13.58	0.77	0.166	( 0.210)	0.149	0.017
164	13.67	0.77	0.166	( 0.209)	0.149	0.017
165	13.75	0.77	0.166	( 0.208)	0.149	0.017
166	13.83	0.77	0.166	( 0.207)	0.149	0.017
167	13.92	0.77	0.166	( 0.206)	0.149	0.017
168	14.00	0.77	0.166	( 0.205)	0.149	0.017
169	14.08	0.90	0.194	( 0.204)	0.175	0.019
170	14.17	0.90	0.194	( 0.203)	0.175	0.019
171	14.25	0.90	0.194	( 0.202)	0.175	0.019
172	14.33	0.87	0.187	( 0.200)	0.168	0.019
173	14.42	0.87	0.187	( 0.199)	0.168	0.019
174	14.50	0.87	0.187	( 0.198)	0.168	0.019
175	14.58	0.87	0.187	( 0.197)	0.168	0.019
176	14.67	0.87	0.187	( 0.196)	0.168	0.019
177	14.75	0.87	0.187	( 0.195)	0.168	0.019
178	14.83	0.83	0.180	( 0.194)	0.162	0.018
179	14.92	0.83	0.180	( 0.193)	0.162	0.018
180	15.00	0.83	0.180	( 0.192)	0.162	0.018
181	15.08	0.80	0.173	( 0.191)	0.156	0.017
182	15.17	0.80	0.173	( 0.190)	0.156	0.017
183	15.25	0.80	0.173	( 0.189)	0.156	0.017
184	15.33	0.77	0.166	( 0.188)	0.149	0.017
185	15.42	0.77	0.166	( 0.188)	0.149	0.017
186	15.50	0.77	0.166	( 0.187)	0.149	0.017
187	15.58	0.63	0.137	( 0.186)	0.123	0.014
188	15.67	0.63	0.137	( 0.185)	0.123	0.014
189	15.75	0.63	0.137	( 0.184)	0.123	0.014
190	15.83	0.63	0.137	( 0.183)	0.123	0.014
191	15.92	0.63	0.137	( 0.182)	0.123	0.014
192	16.00	0.63	0.137	( 0.181)	0.123	0.014
193	16.08	0.13	0.029	( 0.180)	0.026	0.003
194	16.17	0.13	0.029	( 0.179)	0.026	0.003
195	16.25	0.13	0.029	( 0.178)	0.026	0.003
196	16.33	0.13	0.029	( 0.177)	0.026	0.003
197	16.42	0.13	0.029	( 0.176)	0.026	0.003
198	16.50	0.13	0.029	( 0.175)	0.026	0.003
199	16.58	0.10	0.022	( 0.175)	0.019	0.002
200	16.67	0.10	0.022	( 0.174)	0.019	0.002
201	16.75	0.10	0.022	( 0.173)	0.019	0.002
202	16.83	0.10	0.022	( 0.172)	0.019	0.002
203	16.92	0.10	0.022	( 0.171)	0.019	0.002
204	17.00	0.10	0.022	( 0.170)	0.019	0.002
205	17.08	0.17	0.036	( 0.169)	0.032	0.004
206	17.17	0.17	0.036	( 0.168)	0.032	0.004
207	17.25	0.17	0.036	( 0.168)	0.032	0.004
208	17.33	0.17	0.036	( 0.167)	0.032	0.004
209	17.42	0.17	0.036	( 0.166)	0.032	0.004
210	17.50	0.17	0.036	( 0.165)	0.032	0.004
211	17.58	0.17	0.036	( 0.164)	0.032	0.004
212	17.67	0.17	0.036	( 0.163)	0.032	0.004
213	17.75	0.17	0.036	( 0.163)	0.032	0.004
214	17.83	0.13	0.029	( 0.162)	0.026	0.003
215	17.92	0.13	0.029	( 0.161)	0.026	0.003
216	18.00	0.13	0.029	( 0.160)	0.026	0.003
217	18.08	0.13	0.029	( 0.159)	0.026	0.003
218	18.17	0.13	0.029	( 0.159)	0.026	0.003
219	18.25	0.13	0.029	( 0.158)	0.026	0.003
220	18.33	0.13	0.029	( 0.157)	0.026	0.003
221	18.42	0.13	0.029	( 0.156)	0.026	0.003
222	18.50	0.13	0.029	( 0.156)	0.026	0.003
223	18.58	0.10	0.022	( 0.155)	0.019	0.002
224	18.67	0.10	0.022	( 0.154)	0.019	0.002
225	18.75	0.10	0.022	( 0.153)	0.019	0.002
226	18.83	0.07	0.014	( 0.153)	0.013	0.001
227	18.92	0.07	0.014	( 0.152)	0.013	0.001
228	19.00	0.07	0.014	( 0.151)	0.013	0.001
229	19.08	0.10	0.022	( 0.150)	0.019	0.002
230	19.17	0.10	0.022	( 0.150)	0.019	0.002
231	19.25	0.10	0.022	( 0.149)	0.019	0.002
232	19.33	0.13	0.029	( 0.148)	0.026	0.003
233	19.42	0.13	0.029	( 0.148)	0.026	0.003
234	19.50	0.13	0.029	( 0.147)	0.026	0.003
235	19.58	0.10	0.022	( 0.146)	0.019	0.002
236	19.67	0.10	0.022	( 0.146)	0.019	0.002
237	19.75	0.10	0.022	( 0.145)	0.019	0.002
238	19.83	0.07	0.014	( 0.144)	0.013	0.001
239	19.92	0.07	0.014	( 0.144)	0.013	0.001
240	20.00	0.07	0.014	( 0.143)	0.013	0.001
241	20.08	0.10	0.022	( 0.142)	0.019	0.002
242	20.17	0.10	0.022	( 0.142)	0.019	0.002



1+40	0.0076	0.06	Q				
1+45	0.0080	0.06	Q				
1+50	0.0085	0.07	Q				
1+55	0.0090	0.07	Q				
2+ 0	0.0095	0.08	Q				
2+ 5	0.0101	0.08	Q				
2+10	0.0106	0.08	QV				
2+15	0.0111	0.08	QV				
2+20	0.0117	0.08	QV				
2+25	0.0122	0.08	QV				
2+30	0.0127	0.08	QV				
2+35	0.0133	0.08	QV				
2+40	0.0140	0.09	QV				
2+45	0.0146	0.10	QV				
2+50	0.0153	0.10	QV				
2+55	0.0159	0.10	QV				
3+ 0	0.0166	0.10	QV				
3+ 5	0.0173	0.10	QV				
3+10	0.0179	0.10	QV				
3+15	0.0186	0.10	QV				
3+20	0.0193	0.10	QV				
3+25	0.0200	0.10	QV				
3+30	0.0206	0.10	Q V				
3+35	0.0213	0.10	Q V				
3+40	0.0220	0.10	Q V				
3+45	0.0226	0.10	Q V				
3+50	0.0233	0.10	Q V				
3+55	0.0241	0.11	Q V				
4+ 0	0.0249	0.11	Q V				
4+ 5	0.0257	0.12	Q V				
4+10	0.0265	0.12	Q V				
4+15	0.0273	0.12	Q V				
4+20	0.0282	0.12	Q V				
4+25	0.0291	0.13	Q V				
4+30	0.0300	0.13	Q V				
4+35	0.0309	0.14	Q V				
4+40	0.0319	0.14	Q V				
4+45	0.0328	0.14	Q V				
4+50	0.0338	0.14	Q V				
4+55	0.0348	0.15	Q V				
5+ 0	0.0359	0.15	Q V				
5+ 5	0.0369	0.14	Q V				
5+10	0.0377	0.12	Q V				
5+15	0.0385	0.12	Q V				
5+20	0.0394	0.12	Q V				
5+25	0.0403	0.13	Q V				
5+30	0.0412	0.13	Q V				
5+35	0.0422	0.14	Q V				
5+40	0.0433	0.15	Q V				
5+45	0.0443	0.15	Q V				
5+50	0.0454	0.15	Q V				
5+55	0.0464	0.16	Q V				
6+ 0	0.0475	0.16	Q V				
6+ 5	0.0486	0.16	Q V				
6+10	0.0498	0.17	Q V				
6+15	0.0510	0.17	Q V				
6+20	0.0522	0.17	Q V				
6+25	0.0534	0.17	Q V				
6+30	0.0546	0.17	Q V				
6+35	0.0559	0.18	Q V				
6+40	0.0572	0.19	Q V				
6+45	0.0585	0.19	Q V				
6+50	0.0598	0.19	Q V				
6+55	0.0612	0.19	Q V				
7+ 0	0.0625	0.19	Q V				
7+ 5	0.0638	0.19	Q V				
7+10	0.0652	0.19	Q V				
7+15	0.0665	0.19	Q V				
7+20	0.0679	0.20	Q V				
7+25	0.0693	0.21	Q V				
7+30	0.0708	0.21	Q V				
7+35	0.0723	0.22	Q V				
7+40	0.0739	0.23	Q V				
7+45	0.0755	0.23	Q V				
7+50	0.0771	0.24	Q V				
7+55	0.0788	0.25	Q V				
8+ 0	0.0806	0.25	Q V				
8+ 5	0.0824	0.27	Q V				
8+10	0.0844	0.28	Q V				
8+15	0.0863	0.29	Q V				
8+20	0.0883	0.29	Q V				
8+25	0.0903	0.29	Q V				
8+30	0.0923	0.29	Q V				
8+35	0.0944	0.30	Q V				
8+40	0.0965	0.31	Q V				
8+45	0.0986	0.31	Q V				

8+50	0.1008	0.32	Q	V		
8+55	0.1031	0.33	Q	V		
9+ 0	0.1053	0.33	Q	V		
9+ 5	0.1077	0.34	Q	V		
9+10	0.1102	0.36	Q	V		
9+15	0.1127	0.37	Q	V		
9+20	0.1153	0.37	Q	V		
9+25	0.1179	0.38	Q	V		
9+30	0.1206	0.39	Q	V		
9+35	0.1233	0.39	Q	V		
9+40	0.1261	0.40	Q	V		
9+45	0.1289	0.41	Q	V		
9+50	0.1317	0.41	Q	V		
9+55	0.1347	0.42	Q	V		
10+ 0	0.1376	0.43	Q	V		
10+ 5	0.1402	0.38	Q	V		
10+10	0.1424	0.32	Q	V		
10+15	0.1444	0.30	Q	V		
10+20	0.1465	0.30	Q	V		
10+25	0.1485	0.29	Q	V		
10+30	0.1505	0.29	Q	V		
10+35	0.1527	0.33	Q	V		
10+40	0.1553	0.37	Q	V		
10+45	0.1579	0.38	Q	V		
10+50	0.1606	0.39	Q	V		
10+55	0.1632	0.39	Q	V		
11+ 0	0.1659	0.39	Q	V		
11+ 5	0.1685	0.38	Q	V		
11+10	0.1711	0.37	Q	V		
11+15	0.1737	0.37	Q	V		
11+20	0.1762	0.37	Q	V		
11+25	0.1787	0.37	Q	V		
11+30	0.1813	0.37	Q	V		
11+35	0.1837	0.36	Q	V		
11+40	0.1860	0.34	Q	V		
11+45	0.1883	0.33	Q	V		
11+50	0.1907	0.34	Q	V		
11+55	0.1931	0.35	Q	V		
12+ 0	0.1954	0.35	Q	V		
12+ 5	0.1982	0.40	Q	V		
12+10	0.2013	0.46	Q	V		
12+15	0.2046	0.47	Q	V		
12+20	0.2080	0.49	Q	V		
12+25	0.2114	0.50	Q	V		
12+30	0.2149	0.50	Q	V		
12+35	0.2185	0.52	Q	V		
12+40	0.2221	0.54	Q	V		
12+45	0.2259	0.54	Q	V		
12+50	0.2296	0.55	Q	V		
12+55	0.2335	0.56	Q	V		
13+ 0	0.2374	0.56	Q	V		
13+ 5	0.2417	0.63	Q	V		
13+10	0.2468	0.74	Q	V		
13+15	0.2522	0.78	Q	V		
13+20	0.2578	0.82	Q	V		
13+25	0.2637	0.85	Q	V		
13+30	0.2698	0.88	Q	V		
13+35	0.2749	0.74	Q	V		
13+40	0.2785	0.53	Q	V		
13+45	0.2818	0.48	Q	V		
13+50	0.2850	0.46	Q	V		
13+55	0.2881	0.45	Q	V		
14+ 0	0.2912	0.45	Q	V		
14+ 5	0.2944	0.47	Q	V		
14+10	0.2980	0.51	Q	V		
14+15	0.3015	0.52	Q	V		
14+20	0.3051	0.51	Q	V		
14+25	0.3086	0.51	Q	V		
14+30	0.3121	0.51	Q	V		
14+35	0.3155	0.51	Q	V		
14+40	0.3190	0.50	Q	V		
14+45	0.3225	0.50	Q	V		
14+50	0.3259	0.50	Q	V		
14+55	0.3293	0.49	Q	V		
15+ 0	0.3326	0.49	Q	V		
15+ 5	0.3359	0.48	Q	V		
15+10	0.3392	0.47	Q	V		
15+15	0.3424	0.47	Q	V		
15+20	0.3456	0.46	Q	V		
15+25	0.3487	0.45	Q	V		
15+30	0.3517	0.45	Q	V		
15+35	0.3546	0.42	Q	V		
15+40	0.3573	0.38	Q	V		
15+45	0.3599	0.37	Q	V		
15+50	0.3624	0.37	Q	V		
15+55	0.3650	0.37	Q	V		

16+ 0	0.3675	0.37	Q	V
16+ 5	0.3693	0.27	Q	V
16+10	0.3702	0.13	Q	V
16+15	0.3709	0.10	Q	V
16+20	0.3715	0.09	Q	V
16+25	0.3721	0.08	Q	V
16+30	0.3726	0.08	Q	V
16+35	0.3731	0.07	Q	V
16+40	0.3735	0.06	Q	V
16+45	0.3739	0.06	Q	V
16+50	0.3743	0.06	Q	V
16+55	0.3747	0.06	Q	V
17+ 0	0.3751	0.06	Q	V
17+ 5	0.3756	0.07	Q	V
17+10	0.3763	0.09	Q	V
17+15	0.3769	0.09	Q	V
17+20	0.3776	0.10	Q	V
17+25	0.3782	0.10	Q	V
17+30	0.3789	0.10	Q	V
17+35	0.3796	0.10	Q	V
17+40	0.3802	0.10	Q	V
17+45	0.3809	0.10	Q	V
17+50	0.3815	0.09	Q	V
17+55	0.3821	0.08	Q	V
18+ 0	0.3826	0.08	Q	V
18+ 5	0.3832	0.08	Q	V
18+10	0.3837	0.08	Q	V
18+15	0.3842	0.08	Q	V
18+20	0.3848	0.08	Q	V
18+25	0.3853	0.08	Q	V
18+30	0.3858	0.08	Q	V
18+35	0.3863	0.07	Q	V
18+40	0.3868	0.06	Q	V
18+45	0.3872	0.06	Q	V
18+50	0.3875	0.05	Q	V
18+55	0.3878	0.04	Q	V
19+ 0	0.3881	0.04	Q	V
19+ 5	0.3884	0.05	Q	V
19+10	0.3888	0.05	Q	V
19+15	0.3892	0.06	Q	V
19+20	0.3896	0.06	Q	V
19+25	0.3901	0.07	Q	V
19+30	0.3907	0.08	Q	V
19+35	0.3911	0.07	Q	V
19+40	0.3916	0.06	Q	V
19+45	0.3920	0.06	Q	V
19+50	0.3923	0.05	Q	V
19+55	0.3926	0.04	Q	V
20+ 0	0.3929	0.04	Q	V
20+ 5	0.3932	0.05	Q	V
20+10	0.3936	0.05	Q	V
20+15	0.3940	0.06	Q	V
20+20	0.3944	0.06	Q	V
20+25	0.3948	0.06	Q	V
20+30	0.3952	0.06	Q	V
20+35	0.3956	0.06	Q	V
20+40	0.3960	0.06	Q	V
20+45	0.3964	0.06	Q	V
20+50	0.3968	0.05	Q	V
20+55	0.3970	0.04	Q	V
21+ 0	0.3973	0.04	Q	V
21+ 5	0.3976	0.05	Q	V
21+10	0.3980	0.05	Q	V
21+15	0.3984	0.06	Q	V
21+20	0.3988	0.05	Q	V
21+25	0.3991	0.04	Q	V
21+30	0.3993	0.04	Q	V
21+35	0.3996	0.05	Q	V
21+40	0.4000	0.05	Q	V
21+45	0.4004	0.06	Q	V
21+50	0.4008	0.05	Q	V
21+55	0.4011	0.04	Q	V
22+ 0	0.4013	0.04	Q	V
22+ 5	0.4017	0.05	Q	V
22+10	0.4020	0.05	Q	V
22+15	0.4024	0.06	Q	V
22+20	0.4028	0.05	Q	V
22+25	0.4031	0.04	Q	V
22+30	0.4033	0.04	Q	V
22+35	0.4036	0.04	Q	V
22+40	0.4039	0.04	Q	V
22+45	0.4041	0.04	Q	V
22+50	0.4044	0.04	Q	V
22+55	0.4047	0.04	Q	V
23+ 0	0.4050	0.04	Q	V
23+ 5	0.4052	0.04	Q	V

23+10	0.4055	0.04	Q				V
23+15	0.4058	0.04	Q				V
23+20	0.4060	0.04	Q				V
23+25	0.4063	0.04	Q				V
23+30	0.4066	0.04	Q				V
23+35	0.4068	0.04	Q				V
23+40	0.4071	0.04	Q				V
23+45	0.4074	0.04	Q				V
23+50	0.4076	0.04	Q				V
23+55	0.4079	0.04	Q				V
24+ 0	0.4082	0.04	Q				V
24+ 5	0.4083	0.03	Q				V
24+10	0.4084	0.01	Q				V
24+15	0.4084	0.00	Q				V
24+20	0.4084	0.00	Q				V
24+25	0.4084	0.00	Q				V

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Section 7.2 – Basin 2 – Existing 2 Year- 24 Hour Hydrograph

Unit Hydrograph Analysis

Copyright (C) CIVILCADD/CIVILDESIGN, 1989 - 2008, Version 8.1
Study date 04/22/24 File: EX22242.out

Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 5006

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

Drainage Area = 51.80(Ac.) = 0.081 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 51.80(Ac.) = 0.081 Sq. Mi.
Length along longest watercourse = 2127.00(Ft.)
Length along longest watercourse measured to centroid = 1064.00(Ft.)
Length along longest watercourse = 0.403 Mi.
Length along longest watercourse measured to centroid = 0.202 Mi.
Difference in elevation = 160.00(Ft.)
Slope along watercourse = 397.1791 Ft./Mi.
Average Manning's 'N' = 0.030
Lag time = 0.089 Hr.
Lag time = 5.34 Min.
25% of lag time = 1.33 Min.
40% of lag time = 2.13 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1] Rainfall(In)[2] weighting[1\*2]
51.80 1.80 93.24

100 YEAR Area rainfall data:

Area(Ac.)[1] Rainfall(In)[2] weighting[1\*2]
51.80 5.00 259.00

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 1.800(In)
Area Averaged 100-Year Rainfall = 5.000(In)

Point rain (area averaged) = 1.800(In)
Areal adjustment factor = 99.99 %
Adjusted average point rain = 1.800(In)

Sub-Area Data:
Area(Ac.) Runoff Index Impervious %
51.800 91.00 0.000
Total Area Entered = 51.80(Ac.)

RI RI Infil. Rate Impervious Adj. Infil. Rate Area% F
AMC2 AMC-1 (In/Hr) (Dec.%) (In/Hr) (Dec.) (In/Hr)
91.0 79.8 0.246 0.000 0.246 1.000 0.246
Sum (F) = 0.246

Area averaged mean soil loss (F) (In/Hr) = 0.246
Minimum soil loss rate ((In/Hr)) = 0.123
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.900

Unit Hydrograph
VALLEY S-Curve

Unit Hydrograph Data

Unit time period Time % of lag Distribution Unit Hydrograph
(hrs) Graph % (CFS)

1	0.083	93.693	17.279	9.021
2	0.167	187.386	47.711	24.907
3	0.250	281.078	16.693	8.714
4	0.333	374.771	7.417	3.872
5	0.417	468.464	4.247	2.217
6	0.500	562.157	2.744	1.432
7	0.583	655.849	1.804	0.942
8	0.667	749.542	1.132	0.591
9	0.750	843.235	0.973	0.508
			Sum = 100.000	Sum= 52.205

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

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr)		Effective (In/Hr)
				Max	Low	
1	0.08	0.07	0.014	( 0.437)	0.013	0.001
2	0.17	0.07	0.014	( 0.435)	0.013	0.001
3	0.25	0.07	0.014	( 0.433)	0.013	0.001
4	0.33	0.10	0.022	( 0.432)	0.019	0.002
5	0.42	0.10	0.022	( 0.430)	0.019	0.002
6	0.50	0.10	0.022	( 0.428)	0.019	0.002
7	0.58	0.10	0.022	( 0.427)	0.019	0.002
8	0.67	0.10	0.022	( 0.425)	0.019	0.002
9	0.75	0.10	0.022	( 0.423)	0.019	0.002
10	0.83	0.13	0.029	( 0.422)	0.026	0.003
11	0.92	0.13	0.029	( 0.420)	0.026	0.003
12	1.00	0.13	0.029	( 0.418)	0.026	0.003
13	1.08	0.10	0.022	( 0.417)	0.019	0.002
14	1.17	0.10	0.022	( 0.415)	0.019	0.002
15	1.25	0.10	0.022	( 0.413)	0.019	0.002
16	1.33	0.10	0.022	( 0.412)	0.019	0.002
17	1.42	0.10	0.022	( 0.410)	0.019	0.002
18	1.50	0.10	0.022	( 0.408)	0.019	0.002
19	1.58	0.10	0.022	( 0.407)	0.019	0.002
20	1.67	0.10	0.022	( 0.405)	0.019	0.002
21	1.75	0.10	0.022	( 0.404)	0.019	0.002
22	1.83	0.13	0.029	( 0.402)	0.026	0.003
23	1.92	0.13	0.029	( 0.400)	0.026	0.003
24	2.00	0.13	0.029	( 0.399)	0.026	0.003
25	2.08	0.13	0.029	( 0.397)	0.026	0.003
26	2.17	0.13	0.029	( 0.395)	0.026	0.003
27	2.25	0.13	0.029	( 0.394)	0.026	0.003
28	2.33	0.13	0.029	( 0.392)	0.026	0.003
29	2.42	0.13	0.029	( 0.391)	0.026	0.003
30	2.50	0.13	0.029	( 0.389)	0.026	0.003
31	2.58	0.17	0.036	( 0.387)	0.032	0.004
32	2.67	0.17	0.036	( 0.386)	0.032	0.004
33	2.75	0.17	0.036	( 0.384)	0.032	0.004
34	2.83	0.17	0.036	( 0.383)	0.032	0.004
35	2.92	0.17	0.036	( 0.381)	0.032	0.004
36	3.00	0.17	0.036	( 0.380)	0.032	0.004
37	3.08	0.17	0.036	( 0.378)	0.032	0.004
38	3.17	0.17	0.036	( 0.376)	0.032	0.004
39	3.25	0.17	0.036	( 0.375)	0.032	0.004
40	3.33	0.17	0.036	( 0.373)	0.032	0.004
41	3.42	0.17	0.036	( 0.372)	0.032	0.004
42	3.50	0.17	0.036	( 0.370)	0.032	0.004
43	3.58	0.17	0.036	( 0.369)	0.032	0.004
44	3.67	0.17	0.036	( 0.367)	0.032	0.004
45	3.75	0.17	0.036	( 0.366)	0.032	0.004
46	3.83	0.20	0.043	( 0.364)	0.039	0.004
47	3.92	0.20	0.043	( 0.362)	0.039	0.004
48	4.00	0.20	0.043	( 0.361)	0.039	0.004
49	4.08	0.20	0.043	( 0.359)	0.039	0.004
50	4.17	0.20	0.043	( 0.358)	0.039	0.004
51	4.25	0.20	0.043	( 0.356)	0.039	0.004
52	4.33	0.23	0.050	( 0.355)	0.045	0.005
53	4.42	0.23	0.050	( 0.353)	0.045	0.005
54	4.50	0.23	0.050	( 0.352)	0.045	0.005
55	4.58	0.23	0.050	( 0.350)	0.045	0.005
56	4.67	0.23	0.050	( 0.349)	0.045	0.005
57	4.75	0.23	0.050	( 0.347)	0.045	0.005
58	4.83	0.27	0.058	( 0.346)	0.052	0.006
59	4.92	0.27	0.058	( 0.344)	0.052	0.006
60	5.00	0.27	0.058	( 0.343)	0.052	0.006
61	5.08	0.20	0.043	( 0.341)	0.039	0.004
62	5.17	0.20	0.043	( 0.340)	0.039	0.004
63	5.25	0.20	0.043	( 0.338)	0.039	0.004
64	5.33	0.23	0.050	( 0.337)	0.045	0.005
65	5.42	0.23	0.050	( 0.335)	0.045	0.005
66	5.50	0.23	0.050	( 0.334)	0.045	0.005
67	5.58	0.27	0.058	( 0.332)	0.052	0.006

68	5.67	0.27	0.058	( 0.331)	0.052	0.006
69	5.75	0.27	0.058	( 0.330)	0.052	0.006
70	5.83	0.27	0.058	( 0.328)	0.052	0.006
71	5.92	0.27	0.058	( 0.327)	0.052	0.006
72	6.00	0.27	0.058	( 0.325)	0.052	0.006
73	6.08	0.30	0.065	( 0.324)	0.058	0.006
74	6.17	0.30	0.065	( 0.322)	0.058	0.006
75	6.25	0.30	0.065	( 0.321)	0.058	0.006
76	6.33	0.30	0.065	( 0.319)	0.058	0.006
77	6.42	0.30	0.065	( 0.318)	0.058	0.006
78	6.50	0.30	0.065	( 0.317)	0.058	0.006
79	6.58	0.33	0.072	( 0.315)	0.065	0.007
80	6.67	0.33	0.072	( 0.314)	0.065	0.007
81	6.75	0.33	0.072	( 0.312)	0.065	0.007
82	6.83	0.33	0.072	( 0.311)	0.065	0.007
83	6.92	0.33	0.072	( 0.310)	0.065	0.007
84	7.00	0.33	0.072	( 0.308)	0.065	0.007
85	7.08	0.33	0.072	( 0.307)	0.065	0.007
86	7.17	0.33	0.072	( 0.305)	0.065	0.007
87	7.25	0.33	0.072	( 0.304)	0.065	0.007
88	7.33	0.37	0.079	( 0.303)	0.071	0.008
89	7.42	0.37	0.079	( 0.301)	0.071	0.008
90	7.50	0.37	0.079	( 0.300)	0.071	0.008
91	7.58	0.40	0.086	( 0.298)	0.078	0.009
92	7.67	0.40	0.086	( 0.297)	0.078	0.009
93	7.75	0.40	0.086	( 0.296)	0.078	0.009
94	7.83	0.43	0.094	( 0.294)	0.084	0.009
95	7.92	0.43	0.094	( 0.293)	0.084	0.009
96	8.00	0.43	0.094	( 0.292)	0.084	0.009
97	8.08	0.50	0.108	( 0.290)	0.097	0.011
98	8.17	0.50	0.108	( 0.289)	0.097	0.011
99	8.25	0.50	0.108	( 0.288)	0.097	0.011
100	8.33	0.50	0.108	( 0.286)	0.097	0.011
101	8.42	0.50	0.108	( 0.285)	0.097	0.011
102	8.50	0.50	0.108	( 0.283)	0.097	0.011
103	8.58	0.53	0.115	( 0.282)	0.104	0.012
104	8.67	0.53	0.115	( 0.281)	0.104	0.012
105	8.75	0.53	0.115	( 0.280)	0.104	0.012
106	8.83	0.57	0.122	( 0.278)	0.110	0.012
107	8.92	0.57	0.122	( 0.277)	0.110	0.012
108	9.00	0.57	0.122	( 0.276)	0.110	0.012
109	9.08	0.63	0.137	( 0.274)	0.123	0.014
110	9.17	0.63	0.137	( 0.273)	0.123	0.014
111	9.25	0.63	0.137	( 0.272)	0.123	0.014
112	9.33	0.67	0.144	( 0.270)	0.130	0.014
113	9.42	0.67	0.144	( 0.269)	0.130	0.014
114	9.50	0.67	0.144	( 0.268)	0.130	0.014
115	9.58	0.70	0.151	( 0.267)	0.136	0.015
116	9.67	0.70	0.151	( 0.265)	0.136	0.015
117	9.75	0.70	0.151	( 0.264)	0.136	0.015
118	9.83	0.73	0.158	( 0.263)	0.143	0.016
119	9.92	0.73	0.158	( 0.261)	0.143	0.016
120	10.00	0.73	0.158	( 0.260)	0.143	0.016
121	10.08	0.50	0.108	( 0.259)	0.097	0.011
122	10.17	0.50	0.108	( 0.258)	0.097	0.011
123	10.25	0.50	0.108	( 0.256)	0.097	0.011
124	10.33	0.50	0.108	( 0.255)	0.097	0.011
125	10.42	0.50	0.108	( 0.254)	0.097	0.011
126	10.50	0.50	0.108	( 0.253)	0.097	0.011
127	10.58	0.67	0.144	( 0.251)	0.130	0.014
128	10.67	0.67	0.144	( 0.250)	0.130	0.014
129	10.75	0.67	0.144	( 0.249)	0.130	0.014
130	10.83	0.67	0.144	( 0.248)	0.130	0.014
131	10.92	0.67	0.144	( 0.247)	0.130	0.014
132	11.00	0.67	0.144	( 0.245)	0.130	0.014
133	11.08	0.63	0.137	( 0.244)	0.123	0.014
134	11.17	0.63	0.137	( 0.243)	0.123	0.014
135	11.25	0.63	0.137	( 0.242)	0.123	0.014
136	11.33	0.63	0.137	( 0.241)	0.123	0.014
137	11.42	0.63	0.137	( 0.239)	0.123	0.014
138	11.50	0.63	0.137	( 0.238)	0.123	0.014
139	11.58	0.57	0.122	( 0.237)	0.110	0.012
140	11.67	0.57	0.122	( 0.236)	0.110	0.012
141	11.75	0.57	0.122	( 0.235)	0.110	0.012
142	11.83	0.60	0.130	( 0.233)	0.117	0.013
143	11.92	0.60	0.130	( 0.232)	0.117	0.013
144	12.00	0.60	0.130	( 0.231)	0.117	0.013
145	12.08	0.83	0.180	( 0.230)	0.162	0.018
146	12.17	0.83	0.180	( 0.229)	0.162	0.018
147	12.25	0.83	0.180	( 0.228)	0.162	0.018
148	12.33	0.87	0.187	( 0.227)	0.168	0.019
149	12.42	0.87	0.187	( 0.225)	0.168	0.019
150	12.50	0.87	0.187	( 0.224)	0.168	0.019
151	12.58	0.93	0.202	( 0.223)	0.181	0.020
152	12.67	0.93	0.202	( 0.222)	0.181	0.020
153	12.75	0.93	0.202	( 0.221)	0.181	0.020

154	12.83	0.97	0.209	(	0.220)	0.188	0.021	
155	12.92	0.97	0.209	(	0.219)	0.188	0.021	
156	13.00	0.97	0.209	(	0.218)	0.188	0.021	
157	13.08	1.13	0.245		0.216	(	0.220)	0.028
158	13.17	1.13	0.245		0.215	(	0.220)	0.029
159	13.25	1.13	0.245		0.214	(	0.220)	0.031
160	13.33	1.13	0.245		0.213	(	0.220)	0.032
161	13.42	1.13	0.245		0.212	(	0.220)	0.033
162	13.50	1.13	0.245		0.211	(	0.220)	0.034
163	13.58	0.77	0.166	(	0.210)	0.149	0.017	
164	13.67	0.77	0.166	(	0.209)	0.149	0.017	
165	13.75	0.77	0.166	(	0.208)	0.149	0.017	
166	13.83	0.77	0.166	(	0.207)	0.149	0.017	
167	13.92	0.77	0.166	(	0.206)	0.149	0.017	
168	14.00	0.77	0.166	(	0.205)	0.149	0.017	
169	14.08	0.90	0.194	(	0.204)	0.175	0.019	
170	14.17	0.90	0.194	(	0.203)	0.175	0.019	
171	14.25	0.90	0.194	(	0.202)	0.175	0.019	
172	14.33	0.87	0.187	(	0.200)	0.168	0.019	
173	14.42	0.87	0.187	(	0.199)	0.168	0.019	
174	14.50	0.87	0.187	(	0.198)	0.168	0.019	
175	14.58	0.87	0.187	(	0.197)	0.168	0.019	
176	14.67	0.87	0.187	(	0.196)	0.168	0.019	
177	14.75	0.87	0.187	(	0.195)	0.168	0.019	
178	14.83	0.83	0.180	(	0.194)	0.162	0.018	
179	14.92	0.83	0.180	(	0.193)	0.162	0.018	
180	15.00	0.83	0.180	(	0.192)	0.162	0.018	
181	15.08	0.80	0.173	(	0.191)	0.156	0.017	
182	15.17	0.80	0.173	(	0.190)	0.156	0.017	
183	15.25	0.80	0.173	(	0.189)	0.156	0.017	
184	15.33	0.77	0.166	(	0.188)	0.149	0.017	
185	15.42	0.77	0.166	(	0.188)	0.149	0.017	
186	15.50	0.77	0.166	(	0.187)	0.149	0.017	
187	15.58	0.63	0.137	(	0.186)	0.123	0.014	
188	15.67	0.63	0.137	(	0.185)	0.123	0.014	
189	15.75	0.63	0.137	(	0.184)	0.123	0.014	
190	15.83	0.63	0.137	(	0.183)	0.123	0.014	
191	15.92	0.63	0.137	(	0.182)	0.123	0.014	
192	16.00	0.63	0.137	(	0.181)	0.123	0.014	
193	16.08	0.13	0.029	(	0.180)	0.026	0.003	
194	16.17	0.13	0.029	(	0.179)	0.026	0.003	
195	16.25	0.13	0.029	(	0.178)	0.026	0.003	
196	16.33	0.13	0.029	(	0.177)	0.026	0.003	
197	16.42	0.13	0.029	(	0.176)	0.026	0.003	
198	16.50	0.13	0.029	(	0.175)	0.026	0.003	
199	16.58	0.10	0.022	(	0.175)	0.019	0.002	
200	16.67	0.10	0.022	(	0.174)	0.019	0.002	
201	16.75	0.10	0.022	(	0.173)	0.019	0.002	
202	16.83	0.10	0.022	(	0.172)	0.019	0.002	
203	16.92	0.10	0.022	(	0.171)	0.019	0.002	
204	17.00	0.10	0.022	(	0.170)	0.019	0.002	
205	17.08	0.17	0.036	(	0.169)	0.032	0.004	
206	17.17	0.17	0.036	(	0.168)	0.032	0.004	
207	17.25	0.17	0.036	(	0.168)	0.032	0.004	
208	17.33	0.17	0.036	(	0.167)	0.032	0.004	
209	17.42	0.17	0.036	(	0.166)	0.032	0.004	
210	17.50	0.17	0.036	(	0.165)	0.032	0.004	
211	17.58	0.17	0.036	(	0.164)	0.032	0.004	
212	17.67	0.17	0.036	(	0.163)	0.032	0.004	
213	17.75	0.17	0.036	(	0.163)	0.032	0.004	
214	17.83	0.13	0.029	(	0.162)	0.026	0.003	
215	17.92	0.13	0.029	(	0.161)	0.026	0.003	
216	18.00	0.13	0.029	(	0.160)	0.026	0.003	
217	18.08	0.13	0.029	(	0.159)	0.026	0.003	
218	18.17	0.13	0.029	(	0.159)	0.026	0.003	
219	18.25	0.13	0.029	(	0.158)	0.026	0.003	
220	18.33	0.13	0.029	(	0.157)	0.026	0.003	
221	18.42	0.13	0.029	(	0.156)	0.026	0.003	
222	18.50	0.13	0.029	(	0.156)	0.026	0.003	
223	18.58	0.10	0.022	(	0.155)	0.019	0.002	
224	18.67	0.10	0.022	(	0.154)	0.019	0.002	
225	18.75	0.10	0.022	(	0.153)	0.019	0.002	
226	18.83	0.07	0.014	(	0.153)	0.013	0.001	
227	18.92	0.07	0.014	(	0.152)	0.013	0.001	
228	19.00	0.07	0.014	(	0.151)	0.013	0.001	
229	19.08	0.10	0.022	(	0.150)	0.019	0.002	
230	19.17	0.10	0.022	(	0.150)	0.019	0.002	
231	19.25	0.10	0.022	(	0.149)	0.019	0.002	
232	19.33	0.13	0.029	(	0.148)	0.026	0.003	
233	19.42	0.13	0.029	(	0.148)	0.026	0.003	
234	19.50	0.13	0.029	(	0.147)	0.026	0.003	
235	19.58	0.10	0.022	(	0.146)	0.019	0.002	
236	19.67	0.10	0.022	(	0.146)	0.019	0.002	
237	19.75	0.10	0.022	(	0.145)	0.019	0.002	
238	19.83	0.07	0.014	(	0.144)	0.013	0.001	
239	19.92	0.07	0.014	(	0.144)	0.013	0.001	



1+25	0.0119	0.11	Q			
1+30	0.0127	0.11	Q			
1+35	0.0135	0.11	Q			
1+40	0.0143	0.11	Q			
1+45	0.0151	0.11	Q			
1+50	0.0159	0.12	Q			
1+55	0.0168	0.14	Q			
2+ 0	0.0178	0.14	Q			
2+ 5	0.0188	0.15	Q			
2+10	0.0198	0.15	QV			
2+15	0.0209	0.15	QV			
2+20	0.0219	0.15	QV			
2+25	0.0229	0.15	QV			
2+30	0.0240	0.15	QV			
2+35	0.0251	0.16	QV			
2+40	0.0263	0.17	QV			
2+45	0.0275	0.18	QV			
2+50	0.0288	0.18	QV			
2+55	0.0301	0.19	QV			
3+ 0	0.0313	0.19	QV			
3+ 5	0.0326	0.19	QV			
3+10	0.0339	0.19	QV			
3+15	0.0352	0.19	QV			
3+20	0.0365	0.19	QV			
3+25	0.0378	0.19	QV			
3+30	0.0391	0.19	QV			
3+35	0.0404	0.19	Q V			
3+40	0.0417	0.19	Q V			
3+45	0.0430	0.19	Q V			
3+50	0.0443	0.19	Q V			
3+55	0.0458	0.21	Q V			
4+ 0	0.0473	0.22	Q V			
4+ 5	0.0488	0.22	Q V			
4+10	0.0504	0.22	Q V			
4+15	0.0519	0.22	Q V			
4+20	0.0535	0.23	Q V			
4+25	0.0552	0.25	Q V			
4+30	0.0570	0.26	QV			
4+35	0.0588	0.26	QV			
4+40	0.0606	0.26	Q V			
4+45	0.0624	0.26	Q V			
4+50	0.0642	0.27	Q V			
4+55	0.0662	0.29	Q V			
5+ 0	0.0682	0.29	Q V			
5+ 5	0.0702	0.28	Q V			
5+10	0.0719	0.25	Q V			
5+15	0.0735	0.24	Q V			
5+20	0.0752	0.24	Q V			
5+25	0.0769	0.25	Q V			
5+30	0.0787	0.26	Q V			
5+35	0.0806	0.27	Q V			
5+40	0.0825	0.29	Q V			
5+45	0.0845	0.29	Q V			
5+50	0.0866	0.30	Q V			
5+55	0.0886	0.30	Q V			
6+ 0	0.0907	0.30	Q V			
6+ 5	0.0928	0.31	Q V			
6+10	0.0950	0.32	Q V			
6+15	0.0973	0.33	Q V			
6+20	0.0996	0.33	Q V			
6+25	0.1019	0.34	Q V			
6+30	0.1043	0.34	Q V			
6+35	0.1066	0.34	Q V			
6+40	0.1091	0.36	Q V			
6+45	0.1117	0.37	Q V			
6+50	0.1142	0.37	Q V			
6+55	0.1168	0.37	Q V			
7+ 0	0.1194	0.37	Q V			
7+ 5	0.1220	0.38	Q V			
7+10	0.1246	0.38	Q V			
7+15	0.1271	0.38	Q V			
7+20	0.1298	0.38	Q V			
7+25	0.1325	0.40	Q V			
7+30	0.1353	0.41	Q V			
7+35	0.1382	0.42	Q V			
7+40	0.1412	0.44	Q V			
7+45	0.1442	0.44	Q V			
7+50	0.1474	0.45	Q V			
7+55	0.1506	0.47	Q V			
8+ 0	0.1539	0.48	Q V			
8+ 5	0.1574	0.50	Q V			
8+10	0.1610	0.53	Q V			
8+15	0.1648	0.55	Q V			
8+20	0.1686	0.56	Q V			
8+25	0.1725	0.56	Q V			
8+30	0.1764	0.56	Q V			

8+35	0.1803	0.57	Q	V		
8+40	0.1843	0.59	Q	V		
8+45	0.1884	0.59	Q	V		
8+50	0.1926	0.60	Q	V		
8+55	0.1969	0.62	Q	V		
9+ 0	0.2012	0.63	Q	V		
9+ 5	0.2057	0.65	Q	V		
9+10	0.2104	0.69	Q	V		
9+15	0.2152	0.70	Q	V		
9+20	0.2201	0.71	Q	V		
9+25	0.2252	0.73	Q	V		
9+30	0.2303	0.74	Q	V		
9+35	0.2355	0.75	Q	V		
9+40	0.2408	0.77	Q	V		
9+45	0.2462	0.78	Q	V		
9+50	0.2516	0.79	Q	V		
9+55	0.2572	0.81	Q	V		
10+ 0	0.2628	0.82	Q	V		
10+ 5	0.2682	0.78	Q	V		
10+10	0.2727	0.65	Q	V		
10+15	0.2769	0.61	Q	V		
10+20	0.2810	0.59	Q	V		
10+25	0.2850	0.58	Q	V		
10+30	0.2889	0.57	Q	V		
10+35	0.2931	0.60	Q	V		
10+40	0.2978	0.69	Q	V		
10+45	0.3028	0.72	Q	V		
10+50	0.3078	0.73	Q	V		
10+55	0.3129	0.74	Q	V		
11+ 0	0.3180	0.74	Q	V		
11+ 5	0.3231	0.74	Q	V		
11+10	0.3281	0.73	Q	V		
11+15	0.3331	0.72	Q	V		
11+20	0.3381	0.72	Q	V		
11+25	0.3430	0.72	Q	V		
11+30	0.3479	0.72	Q	V		
11+35	0.3528	0.70	Q	V		
11+40	0.3573	0.67	Q	V		
11+45	0.3618	0.65	Q	V		
11+50	0.3663	0.65	Q	V		
11+55	0.3709	0.67	Q	V		
12+ 0	0.3756	0.67	Q	V		
12+ 5	0.3805	0.72	Q	V		
12+10	0.3864	0.85	Q	V		
12+15	0.3925	0.89	Q	V		
12+20	0.3988	0.92	Q	V		
12+25	0.4053	0.95	Q	V		
12+30	0.4120	0.96	Q	V		
12+35	0.4187	0.98	Q	V		
12+40	0.4257	1.02	Q	V		
12+45	0.4329	1.04	Q	V		
12+50	0.4401	1.05	Q	V		
12+55	0.4475	1.07	Q	V		
13+ 0	0.4549	1.08	Q	V		
13+ 5	0.4629	1.15	Q	V		
13+10	0.4722	1.35	Q	V		
13+15	0.4822	1.45	Q	V		
13+20	0.4927	1.53	Q	V		
13+25	0.5037	1.60	Q	V		
13+30	0.5152	1.66	Q	V		
13+35	0.5259	1.56	Q	V		
13+40	0.5338	1.15	Q	V		
13+45	0.5408	1.02	Q	V		
13+50	0.5474	0.96	Q	V		
13+55	0.5537	0.92	Q	V		
14+ 0	0.5599	0.90	Q	V		
14+ 5	0.5662	0.91	Q	V		
14+10	0.5729	0.97	Q	V		
14+15	0.5797	0.99	Q	V		
14+20	0.5865	0.99	Q	V		
14+25	0.5933	0.98	Q	V		
14+30	0.6000	0.98	Q	V		
14+35	0.6068	0.98	Q	V		
14+40	0.6135	0.98	Q	V		
14+45	0.6202	0.98	Q	V		
14+50	0.6269	0.97	Q	V		
14+55	0.6335	0.95	Q	V		
15+ 0	0.6400	0.95	Q	V		
15+ 5	0.6465	0.94	Q	V		
15+10	0.6528	0.92	Q	V		
15+15	0.6591	0.91	Q	V		
15+20	0.6653	0.90	Q	V		
15+25	0.6714	0.88	Q	V		
15+30	0.6774	0.87	Q	V		
15+35	0.6832	0.84	Q	V		
15+40	0.6885	0.77	Q	V		

15+45	0.6936	0.74	Q			V
15+50	0.6986	0.73	Q			V
15+55	0.7036	0.72	Q			V
16+ 0	0.7086	0.72	Q			V
16+ 5	0.7129	0.62	Q			V
16+10	0.7153	0.35	Q			V
16+15	0.7170	0.25	Q			V
16+20	0.7185	0.21	Q			V
16+25	0.7198	0.19	Q			V
16+30	0.7210	0.17	Q			V
16+35	0.7220	0.16	Q			V
16+40	0.7229	0.13	Q			V
16+45	0.7238	0.12	Q			V
16+50	0.7246	0.12	Q			V
16+55	0.7254	0.12	Q			V
17+ 0	0.7261	0.11	Q			V
17+ 5	0.7270	0.13	Q			V
17+10	0.7281	0.16	Q			V
17+15	0.7293	0.17	Q			V
17+20	0.7306	0.18	Q			V
17+25	0.7318	0.18	Q			V
17+30	0.7331	0.19	Q			V
17+35	0.7344	0.19	Q			V
17+40	0.7357	0.19	Q			V
17+45	0.7370	0.19	Q			V
17+50	0.7382	0.18	Q			V
17+55	0.7394	0.16	Q			V
18+ 0	0.7404	0.16	Q			V
18+ 5	0.7415	0.15	Q			V
18+10	0.7426	0.15	Q			V
18+15	0.7436	0.15	Q			V
18+20	0.7446	0.15	Q			V
18+25	0.7457	0.15	Q			V
18+30	0.7467	0.15	Q			V
18+35	0.7477	0.14	Q			V
18+40	0.7486	0.13	Q			V
18+45	0.7494	0.12	Q			V
18+50	0.7502	0.11	Q			V
18+55	0.7508	0.09	Q			V
19+ 0	0.7514	0.08	Q			V
19+ 5	0.7520	0.09	Q			V
19+10	0.7527	0.10	Q			V
19+15	0.7534	0.11	Q			V
19+20	0.7542	0.12	Q			V
19+25	0.7551	0.14	Q			V
19+30	0.7561	0.14	Q			V
19+35	0.7571	0.14	Q			V
19+40	0.7579	0.12	Q			V
19+45	0.7587	0.12	Q			V
19+50	0.7595	0.11	Q			V
19+55	0.7601	0.09	Q			V
20+ 0	0.7607	0.08	Q			V
20+ 5	0.7613	0.09	Q			V
20+10	0.7620	0.10	Q			V
20+15	0.7627	0.11	Q			V
20+20	0.7635	0.11	Q			V
20+25	0.7642	0.11	Q			V
20+30	0.7650	0.11	Q			V
20+35	0.7658	0.11	Q			V
20+40	0.7666	0.11	Q			V
20+45	0.7673	0.11	Q			V
20+50	0.7681	0.11	Q			V
20+55	0.7687	0.09	Q			V
21+ 0	0.7692	0.08	Q			V
21+ 5	0.7698	0.09	Q			V
21+10	0.7705	0.10	Q			V
21+15	0.7713	0.11	Q			V
21+20	0.7720	0.10	Q			V
21+25	0.7726	0.09	Q			V
21+30	0.7731	0.08	Q			V
21+35	0.7737	0.09	Q			V
21+40	0.7744	0.10	Q			V
21+45	0.7752	0.11	Q			V
21+50	0.7759	0.10	Q			V
21+55	0.7765	0.09	Q			V
22+ 0	0.7770	0.08	Q			V
22+ 5	0.7776	0.09	Q			V
22+10	0.7783	0.10	Q			V
22+15	0.7790	0.11	Q			V
22+20	0.7797	0.10	Q			V
22+25	0.7803	0.09	Q			V
22+30	0.7809	0.08	Q			V
22+35	0.7814	0.08	Q			V
22+40	0.7820	0.08	Q			V
22+45	0.7825	0.08	Q			V
22+50	0.7830	0.08	Q			V

22+55	0.7835	0.08	Q				V
23+ 0	0.7841	0.08	Q				V
23+ 5	0.7846	0.08	Q				V
23+10	0.7851	0.08	Q				V
23+15	0.7856	0.08	Q				V
23+20	0.7861	0.08	Q				V
23+25	0.7867	0.08	Q				V
23+30	0.7872	0.08	Q				V
23+35	0.7877	0.08	Q				V
23+40	0.7882	0.08	Q				V
23+45	0.7887	0.08	Q				V
23+50	0.7892	0.08	Q				V
23+55	0.7898	0.08	Q				V
24+ 0	0.7903	0.08	Q				V
24+ 5	0.7907	0.06	Q				V
24+10	0.7909	0.03	Q				V
24+15	0.7910	0.01	Q				V
24+20	0.7910	0.01	Q				V
24+25	0.7911	0.01	Q				V
24+30	0.7911	0.00	Q				V
24+35	0.7911	0.00	Q				V
24+40	0.7911	0.00	Q				V

Section 7.3 – Basin 3 – Existing 2 Year- 24 Hour Hydrograph

Unit Hydrograph Analysis

Copyright (C) CIVILCADD/CIVILDESIGN, 1989 - 2008, Version 8.1  
 Study date 04/22/24 File: EX32242.out

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Riverside County Synthetic Unit Hydrology Method  
 RCFC & WCD Manual date - April 1978

Program License Serial Number 5006

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

English Units used in output format

-----  
 Drainage Area = 7.79(Ac.) = 0.012 Sq. Mi.  
 Drainage Area for Depth-Area Areal Adjustment = 7.79(Ac.) = 0.012 Sq. Mi.  
 Length along longest watercourse = 1222.00(Ft.)  
 Length along longest watercourse measured to centroid = 611.00(Ft.)  
 Length along longest watercourse = 0.231 Mi.  
 Length along longest watercourse measured to centroid = 0.116 Mi.  
 Difference in elevation = 89.00(Ft.)  
 Slope along watercourse = 384.5499 Ft./Mi.  
 Average Manning's 'N' = 0.030  
 Lag time = 0.059 Hr.  
 Lag time = 3.52 Min.  
 25% of lag time = 0.88 Min.  
 40% of lag time = 1.41 Min.  
 Unit time = 5.00 Min.  
 Duration of storm = 24 Hour(s)  
 User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	weighting[1*2]
7.79	1.80	14.02

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	weighting[1*2]
7.79	5.00	38.95

STORM EVENT (YEAR) = 2.00  
 Area Averaged 2-Year Rainfall = 1.800(In)  
 Area Averaged 100-Year Rainfall = 5.000(In)

Point rain (area averaged) = 1.800(In)  
 Areal adjustment factor = 100.00 %  
 Adjusted average point rain = 1.800(In)

Sub-Area Data:  
 Area(Ac.)      Runoff Index      Impervious %  
 7.790            91.00            0.000  
 Total Area Entered = 7.79(Ac.)

RI	RI	Infil. Rate	Impervious	Adj. Infil. Rate	Area%	F
AMC2	AMC-1	(In/Hr)	(Dec.%)	(In/Hr)	(Dec.)	(In/Hr)
91.0	79.8	0.246	0.000	0.246	1.000	0.246
						Sum (F) = 0.246

Area averaged mean soil loss (F) (In/Hr) = 0.246  
 Minimum soil loss rate ((In/Hr)) = 0.123  
 (for 24 hour storm duration)  
 Soil loss rate (decimal) = 0.900

-----  
 Unit Hydrograph  
 VALLEY S-Curve

-----  
 Unit Hydrograph Data

Unit time period	Time % of lag	Distribution	Unit Hydrograph
(hrs)		Graph %	(CFS)

1	0.083	141.921	31.169	2.447
2	0.167	283.842	47.579	3.735
3	0.250	425.763	11.677	0.917
4	0.333	567.684	5.139	0.403
5	0.417	709.604	2.712	0.213
6	0.500	851.525	1.724	0.135
			Sum = 100.000	Sum= 7.851

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

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr)		Effective (In/Hr)
				Max	Low	
1	0.08	0.07	0.014	( 0.437)	0.013	0.001
2	0.17	0.07	0.014	( 0.435)	0.013	0.001
3	0.25	0.07	0.014	( 0.433)	0.013	0.001
4	0.33	0.10	0.022	( 0.432)	0.019	0.002
5	0.42	0.10	0.022	( 0.430)	0.019	0.002
6	0.50	0.10	0.022	( 0.428)	0.019	0.002
7	0.58	0.10	0.022	( 0.427)	0.019	0.002
8	0.67	0.10	0.022	( 0.425)	0.019	0.002
9	0.75	0.10	0.022	( 0.423)	0.019	0.002
10	0.83	0.13	0.029	( 0.422)	0.026	0.003
11	0.92	0.13	0.029	( 0.420)	0.026	0.003
12	1.00	0.13	0.029	( 0.418)	0.026	0.003
13	1.08	0.10	0.022	( 0.417)	0.019	0.002
14	1.17	0.10	0.022	( 0.415)	0.019	0.002
15	1.25	0.10	0.022	( 0.413)	0.019	0.002
16	1.33	0.10	0.022	( 0.412)	0.019	0.002
17	1.42	0.10	0.022	( 0.410)	0.019	0.002
18	1.50	0.10	0.022	( 0.408)	0.019	0.002
19	1.58	0.10	0.022	( 0.407)	0.019	0.002
20	1.67	0.10	0.022	( 0.405)	0.019	0.002
21	1.75	0.10	0.022	( 0.404)	0.019	0.002
22	1.83	0.13	0.029	( 0.402)	0.026	0.003
23	1.92	0.13	0.029	( 0.400)	0.026	0.003
24	2.00	0.13	0.029	( 0.399)	0.026	0.003
25	2.08	0.13	0.029	( 0.397)	0.026	0.003
26	2.17	0.13	0.029	( 0.395)	0.026	0.003
27	2.25	0.13	0.029	( 0.394)	0.026	0.003
28	2.33	0.13	0.029	( 0.392)	0.026	0.003
29	2.42	0.13	0.029	( 0.391)	0.026	0.003
30	2.50	0.13	0.029	( 0.389)	0.026	0.003
31	2.58	0.17	0.036	( 0.387)	0.032	0.004
32	2.67	0.17	0.036	( 0.386)	0.032	0.004
33	2.75	0.17	0.036	( 0.384)	0.032	0.004
34	2.83	0.17	0.036	( 0.383)	0.032	0.004
35	2.92	0.17	0.036	( 0.381)	0.032	0.004
36	3.00	0.17	0.036	( 0.380)	0.032	0.004
37	3.08	0.17	0.036	( 0.378)	0.032	0.004
38	3.17	0.17	0.036	( 0.376)	0.032	0.004
39	3.25	0.17	0.036	( 0.375)	0.032	0.004
40	3.33	0.17	0.036	( 0.373)	0.032	0.004
41	3.42	0.17	0.036	( 0.372)	0.032	0.004
42	3.50	0.17	0.036	( 0.370)	0.032	0.004
43	3.58	0.17	0.036	( 0.369)	0.032	0.004
44	3.67	0.17	0.036	( 0.367)	0.032	0.004
45	3.75	0.17	0.036	( 0.366)	0.032	0.004
46	3.83	0.20	0.043	( 0.364)	0.039	0.004
47	3.92	0.20	0.043	( 0.362)	0.039	0.004
48	4.00	0.20	0.043	( 0.361)	0.039	0.004
49	4.08	0.20	0.043	( 0.359)	0.039	0.004
50	4.17	0.20	0.043	( 0.358)	0.039	0.004
51	4.25	0.20	0.043	( 0.356)	0.039	0.004
52	4.33	0.23	0.050	( 0.355)	0.045	0.005
53	4.42	0.23	0.050	( 0.353)	0.045	0.005
54	4.50	0.23	0.050	( 0.352)	0.045	0.005
55	4.58	0.23	0.050	( 0.350)	0.045	0.005
56	4.67	0.23	0.050	( 0.349)	0.045	0.005
57	4.75	0.23	0.050	( 0.347)	0.045	0.005
58	4.83	0.27	0.058	( 0.346)	0.052	0.006
59	4.92	0.27	0.058	( 0.344)	0.052	0.006
60	5.00	0.27	0.058	( 0.343)	0.052	0.006
61	5.08	0.20	0.043	( 0.341)	0.039	0.004
62	5.17	0.20	0.043	( 0.340)	0.039	0.004
63	5.25	0.20	0.043	( 0.338)	0.039	0.004
64	5.33	0.23	0.050	( 0.337)	0.045	0.005
65	5.42	0.23	0.050	( 0.335)	0.045	0.005
66	5.50	0.23	0.050	( 0.334)	0.045	0.005
67	5.58	0.27	0.058	( 0.332)	0.052	0.006
68	5.67	0.27	0.058	( 0.331)	0.052	0.006
69	5.75	0.27	0.058	( 0.330)	0.052	0.006
70	5.83	0.27	0.058	( 0.328)	0.052	0.006

71	5.92	0.27	0.058	( 0.327)	0.052	0.006
72	6.00	0.27	0.058	( 0.325)	0.052	0.006
73	6.08	0.30	0.065	( 0.324)	0.058	0.006
74	6.17	0.30	0.065	( 0.322)	0.058	0.006
75	6.25	0.30	0.065	( 0.321)	0.058	0.006
76	6.33	0.30	0.065	( 0.319)	0.058	0.006
77	6.42	0.30	0.065	( 0.318)	0.058	0.006
78	6.50	0.30	0.065	( 0.317)	0.058	0.006
79	6.58	0.33	0.072	( 0.315)	0.065	0.007
80	6.67	0.33	0.072	( 0.314)	0.065	0.007
81	6.75	0.33	0.072	( 0.312)	0.065	0.007
82	6.83	0.33	0.072	( 0.311)	0.065	0.007
83	6.92	0.33	0.072	( 0.310)	0.065	0.007
84	7.00	0.33	0.072	( 0.308)	0.065	0.007
85	7.08	0.33	0.072	( 0.307)	0.065	0.007
86	7.17	0.33	0.072	( 0.305)	0.065	0.007
87	7.25	0.33	0.072	( 0.304)	0.065	0.007
88	7.33	0.37	0.079	( 0.303)	0.071	0.008
89	7.42	0.37	0.079	( 0.301)	0.071	0.008
90	7.50	0.37	0.079	( 0.300)	0.071	0.008
91	7.58	0.40	0.086	( 0.298)	0.078	0.009
92	7.67	0.40	0.086	( 0.297)	0.078	0.009
93	7.75	0.40	0.086	( 0.296)	0.078	0.009
94	7.83	0.43	0.094	( 0.294)	0.084	0.009
95	7.92	0.43	0.094	( 0.293)	0.084	0.009
96	8.00	0.43	0.094	( 0.292)	0.084	0.009
97	8.08	0.50	0.108	( 0.290)	0.097	0.011
98	8.17	0.50	0.108	( 0.289)	0.097	0.011
99	8.25	0.50	0.108	( 0.288)	0.097	0.011
100	8.33	0.50	0.108	( 0.286)	0.097	0.011
101	8.42	0.50	0.108	( 0.285)	0.097	0.011
102	8.50	0.50	0.108	( 0.283)	0.097	0.011
103	8.58	0.53	0.115	( 0.282)	0.104	0.012
104	8.67	0.53	0.115	( 0.281)	0.104	0.012
105	8.75	0.53	0.115	( 0.280)	0.104	0.012
106	8.83	0.57	0.122	( 0.278)	0.110	0.012
107	8.92	0.57	0.122	( 0.277)	0.110	0.012
108	9.00	0.57	0.122	( 0.276)	0.110	0.012
109	9.08	0.63	0.137	( 0.274)	0.123	0.014
110	9.17	0.63	0.137	( 0.273)	0.123	0.014
111	9.25	0.63	0.137	( 0.272)	0.123	0.014
112	9.33	0.67	0.144	( 0.270)	0.130	0.014
113	9.42	0.67	0.144	( 0.269)	0.130	0.014
114	9.50	0.67	0.144	( 0.268)	0.130	0.014
115	9.58	0.70	0.151	( 0.267)	0.136	0.015
116	9.67	0.70	0.151	( 0.265)	0.136	0.015
117	9.75	0.70	0.151	( 0.264)	0.136	0.015
118	9.83	0.73	0.158	( 0.263)	0.143	0.016
119	9.92	0.73	0.158	( 0.261)	0.143	0.016
120	10.00	0.73	0.158	( 0.260)	0.143	0.016
121	10.08	0.50	0.108	( 0.259)	0.097	0.011
122	10.17	0.50	0.108	( 0.258)	0.097	0.011
123	10.25	0.50	0.108	( 0.256)	0.097	0.011
124	10.33	0.50	0.108	( 0.255)	0.097	0.011
125	10.42	0.50	0.108	( 0.254)	0.097	0.011
126	10.50	0.50	0.108	( 0.253)	0.097	0.011
127	10.58	0.67	0.144	( 0.251)	0.130	0.014
128	10.67	0.67	0.144	( 0.250)	0.130	0.014
129	10.75	0.67	0.144	( 0.249)	0.130	0.014
130	10.83	0.67	0.144	( 0.248)	0.130	0.014
131	10.92	0.67	0.144	( 0.247)	0.130	0.014
132	11.00	0.67	0.144	( 0.245)	0.130	0.014
133	11.08	0.63	0.137	( 0.244)	0.123	0.014
134	11.17	0.63	0.137	( 0.243)	0.123	0.014
135	11.25	0.63	0.137	( 0.242)	0.123	0.014
136	11.33	0.63	0.137	( 0.241)	0.123	0.014
137	11.42	0.63	0.137	( 0.239)	0.123	0.014
138	11.50	0.63	0.137	( 0.238)	0.123	0.014
139	11.58	0.57	0.122	( 0.237)	0.110	0.012
140	11.67	0.57	0.122	( 0.236)	0.110	0.012
141	11.75	0.57	0.122	( 0.235)	0.110	0.012
142	11.83	0.60	0.130	( 0.233)	0.117	0.013
143	11.92	0.60	0.130	( 0.232)	0.117	0.013
144	12.00	0.60	0.130	( 0.231)	0.117	0.013
145	12.08	0.83	0.180	( 0.230)	0.162	0.018
146	12.17	0.83	0.180	( 0.229)	0.162	0.018
147	12.25	0.83	0.180	( 0.228)	0.162	0.018
148	12.33	0.87	0.187	( 0.227)	0.168	0.019
149	12.42	0.87	0.187	( 0.225)	0.168	0.019
150	12.50	0.87	0.187	( 0.224)	0.168	0.019
151	12.58	0.93	0.202	( 0.223)	0.181	0.020
152	12.67	0.93	0.202	( 0.222)	0.181	0.020
153	12.75	0.93	0.202	( 0.221)	0.181	0.020
154	12.83	0.97	0.209	( 0.220)	0.188	0.021
155	12.92	0.97	0.209	( 0.219)	0.188	0.021
156	13.00	0.97	0.209	( 0.218)	0.188	0.021

157	13.08	1.13	0.245	0.216	( 0.220)	0.028
158	13.17	1.13	0.245	0.215	( 0.220)	0.029
159	13.25	1.13	0.245	0.214	( 0.220)	0.031
160	13.33	1.13	0.245	0.213	( 0.220)	0.032
161	13.42	1.13	0.245	0.212	( 0.220)	0.033
162	13.50	1.13	0.245	0.211	( 0.220)	0.034
163	13.58	0.77	0.166	( 0.210)	0.149	0.017
164	13.67	0.77	0.166	( 0.209)	0.149	0.017
165	13.75	0.77	0.166	( 0.208)	0.149	0.017
166	13.83	0.77	0.166	( 0.207)	0.149	0.017
167	13.92	0.77	0.166	( 0.206)	0.149	0.017
168	14.00	0.77	0.166	( 0.205)	0.149	0.017
169	14.08	0.90	0.194	( 0.204)	0.175	0.019
170	14.17	0.90	0.194	( 0.203)	0.175	0.019
171	14.25	0.90	0.194	( 0.202)	0.175	0.019
172	14.33	0.87	0.187	( 0.200)	0.168	0.019
173	14.42	0.87	0.187	( 0.199)	0.168	0.019
174	14.50	0.87	0.187	( 0.198)	0.168	0.019
175	14.58	0.87	0.187	( 0.197)	0.168	0.019
176	14.67	0.87	0.187	( 0.196)	0.168	0.019
177	14.75	0.87	0.187	( 0.195)	0.168	0.019
178	14.83	0.83	0.180	( 0.194)	0.162	0.018
179	14.92	0.83	0.180	( 0.193)	0.162	0.018
180	15.00	0.83	0.180	( 0.192)	0.162	0.018
181	15.08	0.80	0.173	( 0.191)	0.156	0.017
182	15.17	0.80	0.173	( 0.190)	0.156	0.017
183	15.25	0.80	0.173	( 0.189)	0.156	0.017
184	15.33	0.77	0.166	( 0.188)	0.149	0.017
185	15.42	0.77	0.166	( 0.188)	0.149	0.017
186	15.50	0.77	0.166	( 0.187)	0.149	0.017
187	15.58	0.63	0.137	( 0.186)	0.123	0.014
188	15.67	0.63	0.137	( 0.185)	0.123	0.014
189	15.75	0.63	0.137	( 0.184)	0.123	0.014
190	15.83	0.63	0.137	( 0.183)	0.123	0.014
191	15.92	0.63	0.137	( 0.182)	0.123	0.014
192	16.00	0.63	0.137	( 0.181)	0.123	0.014
193	16.08	0.13	0.029	( 0.180)	0.026	0.003
194	16.17	0.13	0.029	( 0.179)	0.026	0.003
195	16.25	0.13	0.029	( 0.178)	0.026	0.003
196	16.33	0.13	0.029	( 0.177)	0.026	0.003
197	16.42	0.13	0.029	( 0.176)	0.026	0.003
198	16.50	0.13	0.029	( 0.175)	0.026	0.003
199	16.58	0.10	0.022	( 0.175)	0.019	0.002
200	16.67	0.10	0.022	( 0.174)	0.019	0.002
201	16.75	0.10	0.022	( 0.173)	0.019	0.002
202	16.83	0.10	0.022	( 0.172)	0.019	0.002
203	16.92	0.10	0.022	( 0.171)	0.019	0.002
204	17.00	0.10	0.022	( 0.170)	0.019	0.002
205	17.08	0.17	0.036	( 0.169)	0.032	0.004
206	17.17	0.17	0.036	( 0.168)	0.032	0.004
207	17.25	0.17	0.036	( 0.168)	0.032	0.004
208	17.33	0.17	0.036	( 0.167)	0.032	0.004
209	17.42	0.17	0.036	( 0.166)	0.032	0.004
210	17.50	0.17	0.036	( 0.165)	0.032	0.004
211	17.58	0.17	0.036	( 0.164)	0.032	0.004
212	17.67	0.17	0.036	( 0.163)	0.032	0.004
213	17.75	0.17	0.036	( 0.163)	0.032	0.004
214	17.83	0.13	0.029	( 0.162)	0.026	0.003
215	17.92	0.13	0.029	( 0.161)	0.026	0.003
216	18.00	0.13	0.029	( 0.160)	0.026	0.003
217	18.08	0.13	0.029	( 0.159)	0.026	0.003
218	18.17	0.13	0.029	( 0.159)	0.026	0.003
219	18.25	0.13	0.029	( 0.158)	0.026	0.003
220	18.33	0.13	0.029	( 0.157)	0.026	0.003
221	18.42	0.13	0.029	( 0.156)	0.026	0.003
222	18.50	0.13	0.029	( 0.156)	0.026	0.003
223	18.58	0.10	0.022	( 0.155)	0.019	0.002
224	18.67	0.10	0.022	( 0.154)	0.019	0.002
225	18.75	0.10	0.022	( 0.153)	0.019	0.002
226	18.83	0.07	0.014	( 0.153)	0.013	0.001
227	18.92	0.07	0.014	( 0.152)	0.013	0.001
228	19.00	0.07	0.014	( 0.151)	0.013	0.001
229	19.08	0.10	0.022	( 0.150)	0.019	0.002
230	19.17	0.10	0.022	( 0.150)	0.019	0.002
231	19.25	0.10	0.022	( 0.149)	0.019	0.002
232	19.33	0.13	0.029	( 0.148)	0.026	0.003
233	19.42	0.13	0.029	( 0.148)	0.026	0.003
234	19.50	0.13	0.029	( 0.147)	0.026	0.003
235	19.58	0.10	0.022	( 0.146)	0.019	0.002
236	19.67	0.10	0.022	( 0.146)	0.019	0.002
237	19.75	0.10	0.022	( 0.145)	0.019	0.002
238	19.83	0.07	0.014	( 0.144)	0.013	0.001
239	19.92	0.07	0.014	( 0.144)	0.013	0.001
240	20.00	0.07	0.014	( 0.143)	0.013	0.001
241	20.08	0.10	0.022	( 0.142)	0.019	0.002
242	20.17	0.10	0.022	( 0.142)	0.019	0.002



1+40	0.0022	0.02	Q				
1+45	0.0023	0.02	Q				
1+50	0.0025	0.02	Q				
1+55	0.0026	0.02	Q				
2+ 0	0.0028	0.02	Q				
2+ 5	0.0029	0.02	Q				
2+10	0.0031	0.02	QV				
2+15	0.0032	0.02	QV				
2+20	0.0034	0.02	QV				
2+25	0.0035	0.02	QV				
2+30	0.0037	0.02	QV				
2+35	0.0039	0.02	QV				
2+40	0.0040	0.03	QV				
2+45	0.0042	0.03	QV				
2+50	0.0044	0.03	QV				
2+55	0.0046	0.03	QV				
3+ 0	0.0048	0.03	QV				
3+ 5	0.0050	0.03	QV				
3+10	0.0052	0.03	QV				
3+15	0.0054	0.03	QV				
3+20	0.0056	0.03	QV				
3+25	0.0058	0.03	QV				
3+30	0.0060	0.03	Q V				
3+35	0.0062	0.03	Q V				
3+40	0.0064	0.03	Q V				
3+45	0.0066	0.03	Q V				
3+50	0.0068	0.03	Q V				
3+55	0.0070	0.03	Q V				
4+ 0	0.0072	0.03	Q V				
4+ 5	0.0075	0.03	Q V				
4+10	0.0077	0.03	Q V				
4+15	0.0079	0.03	Q V				
4+20	0.0082	0.04	Q V				
4+25	0.0084	0.04	Q V				
4+30	0.0087	0.04	Q V				
4+35	0.0090	0.04	Q V				
4+40	0.0093	0.04	Q V				
4+45	0.0095	0.04	Q V				
4+50	0.0098	0.04	Q V				
4+55	0.0101	0.04	Q V				
5+ 0	0.0104	0.04	Q V				
5+ 5	0.0107	0.04	Q V				
5+10	0.0110	0.04	Q V				
5+15	0.0112	0.04	Q V				
5+20	0.0114	0.04	Q V				
5+25	0.0117	0.04	Q V				
5+30	0.0120	0.04	Q V				
5+35	0.0123	0.04	Q V				
5+40	0.0126	0.04	Q V				
5+45	0.0129	0.04	Q V				
5+50	0.0132	0.04	Q V				
5+55	0.0135	0.05	Q V				
6+ 0	0.0138	0.05	Q V				
6+ 5	0.0141	0.05	Q V				
6+10	0.0145	0.05	Q V				
6+15	0.0148	0.05	Q V				
6+20	0.0152	0.05	Q V				
6+25	0.0155	0.05	Q V				
6+30	0.0159	0.05	Q V				
6+35	0.0162	0.05	Q V				
6+40	0.0166	0.06	Q V				
6+45	0.0170	0.06	Q V				
6+50	0.0174	0.06	Q V				
6+55	0.0178	0.06	Q V				
7+ 0	0.0182	0.06	Q V				
7+ 5	0.0186	0.06	Q V				
7+10	0.0189	0.06	Q V				
7+15	0.0193	0.06	Q V				
7+20	0.0197	0.06	Q V				
7+25	0.0202	0.06	Q V				
7+30	0.0206	0.06	Q V				
7+35	0.0210	0.06	Q V				
7+40	0.0215	0.07	Q V				
7+45	0.0219	0.07	Q V				
7+50	0.0224	0.07	Q V				
7+55	0.0229	0.07	Q V				
8+ 0	0.0234	0.07	Q V				
8+ 5	0.0239	0.08	Q V				
8+10	0.0245	0.08	Q V				
8+15	0.0251	0.08	Q V				
8+20	0.0257	0.08	Q V				
8+25	0.0263	0.08	Q V				
8+30	0.0268	0.08	Q V				
8+35	0.0274	0.09	Q V				
8+40	0.0281	0.09	Q V				
8+45	0.0287	0.09	Q V				

8+50	0.0293	0.09	Q	V			
8+55	0.0300	0.09	Q	V			
9+ 0	0.0306	0.10	Q	V			
9+ 5	0.0313	0.10	Q	V			
9+10	0.0320	0.10	Q	V			
9+15	0.0328	0.11	Q	V			
9+20	0.0335	0.11	Q	V			
9+25	0.0343	0.11	Q	V			
9+30	0.0351	0.11	Q	V			
9+35	0.0358	0.11	Q	V			
9+40	0.0366	0.12	Q	V			
9+45	0.0375	0.12	Q	V			
9+50	0.0383	0.12	Q	V			
9+55	0.0391	0.12	Q	V			
10+ 0	0.0400	0.12	Q	V			
10+ 5	0.0408	0.11	Q	V			
10+10	0.0414	0.09	Q	V			
10+15	0.0420	0.09	Q	V			
10+20	0.0426	0.09	Q	V			
10+25	0.0432	0.09	Q	V			
10+30	0.0438	0.08	Q	V			
10+35	0.0444	0.09	Q	V			
10+40	0.0452	0.11	Q	V			
10+45	0.0459	0.11	Q	V			
10+50	0.0467	0.11	Q	V			
10+55	0.0475	0.11	Q	V			
11+ 0	0.0483	0.11	Q	V			
11+ 5	0.0490	0.11	Q	V			
11+10	0.0498	0.11	Q	V			
11+15	0.0505	0.11	Q	V			
11+20	0.0513	0.11	Q	V			
11+25	0.0520	0.11	Q	V			
11+30	0.0527	0.11	Q	V			
11+35	0.0534	0.10	Q	V			
11+40	0.0541	0.10	Q	V			
11+45	0.0548	0.10	Q	V			
11+50	0.0555	0.10	Q	V			
11+55	0.0562	0.10	Q	V			
12+ 0	0.0569	0.10	Q	V			
12+ 5	0.0577	0.11	Q	V			
12+10	0.0586	0.13	Q	V			
12+15	0.0595	0.14	Q	V			
12+20	0.0605	0.14	Q	V			
12+25	0.0615	0.15	Q	V			
12+30	0.0625	0.15	Q	V			
12+35	0.0635	0.15	Q	V			
12+40	0.0646	0.16	Q	V			
12+45	0.0657	0.16	Q	V			
12+50	0.0668	0.16	Q	V			
12+55	0.0679	0.16	Q	V			
13+ 0	0.0690	0.16	Q	V			
13+ 5	0.0703	0.18	Q	V			
13+10	0.0718	0.21	Q	V			
13+15	0.0733	0.23	Q	V			
13+20	0.0749	0.24	Q	V			
13+25	0.0766	0.25	Q	V			
13+30	0.0784	0.26	Q	V			
13+35	0.0799	0.22	Q	V			
13+40	0.0810	0.16	Q	V			
13+45	0.0820	0.14	Q	V			
13+50	0.0829	0.14	Q	V			
13+55	0.0838	0.13	Q	V			
14+ 0	0.0847	0.13	Q	V			
14+ 5	0.0857	0.14	Q	V			
14+10	0.0867	0.15	Q	V			
14+15	0.0877	0.15	Q	V			
14+20	0.0888	0.15	Q	V			
14+25	0.0898	0.15	Q	V			
14+30	0.0908	0.15	Q	V			
14+35	0.0918	0.15	Q	V			
14+40	0.0928	0.15	Q	V			
14+45	0.0938	0.15	Q	V			
14+50	0.0948	0.15	Q	V			
14+55	0.0958	0.14	Q	V			
15+ 0	0.0968	0.14	Q	V			
15+ 5	0.0978	0.14	Q	V			
15+10	0.0987	0.14	Q	V			
15+15	0.0997	0.14	Q	V			
15+20	0.1006	0.13	Q	V			
15+25	0.1015	0.13	Q	V			
15+30	0.1024	0.13	Q	V			
15+35	0.1032	0.12	Q	V			
15+40	0.1040	0.11	Q	V			
15+45	0.1048	0.11	Q	V			
15+50	0.1055	0.11	Q	V			
15+55	0.1062	0.11	Q	V			

16+ 0	0.1070	0.11	Q			V
16+ 5	0.1075	0.08	Q			V
16+10	0.1078	0.04	Q			V
16+15	0.1080	0.03	Q			V
16+20	0.1082	0.03	Q			V
16+25	0.1084	0.02	Q			V
16+30	0.1085	0.02	Q			V
16+35	0.1087	0.02	Q			V
16+40	0.1088	0.02	Q			V
16+45	0.1089	0.02	Q			V
16+50	0.1090	0.02	Q			V
16+55	0.1092	0.02	Q			V
17+ 0	0.1093	0.02	Q			V
17+ 5	0.1094	0.02	Q			V
17+10	0.1096	0.03	Q			V
17+15	0.1098	0.03	Q			V
17+20	0.1100	0.03	Q			V
17+25	0.1102	0.03	Q			V
17+30	0.1104	0.03	Q			V
17+35	0.1106	0.03	Q			V
17+40	0.1108	0.03	Q			V
17+45	0.1110	0.03	Q			V
17+50	0.1111	0.03	Q			V
17+55	0.1113	0.02	Q			V
18+ 0	0.1115	0.02	Q			V
18+ 5	0.1116	0.02	Q			V
18+10	0.1118	0.02	Q			V
18+15	0.1119	0.02	Q			V
18+20	0.1121	0.02	Q			V
18+25	0.1122	0.02	Q			V
18+30	0.1124	0.02	Q			V
18+35	0.1125	0.02	Q			V
18+40	0.1127	0.02	Q			V
18+45	0.1128	0.02	Q			V
18+50	0.1129	0.02	Q			V
18+55	0.1130	0.01	Q			V
19+ 0	0.1131	0.01	Q			V
19+ 5	0.1132	0.01	Q			V
19+10	0.1133	0.02	Q			V
19+15	0.1134	0.02	Q			V
19+20	0.1135	0.02	Q			V
19+25	0.1136	0.02	Q			V
19+30	0.1138	0.02	Q			V
19+35	0.1139	0.02	Q			V
19+40	0.1141	0.02	Q			V
19+45	0.1142	0.02	Q			V
19+50	0.1143	0.02	Q			V
19+55	0.1144	0.01	Q			V
20+ 0	0.1145	0.01	Q			V
20+ 5	0.1146	0.01	Q			V
20+10	0.1147	0.02	Q			V
20+15	0.1148	0.02	Q			V
20+20	0.1149	0.02	Q			V
20+25	0.1150	0.02	Q			V
20+30	0.1151	0.02	Q			V
20+35	0.1152	0.02	Q			V
20+40	0.1154	0.02	Q			V
20+45	0.1155	0.02	Q			V
20+50	0.1156	0.02	Q			V
20+55	0.1157	0.01	Q			V
21+ 0	0.1157	0.01	Q			V
21+ 5	0.1158	0.01	Q			V
21+10	0.1159	0.02	Q			V
21+15	0.1161	0.02	Q			V
21+20	0.1162	0.01	Q			V
21+25	0.1163	0.01	Q			V
21+30	0.1163	0.01	Q			V
21+35	0.1164	0.01	Q			V
21+40	0.1165	0.02	Q			V
21+45	0.1166	0.02	Q			V
21+50	0.1167	0.01	Q			V
21+55	0.1168	0.01	Q			V
22+ 0	0.1169	0.01	Q			V
22+ 5	0.1170	0.01	Q			V
22+10	0.1171	0.02	Q			V
22+15	0.1172	0.02	Q			V
22+20	0.1173	0.01	Q			V
22+25	0.1174	0.01	Q			V
22+30	0.1175	0.01	Q			V
22+35	0.1176	0.01	Q			V
22+40	0.1177	0.01	Q			V
22+45	0.1177	0.01	Q			V
22+50	0.1178	0.01	Q			V
22+55	0.1179	0.01	Q			V
23+ 0	0.1180	0.01	Q			V
23+ 5	0.1180	0.01	Q			V

23+10	0.1181	0.01	Q				V
23+15	0.1182	0.01	Q				V
23+20	0.1183	0.01	Q				V
23+25	0.1184	0.01	Q				V
23+30	0.1184	0.01	Q				V
23+35	0.1185	0.01	Q				V
23+40	0.1186	0.01	Q				V
23+45	0.1187	0.01	Q				V
23+50	0.1187	0.01	Q				V
23+55	0.1188	0.01	Q				V
24+ 0	0.1189	0.01	Q				V
24+ 5	0.1190	0.01	Q				V
24+10	0.1190	0.00	Q				V
24+15	0.1190	0.00	Q				V
24+20	0.1190	0.00	Q				V
24+25	0.1190	0.00	Q				V

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Section 7.4 – Basin 1 – Proposed 2 Year- 24 Hour Hydrograph

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

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Study date 04/22/24 File: pro12242.out

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Riverside County Synthetic Unit Hydrology Method  
RCFC & WCD Manual date - April 1978

Program License Serial Number 5006

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

English Units used in output format

-----  
Drainage Area = 26.74(Ac.) = 0.042 Sq. Mi.  
Drainage Area for Depth-Area Area Adjustment = 26.74(Ac.) = 0.042 Sq. Mi.  
Length along longest watercourse = 2399.00(Ft.)  
Length along longest watercourse measured to centroid = 1200.00(Ft.)  
Length along longest watercourse = 0.454 Mi.  
Length along longest watercourse measured to centroid = 0.227 Mi.  
Difference in elevation = 81.00(Ft.)  
Slope along watercourse = 178.2743 Ft./Mi.  
Average Manning's 'N' = 0.015  
Lag time = 0.057 Hr.  
Lag time = 3.40 Min.  
25% of lag time = 0.85 Min.  
40% of lag time = 1.36 Min.  
Unit time = 5.00 Min.  
Duration of storm = 24 Hour(s)  
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	weighting[1*2]
26.74	1.80	48.13

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	weighting[1*2]
26.74	5.00	133.70

STORM EVENT (YEAR) = 2.00  
Area Averaged 2-Year Rainfall = 1.800(In)  
Area Averaged 100-Year Rainfall = 5.000(In)

Point rain (area averaged) = 1.800(In)  
Areal adjustment factor = 99.99 %  
Adjusted average point rain = 1.800(In)

Sub-Area Data:  
Area(Ac.)      Runoff Index      Impervious %  
26.740      91.00      0.500  
Total Area Entered = 26.74(Ac.)

RI	RI	Infil. Rate	Impervious	Adj. Infil. Rate	Area%	F
AMC2	AMC-1	(In/Hr)	(Dec.%)	(In/Hr)	(Dec.)	(In/Hr)
91.0	79.8	0.246	0.500	0.135	1.000	0.135
Sum (F) =						0.135

Area averaged mean soil loss (F) (In/Hr) = 0.135  
Minimum soil loss rate ((In/Hr)) = 0.068  
(for 24 hour storm duration)  
Soil loss rate (decimal) = 0.500

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

Unit Hydrograph Data

Unit	Time period (hrs)	Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	146.867	32.409	8.734
2	0.167	293.734	47.236	12.730
3	0.250	440.601	11.368	3.064
4	0.333	587.468	4.979	1.342
5	0.417	734.335	2.561	0.690
6	0.500	881.203	1.446	0.390
			Sum = 100.000	Sum= 26.949

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

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In./Hr)	Loss rate(In./Hr)		Effective (In./Hr)
				Max	Low	
1	0.08	0.07	0.014	( 0.240)	0.007	0.007
2	0.17	0.07	0.014	( 0.239)	0.007	0.007
3	0.25	0.07	0.014	( 0.238)	0.007	0.007
4	0.33	0.10	0.022	( 0.237)	0.011	0.011
5	0.42	0.10	0.022	( 0.236)	0.011	0.011
6	0.50	0.10	0.022	( 0.236)	0.011	0.011
7	0.58	0.10	0.022	( 0.235)	0.011	0.011
8	0.67	0.10	0.022	( 0.234)	0.011	0.011
9	0.75	0.10	0.022	( 0.233)	0.011	0.011
10	0.83	0.13	0.029	( 0.232)	0.014	0.014
11	0.92	0.13	0.029	( 0.231)	0.014	0.014
12	1.00	0.13	0.029	( 0.230)	0.014	0.014
13	1.08	0.10	0.022	( 0.229)	0.011	0.011
14	1.17	0.10	0.022	( 0.228)	0.011	0.011
15	1.25	0.10	0.022	( 0.227)	0.011	0.011
16	1.33	0.10	0.022	( 0.226)	0.011	0.011
17	1.42	0.10	0.022	( 0.226)	0.011	0.011
18	1.50	0.10	0.022	( 0.225)	0.011	0.011
19	1.58	0.10	0.022	( 0.224)	0.011	0.011
20	1.67	0.10	0.022	( 0.223)	0.011	0.011
21	1.75	0.10	0.022	( 0.222)	0.011	0.011
22	1.83	0.13	0.029	( 0.221)	0.014	0.014
23	1.92	0.13	0.029	( 0.220)	0.014	0.014
24	2.00	0.13	0.029	( 0.219)	0.014	0.014
25	2.08	0.13	0.029	( 0.218)	0.014	0.014
26	2.17	0.13	0.029	( 0.218)	0.014	0.014
27	2.25	0.13	0.029	( 0.217)	0.014	0.014
28	2.33	0.13	0.029	( 0.216)	0.014	0.014
29	2.42	0.13	0.029	( 0.215)	0.014	0.014
30	2.50	0.13	0.029	( 0.214)	0.014	0.014
31	2.58	0.17	0.036	( 0.213)	0.018	0.018
32	2.67	0.17	0.036	( 0.212)	0.018	0.018
33	2.75	0.17	0.036	( 0.211)	0.018	0.018
34	2.83	0.17	0.036	( 0.211)	0.018	0.018
35	2.92	0.17	0.036	( 0.210)	0.018	0.018
36	3.00	0.17	0.036	( 0.209)	0.018	0.018
37	3.08	0.17	0.036	( 0.208)	0.018	0.018
38	3.17	0.17	0.036	( 0.207)	0.018	0.018
39	3.25	0.17	0.036	( 0.206)	0.018	0.018
40	3.33	0.17	0.036	( 0.205)	0.018	0.018
41	3.42	0.17	0.036	( 0.204)	0.018	0.018
42	3.50	0.17	0.036	( 0.204)	0.018	0.018
43	3.58	0.17	0.036	( 0.203)	0.018	0.018
44	3.67	0.17	0.036	( 0.202)	0.018	0.018
45	3.75	0.17	0.036	( 0.201)	0.018	0.018
46	3.83	0.20	0.043	( 0.200)	0.022	0.022
47	3.92	0.20	0.043	( 0.199)	0.022	0.022
48	4.00	0.20	0.043	( 0.199)	0.022	0.022
49	4.08	0.20	0.043	( 0.198)	0.022	0.022
50	4.17	0.20	0.043	( 0.197)	0.022	0.022
51	4.25	0.20	0.043	( 0.196)	0.022	0.022
52	4.33	0.23	0.050	( 0.195)	0.025	0.025
53	4.42	0.23	0.050	( 0.194)	0.025	0.025
54	4.50	0.23	0.050	( 0.193)	0.025	0.025
55	4.58	0.23	0.050	( 0.193)	0.025	0.025
56	4.67	0.23	0.050	( 0.192)	0.025	0.025
57	4.75	0.23	0.050	( 0.191)	0.025	0.025
58	4.83	0.27	0.058	( 0.190)	0.029	0.029
59	4.92	0.27	0.058	( 0.189)	0.029	0.029
60	5.00	0.27	0.058	( 0.189)	0.029	0.029
61	5.08	0.20	0.043	( 0.188)	0.022	0.022
62	5.17	0.20	0.043	( 0.187)	0.022	0.022
63	5.25	0.20	0.043	( 0.186)	0.022	0.022
64	5.33	0.23	0.050	( 0.185)	0.025	0.025
65	5.42	0.23	0.050	( 0.184)	0.025	0.025
66	5.50	0.23	0.050	( 0.184)	0.025	0.025

67	5.58	0.27	0.058	( 0.183)	0.029	0.029
68	5.67	0.27	0.058	( 0.182)	0.029	0.029
69	5.75	0.27	0.058	( 0.181)	0.029	0.029
70	5.83	0.27	0.058	( 0.180)	0.029	0.029
71	5.92	0.27	0.058	( 0.180)	0.029	0.029
72	6.00	0.27	0.058	( 0.179)	0.029	0.029
73	6.08	0.30	0.065	( 0.178)	0.032	0.032
74	6.17	0.30	0.065	( 0.177)	0.032	0.032
75	6.25	0.30	0.065	( 0.176)	0.032	0.032
76	6.33	0.30	0.065	( 0.176)	0.032	0.032
77	6.42	0.30	0.065	( 0.175)	0.032	0.032
78	6.50	0.30	0.065	( 0.174)	0.032	0.032
79	6.58	0.33	0.072	( 0.173)	0.036	0.036
80	6.67	0.33	0.072	( 0.173)	0.036	0.036
81	6.75	0.33	0.072	( 0.172)	0.036	0.036
82	6.83	0.33	0.072	( 0.171)	0.036	0.036
83	6.92	0.33	0.072	( 0.170)	0.036	0.036
84	7.00	0.33	0.072	( 0.169)	0.036	0.036
85	7.08	0.33	0.072	( 0.169)	0.036	0.036
86	7.17	0.33	0.072	( 0.168)	0.036	0.036
87	7.25	0.33	0.072	( 0.167)	0.036	0.036
88	7.33	0.37	0.079	( 0.166)	0.040	0.040
89	7.42	0.37	0.079	( 0.166)	0.040	0.040
90	7.50	0.37	0.079	( 0.165)	0.040	0.040
91	7.58	0.40	0.086	( 0.164)	0.043	0.043
92	7.67	0.40	0.086	( 0.163)	0.043	0.043
93	7.75	0.40	0.086	( 0.163)	0.043	0.043
94	7.83	0.43	0.094	( 0.162)	0.047	0.047
95	7.92	0.43	0.094	( 0.161)	0.047	0.047
96	8.00	0.43	0.094	( 0.160)	0.047	0.047
97	8.08	0.50	0.108	( 0.160)	0.054	0.054
98	8.17	0.50	0.108	( 0.159)	0.054	0.054
99	8.25	0.50	0.108	( 0.158)	0.054	0.054
100	8.33	0.50	0.108	( 0.157)	0.054	0.054
101	8.42	0.50	0.108	( 0.157)	0.054	0.054
102	8.50	0.50	0.108	( 0.156)	0.054	0.054
103	8.58	0.53	0.115	( 0.155)	0.058	0.058
104	8.67	0.53	0.115	( 0.154)	0.058	0.058
105	8.75	0.53	0.115	( 0.154)	0.058	0.058
106	8.83	0.57	0.122	( 0.153)	0.061	0.061
107	8.92	0.57	0.122	( 0.152)	0.061	0.061
108	9.00	0.57	0.122	( 0.152)	0.061	0.061
109	9.08	0.63	0.137	( 0.151)	0.068	0.068
110	9.17	0.63	0.137	( 0.150)	0.068	0.068
111	9.25	0.63	0.137	( 0.149)	0.068	0.068
112	9.33	0.67	0.144	( 0.149)	0.072	0.072
113	9.42	0.67	0.144	( 0.148)	0.072	0.072
114	9.50	0.67	0.144	( 0.147)	0.072	0.072
115	9.58	0.70	0.151	( 0.147)	0.076	0.076
116	9.67	0.70	0.151	( 0.146)	0.076	0.076
117	9.75	0.70	0.151	( 0.145)	0.076	0.076
118	9.83	0.73	0.158	( 0.144)	0.079	0.079
119	9.92	0.73	0.158	( 0.144)	0.079	0.079
120	10.00	0.73	0.158	( 0.143)	0.079	0.079
121	10.08	0.50	0.108	( 0.142)	0.054	0.054
122	10.17	0.50	0.108	( 0.142)	0.054	0.054
123	10.25	0.50	0.108	( 0.141)	0.054	0.054
124	10.33	0.50	0.108	( 0.140)	0.054	0.054
125	10.42	0.50	0.108	( 0.140)	0.054	0.054
126	10.50	0.50	0.108	( 0.139)	0.054	0.054
127	10.58	0.67	0.144	( 0.138)	0.072	0.072
128	10.67	0.67	0.144	( 0.138)	0.072	0.072
129	10.75	0.67	0.144	( 0.137)	0.072	0.072
130	10.83	0.67	0.144	( 0.136)	0.072	0.072
131	10.92	0.67	0.144	( 0.136)	0.072	0.072
132	11.00	0.67	0.144	( 0.135)	0.072	0.072
133	11.08	0.63	0.137	( 0.134)	0.068	0.068
134	11.17	0.63	0.137	( 0.134)	0.068	0.068
135	11.25	0.63	0.137	( 0.133)	0.068	0.068
136	11.33	0.63	0.137	( 0.132)	0.068	0.068
137	11.42	0.63	0.137	( 0.132)	0.068	0.068
138	11.50	0.63	0.137	( 0.131)	0.068	0.068
139	11.58	0.57	0.122	( 0.130)	0.061	0.061
140	11.67	0.57	0.122	( 0.130)	0.061	0.061
141	11.75	0.57	0.122	( 0.129)	0.061	0.061
142	11.83	0.60	0.130	( 0.128)	0.065	0.065
143	11.92	0.60	0.130	( 0.128)	0.065	0.065
144	12.00	0.60	0.130	( 0.127)	0.065	0.065
145	12.08	0.83	0.180	( 0.126)	0.090	0.090
146	12.17	0.83	0.180	( 0.126)	0.090	0.090
147	12.25	0.83	0.180	( 0.125)	0.090	0.090
148	12.33	0.87	0.187	( 0.125)	0.094	0.094
149	12.42	0.87	0.187	( 0.124)	0.094	0.094
150	12.50	0.87	0.187	( 0.123)	0.094	0.094

151	12.58	0.93	0.202	(	0.123)	0.101	0.101	
152	12.67	0.93	0.202	(	0.122)	0.101	0.101	
153	12.75	0.93	0.202	(	0.121)	0.101	0.101	
154	12.83	0.97	0.209	(	0.121)	0.104	0.104	
155	12.92	0.97	0.209	(	0.120)	0.104	0.104	
156	13.00	0.97	0.209	(	0.120)	0.104	0.104	
157	13.08	1.13	0.245	(	0.119	(	0.122)	0.126
158	13.17	1.13	0.245	(	0.118	(	0.122)	0.126
159	13.25	1.13	0.245	(	0.118	(	0.122)	0.127
160	13.33	1.13	0.245	(	0.117	(	0.122)	0.128
161	13.42	1.13	0.245	(	0.117	(	0.122)	0.128
162	13.50	1.13	0.245	(	0.116	(	0.122)	0.129
163	13.58	0.77	0.166	(	0.115)	0.083	0.083	
164	13.67	0.77	0.166	(	0.115)	0.083	0.083	
165	13.75	0.77	0.166	(	0.114)	0.083	0.083	
166	13.83	0.77	0.166	(	0.114)	0.083	0.083	
167	13.92	0.77	0.166	(	0.113)	0.083	0.083	
168	14.00	0.77	0.166	(	0.113)	0.083	0.083	
169	14.08	0.90	0.194	(	0.112)	0.097	0.097	
170	14.17	0.90	0.194	(	0.111)	0.097	0.097	
171	14.25	0.90	0.194	(	0.111)	0.097	0.097	
172	14.33	0.87	0.187	(	0.110)	0.094	0.094	
173	14.42	0.87	0.187	(	0.110)	0.094	0.094	
174	14.50	0.87	0.187	(	0.109)	0.094	0.094	
175	14.58	0.87	0.187	(	0.109)	0.094	0.094	
176	14.67	0.87	0.187	(	0.108)	0.094	0.094	
177	14.75	0.87	0.187	(	0.107)	0.094	0.094	
178	14.83	0.83	0.180	(	0.107)	0.090	0.090	
179	14.92	0.83	0.180	(	0.106)	0.090	0.090	
180	15.00	0.83	0.180	(	0.106)	0.090	0.090	
181	15.08	0.80	0.173	(	0.105)	0.086	0.086	
182	15.17	0.80	0.173	(	0.105)	0.086	0.086	
183	15.25	0.80	0.173	(	0.104)	0.086	0.086	
184	15.33	0.77	0.166	(	0.104)	0.083	0.083	
185	15.42	0.77	0.166	(	0.103)	0.083	0.083	
186	15.50	0.77	0.166	(	0.103)	0.083	0.083	
187	15.58	0.63	0.137	(	0.102)	0.068	0.068	
188	15.67	0.63	0.137	(	0.102)	0.068	0.068	
189	15.75	0.63	0.137	(	0.101)	0.068	0.068	
190	15.83	0.63	0.137	(	0.101)	0.068	0.068	
191	15.92	0.63	0.137	(	0.100)	0.068	0.068	
192	16.00	0.63	0.137	(	0.100)	0.068	0.068	
193	16.08	0.13	0.029	(	0.099)	0.014	0.014	
194	16.17	0.13	0.029	(	0.098)	0.014	0.014	
195	16.25	0.13	0.029	(	0.098)	0.014	0.014	
196	16.33	0.13	0.029	(	0.097)	0.014	0.014	
197	16.42	0.13	0.029	(	0.097)	0.014	0.014	
198	16.50	0.13	0.029	(	0.096)	0.014	0.014	
199	16.58	0.10	0.022	(	0.096)	0.011	0.011	
200	16.67	0.10	0.022	(	0.096)	0.011	0.011	
201	16.75	0.10	0.022	(	0.095)	0.011	0.011	
202	16.83	0.10	0.022	(	0.095)	0.011	0.011	
203	16.92	0.10	0.022	(	0.094)	0.011	0.011	
204	17.00	0.10	0.022	(	0.094)	0.011	0.011	
205	17.08	0.17	0.036	(	0.093)	0.018	0.018	
206	17.17	0.17	0.036	(	0.093)	0.018	0.018	
207	17.25	0.17	0.036	(	0.092)	0.018	0.018	
208	17.33	0.17	0.036	(	0.092)	0.018	0.018	
209	17.42	0.17	0.036	(	0.091)	0.018	0.018	
210	17.50	0.17	0.036	(	0.091)	0.018	0.018	
211	17.58	0.17	0.036	(	0.090)	0.018	0.018	
212	17.67	0.17	0.036	(	0.090)	0.018	0.018	
213	17.75	0.17	0.036	(	0.089)	0.018	0.018	
214	17.83	0.13	0.029	(	0.089)	0.014	0.014	
215	17.92	0.13	0.029	(	0.089)	0.014	0.014	
216	18.00	0.13	0.029	(	0.088)	0.014	0.014	
217	18.08	0.13	0.029	(	0.088)	0.014	0.014	
218	18.17	0.13	0.029	(	0.087)	0.014	0.014	
219	18.25	0.13	0.029	(	0.087)	0.014	0.014	
220	18.33	0.13	0.029	(	0.086)	0.014	0.014	
221	18.42	0.13	0.029	(	0.086)	0.014	0.014	
222	18.50	0.13	0.029	(	0.086)	0.014	0.014	
223	18.58	0.10	0.022	(	0.085)	0.011	0.011	
224	18.67	0.10	0.022	(	0.085)	0.011	0.011	
225	18.75	0.10	0.022	(	0.084)	0.011	0.011	
226	18.83	0.07	0.014	(	0.084)	0.007	0.007	
227	18.92	0.07	0.014	(	0.084)	0.007	0.007	
228	19.00	0.07	0.014	(	0.083)	0.007	0.007	
229	19.08	0.10	0.022	(	0.083)	0.011	0.011	
230	19.17	0.10	0.022	(	0.082)	0.011	0.011	
231	19.25	0.10	0.022	(	0.082)	0.011	0.011	
232	19.33	0.13	0.029	(	0.082)	0.014	0.014	
233	19.42	0.13	0.029	(	0.081)	0.014	0.014	
234	19.50	0.13	0.029	(	0.081)	0.014	0.014	

235	19.58	0.10	0.022	( 0.080)	0.011	0.011
236	19.67	0.10	0.022	( 0.080)	0.011	0.011
237	19.75	0.10	0.022	( 0.080)	0.011	0.011
238	19.83	0.07	0.014	( 0.079)	0.007	0.007
239	19.92	0.07	0.014	( 0.079)	0.007	0.007
240	20.00	0.07	0.014	( 0.079)	0.007	0.007
241	20.08	0.10	0.022	( 0.078)	0.011	0.011
242	20.17	0.10	0.022	( 0.078)	0.011	0.011
243	20.25	0.10	0.022	( 0.078)	0.011	0.011
244	20.33	0.10	0.022	( 0.077)	0.011	0.011
245	20.42	0.10	0.022	( 0.077)	0.011	0.011
246	20.50	0.10	0.022	( 0.077)	0.011	0.011
247	20.58	0.10	0.022	( 0.076)	0.011	0.011
248	20.67	0.10	0.022	( 0.076)	0.011	0.011
249	20.75	0.10	0.022	( 0.076)	0.011	0.011
250	20.83	0.07	0.014	( 0.075)	0.007	0.007
251	20.92	0.07	0.014	( 0.075)	0.007	0.007
252	21.00	0.07	0.014	( 0.075)	0.007	0.007
253	21.08	0.10	0.022	( 0.074)	0.011	0.011
254	21.17	0.10	0.022	( 0.074)	0.011	0.011
255	21.25	0.10	0.022	( 0.074)	0.011	0.011
256	21.33	0.07	0.014	( 0.074)	0.007	0.007
257	21.42	0.07	0.014	( 0.073)	0.007	0.007
258	21.50	0.07	0.014	( 0.073)	0.007	0.007
259	21.58	0.10	0.022	( 0.073)	0.011	0.011
260	21.67	0.10	0.022	( 0.073)	0.011	0.011
261	21.75	0.10	0.022	( 0.072)	0.011	0.011
262	21.83	0.07	0.014	( 0.072)	0.007	0.007
263	21.92	0.07	0.014	( 0.072)	0.007	0.007
264	22.00	0.07	0.014	( 0.072)	0.007	0.007
265	22.08	0.10	0.022	( 0.071)	0.011	0.011
266	22.17	0.10	0.022	( 0.071)	0.011	0.011
267	22.25	0.10	0.022	( 0.071)	0.011	0.011
268	22.33	0.07	0.014	( 0.071)	0.007	0.007
269	22.42	0.07	0.014	( 0.070)	0.007	0.007
270	22.50	0.07	0.014	( 0.070)	0.007	0.007
271	22.58	0.07	0.014	( 0.070)	0.007	0.007
272	22.67	0.07	0.014	( 0.070)	0.007	0.007
273	22.75	0.07	0.014	( 0.070)	0.007	0.007
274	22.83	0.07	0.014	( 0.069)	0.007	0.007
275	22.92	0.07	0.014	( 0.069)	0.007	0.007
276	23.00	0.07	0.014	( 0.069)	0.007	0.007
277	23.08	0.07	0.014	( 0.069)	0.007	0.007
278	23.17	0.07	0.014	( 0.069)	0.007	0.007
279	23.25	0.07	0.014	( 0.069)	0.007	0.007
280	23.33	0.07	0.014	( 0.068)	0.007	0.007
281	23.42	0.07	0.014	( 0.068)	0.007	0.007
282	23.50	0.07	0.014	( 0.068)	0.007	0.007
283	23.58	0.07	0.014	( 0.068)	0.007	0.007
284	23.67	0.07	0.014	( 0.068)	0.007	0.007
285	23.75	0.07	0.014	( 0.068)	0.007	0.007
286	23.83	0.07	0.014	( 0.068)	0.007	0.007
287	23.92	0.07	0.014	( 0.068)	0.007	0.007
288	24.00	0.07	0.014	( 0.068)	0.007	0.007

Sum = 100.0 (Loss Rate Not Used) Sum = 10.8

Flood volume = Effective rainfall 0.90(In)  
times area 26.7(Ac.)/[In]/(Ft.)] = 2.0(Ac.Ft)  
Total soil loss = 0.90(In)  
Total soil loss = 2.000(Ac.Ft)  
Total rainfall = 1.80(In)  
Flood volume = 87590.2 Cubic Feet  
Total soil loss = 87119.9 Cubic Feet

-----  
Peak flow rate of this hydrograph = 3.455(CFS)  
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+++++

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

-----  
Hydrograph in 5 Minute intervals ((CFS))  
-----

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0004	0.06	Q				
0+10	0.0015	0.15	Q				
0+15	0.0027	0.18	Q				
0+20	0.0042	0.22	Q				
0+25	0.0061	0.27	VQ				
0+30	0.0080	0.28	VQ				
0+35	0.0100	0.29	VQ				
0+40	0.0120	0.29	VQ				
0+45	0.0140	0.29	VQ				

0+50	0.0162	0.32	VQ
0+55	0.0187	0.37	VQ
1+ 0	0.0214	0.38	VQ
1+ 5	0.0238	0.35	VQ
1+10	0.0259	0.31	VQ
1+15	0.0280	0.30	VQ
1+20	0.0300	0.30	VQ
1+25	0.0320	0.29	VQ
1+30	0.0340	0.29	VQ
1+35	0.0360	0.29	VQ
1+40	0.0381	0.29	VQ
1+45	0.0401	0.29	VQ
1+50	0.0423	0.32	VQ
1+55	0.0448	0.37	VQ
2+ 0	0.0474	0.38	VQ
2+ 5	0.0501	0.38	VQ
2+10	0.0527	0.39	Q
2+15	0.0554	0.39	Q
2+20	0.0581	0.39	Q
2+25	0.0608	0.39	Q
2+30	0.0634	0.39	Q
2+35	0.0663	0.42	Q
2+40	0.0695	0.47	Q
2+45	0.0728	0.48	Q
2+50	0.0761	0.48	Q
2+55	0.0795	0.48	Q
3+ 0	0.0828	0.49	Q
3+ 5	0.0862	0.49	Q
3+10	0.0895	0.49	Q
3+15	0.0928	0.49	Q
3+20	0.0962	0.49	Q
3+25	0.0995	0.49	Q
3+30	0.1029	0.49	QV
3+35	0.1062	0.49	QV
3+40	0.1095	0.49	QV
3+45	0.1129	0.49	QV
3+50	0.1164	0.52	Q
3+55	0.1203	0.56	Q
4+ 0	0.1243	0.57	Q
4+ 5	0.1283	0.58	Q
4+10	0.1323	0.58	Q
4+15	0.1363	0.58	Q
4+20	0.1405	0.61	Q
4+25	0.1450	0.66	Q
4+30	0.1497	0.67	Q
4+35	0.1543	0.68	QV
4+40	0.1590	0.68	QV
4+45	0.1637	0.68	QV
4+50	0.1686	0.71	QV
4+55	0.1738	0.76	Q
5+ 0	0.1791	0.77	Q
5+ 5	0.1839	0.71	QV
5+10	0.1882	0.62	QV
5+15	0.1923	0.60	QV
5+20	0.1966	0.62	QV
5+25	0.2012	0.66	Q
5+30	0.2058	0.67	Q
5+35	0.2107	0.71	Q
5+40	0.2159	0.76	Q
5+45	0.2212	0.77	QV
5+50	0.2265	0.77	QV
5+55	0.2318	0.78	QV
6+ 0	0.2372	0.78	QV
6+ 5	0.2427	0.81	QV
6+10	0.2486	0.85	QV
6+15	0.2546	0.86	Q
6+20	0.2606	0.87	Q
6+25	0.2666	0.87	Q
6+30	0.2726	0.87	Q
6+35	0.2788	0.91	Q
6+40	0.2854	0.95	Q
6+45	0.2920	0.96	Q
6+50	0.2987	0.97	Q
6+55	0.3053	0.97	Q
7+ 0	0.3120	0.97	Q
7+ 5	0.3187	0.97	Q
7+10	0.3254	0.97	Q
7+15	0.3321	0.97	Q
7+20	0.3390	1.00	Q
7+25	0.3462	1.05	Q
7+30	0.3535	1.06	Q
7+35	0.3610	1.10	Q
7+40	0.3689	1.14	Q
7+45	0.3769	1.16	Q

7+50	0.3851	1.19			
7+55	0.3936	1.24			
8+ 0	0.4022	1.25			
8+ 5	0.4113	1.32			
8+10	0.4211	1.42			
8+15	0.4310	1.44			
8+20	0.4410	1.45			
8+25	0.4510	1.45			
8+30	0.4610	1.46			
8+35	0.4712	1.49			
8+40	0.4818	1.53			
8+45	0.4924	1.54			
8+50	0.5033	1.58			
8+55	0.5145	1.63			
9+ 0	0.5258	1.64			
9+ 5	0.5376	1.71			
9+10	0.5500	1.80			
9+15	0.5626	1.83			
9+20	0.5755	1.87			
9+25	0.5887	1.92			
9+30	0.6020	1.93			
9+35	0.6156	1.97			
9+40	0.6295	2.02			
9+45	0.6434	2.03			
9+50	0.6577	2.07			
9+55	0.6722	2.11			
10+ 0	0.6869	2.13			
10+ 5	0.7000	1.91			
10+10	0.7110	1.59			
10+15	0.7214	1.52			
10+20	0.7317	1.48			
10+25	0.7418	1.47			
10+30	0.7518	1.46			
10+35	0.7629	1.61			
10+40	0.7756	1.84			
10+45	0.7887	1.90			
10+50	0.8019	1.92			
10+55	0.8152	1.93			
11+ 0	0.8286	1.94			
11+ 5	0.8417	1.91			
11+10	0.8546	1.86			
11+15	0.8673	1.85			
11+20	0.8801	1.85			
11+25	0.8928	1.85			
11+30	0.9055	1.84			
11+35	0.9177	1.78			
11+40	0.9294	1.69			
11+45	0.9409	1.67			
11+50	0.9525	1.69			
11+55	0.9644	1.73			
12+ 0	0.9764	1.74			
12+ 5	0.9899	1.96			
12+10	1.0056	2.29			
12+15	1.0219	2.37			
12+20	1.0387	2.43			
12+25	1.0559	2.49			
12+30	1.0732	2.51			
12+35	1.0910	2.58			
12+40	1.1094	2.68			
12+45	1.1280	2.70			
12+50	1.1469	2.74			
12+55	1.1661	2.79			
13+ 0	1.1854	2.81			
13+ 5	1.2061	3.00			
13+10	1.2286	3.28			
13+15	1.2518	3.36			
13+20	1.2752	3.40			
13+25	1.2988	3.43			
13+30	1.3226	3.45			
13+35	1.3437	3.06			
13+40	1.3608	2.48			
13+45	1.3769	2.34			
13+50	1.3926	2.28			
13+55	1.4081	2.25			
14+ 0	1.4235	2.23			
14+ 5	1.4398	2.36			
14+10	1.4573	2.54			
14+15	1.4751	2.59			
14+20	1.4928	2.57			
14+25	1.5103	2.54			
14+30	1.5277	2.53			
14+35	1.5451	2.53			
14+40	1.5625	2.52			
14+45	1.5799	2.52			

14+50	1.5971	2.49			
14+55	1.6139	2.45			
15+ 0	1.6307	2.44			
15+ 5	1.6472	2.40			
15+10	1.6634	2.35			
15+15	1.6795	2.34			
15+20	1.6953	2.30			
15+25	1.7109	2.25			
15+30	1.7263	2.24			
15+35	1.7408	2.11			
15+40	1.7541	1.92			
15+45	1.7670	1.88			
15+50	1.7798	1.86			
15+55	1.7926	1.85			
16+ 0	1.8053	1.84			
16+ 5	1.8147	1.37			
16+10	1.8194	0.68			
16+15	1.8230	0.52			
16+20	1.8261	0.45			
16+25	1.8289	0.41			
16+30	1.8316	0.39			
16+35	1.8340	0.36			
16+40	1.8362	0.31			
16+45	1.8382	0.30			
16+50	1.8403	0.30			
16+55	1.8423	0.29			
17+ 0	1.8443	0.29			
17+ 5	1.8467	0.35			
17+10	1.8498	0.45			
17+15	1.8530	0.47			
17+20	1.8563	0.48			
17+25	1.8596	0.48			
17+30	1.8630	0.49			
17+35	1.8663	0.49			
17+40	1.8697	0.49			
17+45	1.8730	0.49			
17+50	1.8761	0.45			
17+55	1.8789	0.41			
18+ 0	1.8817	0.40			
18+ 5	1.8844	0.39			
18+10	1.8871	0.39			
18+15	1.8897	0.39			
18+20	1.8924	0.39			
18+25	1.8951	0.39			
18+30	1.8978	0.39			
18+35	1.9002	0.36			
18+40	1.9024	0.31			
18+45	1.9044	0.30			
18+50	1.9062	0.26			
18+55	1.9077	0.22			
19+ 0	1.9091	0.20			
19+ 5	1.9107	0.23			
19+10	1.9126	0.27			
19+15	1.9145	0.28			
19+20	1.9167	0.32			
19+25	1.9192	0.37			
19+30	1.9219	0.38			
19+35	1.9243	0.35			
19+40	1.9264	0.31			
19+45	1.9285	0.30			
19+50	1.9303	0.26			
19+55	1.9318	0.22			
20+ 0	1.9332	0.20			
20+ 5	1.9348	0.23			
20+10	1.9366	0.27			
20+15	1.9386	0.28			
20+20	1.9406	0.29			
20+25	1.9426	0.29			
20+30	1.9446	0.29			
20+35	1.9466	0.29			
20+40	1.9486	0.29			
20+45	1.9506	0.29			
20+50	1.9524	0.26			
20+55	1.9538	0.21			
21+ 0	1.9552	0.20			
21+ 5	1.9568	0.23			
21+10	1.9587	0.27			
21+15	1.9606	0.28			
21+20	1.9624	0.26			
21+25	1.9639	0.21			
21+30	1.9653	0.20			
21+35	1.9668	0.23			
21+40	1.9687	0.27			
21+45	1.9707	0.28			

21+50	1.9724	0.26	Q				V
21+55	1.9739	0.21	Q				V
22+ 0	1.9753	0.20	Q				V
22+ 5	1.9769	0.23	Q				V
22+10	1.9788	0.27	Q				V
22+15	1.9807	0.28	Q				V
22+20	1.9825	0.26	Q				V
22+25	1.9839	0.21	Q				V
22+30	1.9853	0.20	Q				V
22+35	1.9867	0.20	Q				V
22+40	1.9880	0.20	Q				V
22+45	1.9894	0.19	Q				V
22+50	1.9907	0.19	Q				V
22+55	1.9920	0.19	Q				V
23+ 0	1.9934	0.19	Q				V
23+ 5	1.9947	0.19	Q				V
23+10	1.9961	0.19	Q				V
23+15	1.9974	0.19	Q				V
23+20	1.9987	0.19	Q				V
23+25	2.0001	0.19	Q				V
23+30	2.0014	0.19	Q				V
23+35	2.0027	0.19	Q				V
23+40	2.0041	0.19	Q				V
23+45	2.0054	0.19	Q				V
23+50	2.0068	0.19	Q				V
23+55	2.0081	0.19	Q				V
24+ 0	2.0094	0.19	Q				V
24+ 5	2.0103	0.13	Q				V
24+10	2.0106	0.04	Q				V
24+15	2.0107	0.02	Q				V
24+20	2.0108	0.01	Q				V
24+25	2.0108	0.00	Q				V

Section 7.5 – Basin 2 – Proposed 2 Year- 24 Hour Hydrograph

Unit Hydrograph Analysis

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 Study date 04/22/24 File: pro22242.out

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Riverside County Synthetic Unit Hydrology Method  
 RCFC & WCD Manual date - April 1978

Program License Serial Number 5006

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

English Units used in output format

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Drainage Area = 51.80(Ac.) = 0.081 Sq. Mi.  
 Drainage Area for Depth-Area Areal Adjustment = 51.80(Ac.) = 0.081 Sq. Mi.  
 Length along longest watercourse = 2976.00(Ft.)  
 Length along longest watercourse measured to centroid = 1488.00(Ft.)  
 Length along longest watercourse = 0.564 Mi.  
 Length along longest watercourse measured to centroid = 0.282 Mi.  
 Difference in elevation = 150.00(Ft.)  
 Slope along watercourse = 266.1290 Ft./Mi.  
 Average Manning's 'N' = 0.015  
 Lag time = 0.062 Hr.  
 Lag time = 3.72 Min.  
 25% of lag time = 0.93 Min.  
 40% of lag time = 1.49 Min.  
 Unit time = 5.00 Min.  
 Duration of storm = 24 Hour(s)  
 User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	weighting[1*2]
51.80	1.80	93.24

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	weighting[1*2]
51.80	5.00	259.00

STORM EVENT (YEAR) = 2.00  
 Area Averaged 2-Year Rainfall = 1.800(In)  
 Area Averaged 100-Year Rainfall = 5.000(In)

Point rain (area averaged) = 1.800(In)  
 Areal adjustment factor = 99.99 %  
 Adjusted average point rain = 1.800(In)

Sub-Area Data:  

Area(Ac.)	Runoff Index	Impervious %
51.800	69.00	0.500

 Total Area Entered = 51.80(Ac.)

RI	RI	Infil. Rate	Impervious	Adj. Infil. Rate	Area%	F
AMC2	AMC-1	(In/Hr)	(Dec.%)	(In/Hr)	(Dec.)	(In/Hr)
69.0	49.8	0.574	0.500	0.316	1.000	0.316
						Sum (F) = 0.316

Area averaged mean soil loss (F) (In/Hr) = 0.316  
 Minimum soil loss rate ((In/Hr)) = 0.158  
 (for 24 hour storm duration)  
 Soil loss rate (decimal) = 0.500

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Unit Hydrograph  
 VALLEY S-Curve

Unit Hydrograph Data				
Unit time period (hrs)	Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)	
1	0.083	134.560	29.252	15.271
2	0.167	269.120	48.041	25.080
3	0.250	403.680	12.175	6.356
4	0.333	538.240	5.402	2.820
5	0.417	672.800	2.941	1.536
6	0.500	807.360	2.189	1.143
Sum = 100.000			Sum=	52.205

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

Unit Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr)		Effective (In/Hr)
			Max	Low	
1	0.08	0.014	( 0.560)	0.007	0.007
2	0.17	0.014	( 0.557)	0.007	0.007
3	0.25	0.014	( 0.555)	0.007	0.007
4	0.33	0.022	( 0.553)	0.011	0.011
5	0.42	0.022	( 0.551)	0.011	0.011
6	0.50	0.022	( 0.549)	0.011	0.011
7	0.58	0.022	( 0.547)	0.011	0.011
8	0.67	0.022	( 0.545)	0.011	0.011
9	0.75	0.022	( 0.542)	0.011	0.011
10	0.83	0.029	( 0.540)	0.014	0.014
11	0.92	0.029	( 0.538)	0.014	0.014
12	1.00	0.029	( 0.536)	0.014	0.014
13	1.08	0.022	( 0.534)	0.011	0.011
14	1.17	0.022	( 0.532)	0.011	0.011
15	1.25	0.022	( 0.530)	0.011	0.011
16	1.33	0.022	( 0.528)	0.011	0.011
17	1.42	0.022	( 0.525)	0.011	0.011
18	1.50	0.022	( 0.523)	0.011	0.011
19	1.58	0.022	( 0.521)	0.011	0.011
20	1.67	0.022	( 0.519)	0.011	0.011
21	1.75	0.022	( 0.517)	0.011	0.011
22	1.83	0.029	( 0.515)	0.014	0.014
23	1.92	0.029	( 0.513)	0.014	0.014
24	2.00	0.029	( 0.511)	0.014	0.014
25	2.08	0.029	( 0.509)	0.014	0.014
26	2.17	0.029	( 0.507)	0.014	0.014
27	2.25	0.029	( 0.505)	0.014	0.014
28	2.33	0.029	( 0.503)	0.014	0.014
29	2.42	0.029	( 0.501)	0.014	0.014
30	2.50	0.029	( 0.499)	0.014	0.014
31	2.58	0.036	( 0.497)	0.018	0.018
32	2.67	0.036	( 0.494)	0.018	0.018
33	2.75	0.036	( 0.492)	0.018	0.018
34	2.83	0.036	( 0.490)	0.018	0.018
35	2.92	0.036	( 0.488)	0.018	0.018
36	3.00	0.036	( 0.486)	0.018	0.018
37	3.08	0.036	( 0.484)	0.018	0.018
38	3.17	0.036	( 0.482)	0.018	0.018
39	3.25	0.036	( 0.480)	0.018	0.018
40	3.33	0.036	( 0.478)	0.018	0.018
41	3.42	0.036	( 0.476)	0.018	0.018
42	3.50	0.036	( 0.474)	0.018	0.018
43	3.58	0.036	( 0.472)	0.018	0.018
44	3.67	0.036	( 0.470)	0.018	0.018
45	3.75	0.036	( 0.468)	0.018	0.018
46	3.83	0.043	( 0.466)	0.022	0.022
47	3.92	0.043	( 0.464)	0.022	0.022
48	4.00	0.043	( 0.463)	0.022	0.022
49	4.08	0.043	( 0.461)	0.022	0.022
50	4.17	0.043	( 0.459)	0.022	0.022
51	4.25	0.043	( 0.457)	0.022	0.022
52	4.33	0.050	( 0.455)	0.025	0.025
53	4.42	0.050	( 0.453)	0.025	0.025
54	4.50	0.050	( 0.451)	0.025	0.025
55	4.58	0.050	( 0.449)	0.025	0.025
56	4.67	0.050	( 0.447)	0.025	0.025
57	4.75	0.050	( 0.445)	0.025	0.025
58	4.83	0.058	( 0.443)	0.029	0.029
59	4.92	0.058	( 0.441)	0.029	0.029
60	5.00	0.058	( 0.439)	0.029	0.029

61	5.08	0.20	0.043	( 0.437)	0.022	0.022
62	5.17	0.20	0.043	( 0.435)	0.022	0.022
63	5.25	0.20	0.043	( 0.434)	0.022	0.022
64	5.33	0.23	0.050	( 0.432)	0.025	0.025
65	5.42	0.23	0.050	( 0.430)	0.025	0.025
66	5.50	0.23	0.050	( 0.428)	0.025	0.025
67	5.58	0.27	0.058	( 0.426)	0.029	0.029
68	5.67	0.27	0.058	( 0.424)	0.029	0.029
69	5.75	0.27	0.058	( 0.422)	0.029	0.029
70	5.83	0.27	0.058	( 0.420)	0.029	0.029
71	5.92	0.27	0.058	( 0.419)	0.029	0.029
72	6.00	0.27	0.058	( 0.417)	0.029	0.029
73	6.08	0.30	0.065	( 0.415)	0.032	0.032
74	6.17	0.30	0.065	( 0.413)	0.032	0.032
75	6.25	0.30	0.065	( 0.411)	0.032	0.032
76	6.33	0.30	0.065	( 0.409)	0.032	0.032
77	6.42	0.30	0.065	( 0.407)	0.032	0.032
78	6.50	0.30	0.065	( 0.406)	0.032	0.032
79	6.58	0.33	0.072	( 0.404)	0.036	0.036
80	6.67	0.33	0.072	( 0.402)	0.036	0.036
81	6.75	0.33	0.072	( 0.400)	0.036	0.036
82	6.83	0.33	0.072	( 0.398)	0.036	0.036
83	6.92	0.33	0.072	( 0.397)	0.036	0.036
84	7.00	0.33	0.072	( 0.395)	0.036	0.036
85	7.08	0.33	0.072	( 0.393)	0.036	0.036
86	7.17	0.33	0.072	( 0.391)	0.036	0.036
87	7.25	0.33	0.072	( 0.389)	0.036	0.036
88	7.33	0.37	0.079	( 0.388)	0.040	0.040
89	7.42	0.37	0.079	( 0.386)	0.040	0.040
90	7.50	0.37	0.079	( 0.384)	0.040	0.040
91	7.58	0.40	0.086	( 0.382)	0.043	0.043
92	7.67	0.40	0.086	( 0.381)	0.043	0.043
93	7.75	0.40	0.086	( 0.379)	0.043	0.043
94	7.83	0.43	0.094	( 0.377)	0.047	0.047
95	7.92	0.43	0.094	( 0.375)	0.047	0.047
96	8.00	0.43	0.094	( 0.374)	0.047	0.047
97	8.08	0.50	0.108	( 0.372)	0.054	0.054
98	8.17	0.50	0.108	( 0.370)	0.054	0.054
99	8.25	0.50	0.108	( 0.368)	0.054	0.054
100	8.33	0.50	0.108	( 0.367)	0.054	0.054
101	8.42	0.50	0.108	( 0.365)	0.054	0.054
102	8.50	0.50	0.108	( 0.363)	0.054	0.054
103	8.58	0.53	0.115	( 0.362)	0.058	0.058
104	8.67	0.53	0.115	( 0.360)	0.058	0.058
105	8.75	0.53	0.115	( 0.358)	0.058	0.058
106	8.83	0.57	0.122	( 0.356)	0.061	0.061
107	8.92	0.57	0.122	( 0.355)	0.061	0.061
108	9.00	0.57	0.122	( 0.353)	0.061	0.061
109	9.08	0.63	0.137	( 0.351)	0.068	0.068
110	9.17	0.63	0.137	( 0.350)	0.068	0.068
111	9.25	0.63	0.137	( 0.348)	0.068	0.068
112	9.33	0.67	0.144	( 0.346)	0.072	0.072
113	9.42	0.67	0.144	( 0.345)	0.072	0.072
114	9.50	0.67	0.144	( 0.343)	0.072	0.072
115	9.58	0.70	0.151	( 0.341)	0.076	0.076
116	9.67	0.70	0.151	( 0.340)	0.076	0.076
117	9.75	0.70	0.151	( 0.338)	0.076	0.076
118	9.83	0.73	0.158	( 0.337)	0.079	0.079
119	9.92	0.73	0.158	( 0.335)	0.079	0.079
120	10.00	0.73	0.158	( 0.333)	0.079	0.079
121	10.08	0.50	0.108	( 0.332)	0.054	0.054
122	10.17	0.50	0.108	( 0.330)	0.054	0.054
123	10.25	0.50	0.108	( 0.329)	0.054	0.054
124	10.33	0.50	0.108	( 0.327)	0.054	0.054
125	10.42	0.50	0.108	( 0.325)	0.054	0.054
126	10.50	0.50	0.108	( 0.324)	0.054	0.054
127	10.58	0.67	0.144	( 0.322)	0.072	0.072
128	10.67	0.67	0.144	( 0.321)	0.072	0.072
129	10.75	0.67	0.144	( 0.319)	0.072	0.072
130	10.83	0.67	0.144	( 0.317)	0.072	0.072
131	10.92	0.67	0.144	( 0.316)	0.072	0.072
132	11.00	0.67	0.144	( 0.314)	0.072	0.072
133	11.08	0.63	0.137	( 0.313)	0.068	0.068
134	11.17	0.63	0.137	( 0.311)	0.068	0.068
135	11.25	0.63	0.137	( 0.310)	0.068	0.068
136	11.33	0.63	0.137	( 0.308)	0.068	0.068
137	11.42	0.63	0.137	( 0.307)	0.068	0.068
138	11.50	0.63	0.137	( 0.305)	0.068	0.068
139	11.58	0.57	0.122	( 0.304)	0.061	0.061
140	11.67	0.57	0.122	( 0.302)	0.061	0.061
141	11.75	0.57	0.122	( 0.301)	0.061	0.061

142	11.83	0.60	0.130	( 0.299)	0.065	0.065
143	11.92	0.60	0.130	( 0.298)	0.065	0.065
144	12.00	0.60	0.130	( 0.296)	0.065	0.065
145	12.08	0.83	0.180	( 0.295)	0.090	0.090
146	12.17	0.83	0.180	( 0.293)	0.090	0.090
147	12.25	0.83	0.180	( 0.292)	0.090	0.090
148	12.33	0.87	0.187	( 0.290)	0.094	0.094
149	12.42	0.87	0.187	( 0.289)	0.094	0.094
150	12.50	0.87	0.187	( 0.287)	0.094	0.094
151	12.58	0.93	0.202	( 0.286)	0.101	0.101
152	12.67	0.93	0.202	( 0.284)	0.101	0.101
153	12.75	0.93	0.202	( 0.283)	0.101	0.101
154	12.83	0.97	0.209	( 0.282)	0.104	0.104
155	12.92	0.97	0.209	( 0.280)	0.104	0.104
156	13.00	0.97	0.209	( 0.279)	0.104	0.104
157	13.08	1.13	0.245	( 0.277)	0.122	0.122
158	13.17	1.13	0.245	( 0.276)	0.122	0.122
159	13.25	1.13	0.245	( 0.275)	0.122	0.122
160	13.33	1.13	0.245	( 0.273)	0.122	0.122
161	13.42	1.13	0.245	( 0.272)	0.122	0.122
162	13.50	1.13	0.245	( 0.270)	0.122	0.122
163	13.58	0.77	0.166	( 0.269)	0.083	0.083
164	13.67	0.77	0.166	( 0.268)	0.083	0.083
165	13.75	0.77	0.166	( 0.266)	0.083	0.083
166	13.83	0.77	0.166	( 0.265)	0.083	0.083
167	13.92	0.77	0.166	( 0.264)	0.083	0.083
168	14.00	0.77	0.166	( 0.262)	0.083	0.083
169	14.08	0.90	0.194	( 0.261)	0.097	0.097
170	14.17	0.90	0.194	( 0.260)	0.097	0.097
171	14.25	0.90	0.194	( 0.258)	0.097	0.097
172	14.33	0.87	0.187	( 0.257)	0.094	0.094
173	14.42	0.87	0.187	( 0.256)	0.094	0.094
174	14.50	0.87	0.187	( 0.254)	0.094	0.094
175	14.58	0.87	0.187	( 0.253)	0.094	0.094
176	14.67	0.87	0.187	( 0.252)	0.094	0.094
177	14.75	0.87	0.187	( 0.250)	0.094	0.094
178	14.83	0.83	0.180	( 0.249)	0.090	0.090
179	14.92	0.83	0.180	( 0.248)	0.090	0.090
180	15.00	0.83	0.180	( 0.247)	0.090	0.090
181	15.08	0.80	0.173	( 0.245)	0.086	0.086
182	15.17	0.80	0.173	( 0.244)	0.086	0.086
183	15.25	0.80	0.173	( 0.243)	0.086	0.086
184	15.33	0.77	0.166	( 0.242)	0.083	0.083
185	15.42	0.77	0.166	( 0.240)	0.083	0.083
186	15.50	0.77	0.166	( 0.239)	0.083	0.083
187	15.58	0.63	0.137	( 0.238)	0.068	0.068
188	15.67	0.63	0.137	( 0.237)	0.068	0.068
189	15.75	0.63	0.137	( 0.235)	0.068	0.068
190	15.83	0.63	0.137	( 0.234)	0.068	0.068
191	15.92	0.63	0.137	( 0.233)	0.068	0.068
192	16.00	0.63	0.137	( 0.232)	0.068	0.068
193	16.08	0.13	0.029	( 0.231)	0.014	0.014
194	16.17	0.13	0.029	( 0.229)	0.014	0.014
195	16.25	0.13	0.029	( 0.228)	0.014	0.014
196	16.33	0.13	0.029	( 0.227)	0.014	0.014
197	16.42	0.13	0.029	( 0.226)	0.014	0.014
198	16.50	0.13	0.029	( 0.225)	0.014	0.014
199	16.58	0.10	0.022	( 0.224)	0.011	0.011
200	16.67	0.10	0.022	( 0.223)	0.011	0.011
201	16.75	0.10	0.022	( 0.221)	0.011	0.011
202	16.83	0.10	0.022	( 0.220)	0.011	0.011
203	16.92	0.10	0.022	( 0.219)	0.011	0.011
204	17.00	0.10	0.022	( 0.218)	0.011	0.011
205	17.08	0.17	0.036	( 0.217)	0.018	0.018
206	17.17	0.17	0.036	( 0.216)	0.018	0.018
207	17.25	0.17	0.036	( 0.215)	0.018	0.018
208	17.33	0.17	0.036	( 0.214)	0.018	0.018
209	17.42	0.17	0.036	( 0.213)	0.018	0.018
210	17.50	0.17	0.036	( 0.212)	0.018	0.018
211	17.58	0.17	0.036	( 0.211)	0.018	0.018
212	17.67	0.17	0.036	( 0.209)	0.018	0.018
213	17.75	0.17	0.036	( 0.208)	0.018	0.018
214	17.83	0.13	0.029	( 0.207)	0.014	0.014
215	17.92	0.13	0.029	( 0.206)	0.014	0.014
216	18.00	0.13	0.029	( 0.205)	0.014	0.014
217	18.08	0.13	0.029	( 0.204)	0.014	0.014
218	18.17	0.13	0.029	( 0.203)	0.014	0.014
219	18.25	0.13	0.029	( 0.202)	0.014	0.014
220	18.33	0.13	0.029	( 0.201)	0.014	0.014
221	18.42	0.13	0.029	( 0.200)	0.014	0.014
222	18.50	0.13	0.029	( 0.199)	0.014	0.014

223	18.58	0.10	0.022	( 0.198)	0.011	0.011
224	18.67	0.10	0.022	( 0.197)	0.011	0.011
225	18.75	0.10	0.022	( 0.197)	0.011	0.011
226	18.83	0.07	0.014	( 0.196)	0.007	0.007
227	18.92	0.07	0.014	( 0.195)	0.007	0.007
228	19.00	0.07	0.014	( 0.194)	0.007	0.007
229	19.08	0.10	0.022	( 0.193)	0.011	0.011
230	19.17	0.10	0.022	( 0.192)	0.011	0.011
231	19.25	0.10	0.022	( 0.191)	0.011	0.011
232	19.33	0.13	0.029	( 0.190)	0.014	0.014
233	19.42	0.13	0.029	( 0.189)	0.014	0.014
234	19.50	0.13	0.029	( 0.188)	0.014	0.014
235	19.58	0.10	0.022	( 0.187)	0.011	0.011
236	19.67	0.10	0.022	( 0.187)	0.011	0.011
237	19.75	0.10	0.022	( 0.186)	0.011	0.011
238	19.83	0.07	0.014	( 0.185)	0.007	0.007
239	19.92	0.07	0.014	( 0.184)	0.007	0.007
240	20.00	0.07	0.014	( 0.183)	0.007	0.007
241	20.08	0.10	0.022	( 0.182)	0.011	0.011
242	20.17	0.10	0.022	( 0.182)	0.011	0.011
243	20.25	0.10	0.022	( 0.181)	0.011	0.011
244	20.33	0.10	0.022	( 0.180)	0.011	0.011
245	20.42	0.10	0.022	( 0.179)	0.011	0.011
246	20.50	0.10	0.022	( 0.179)	0.011	0.011
247	20.58	0.10	0.022	( 0.178)	0.011	0.011
248	20.67	0.10	0.022	( 0.177)	0.011	0.011
249	20.75	0.10	0.022	( 0.176)	0.011	0.011
250	20.83	0.07	0.014	( 0.176)	0.007	0.007
251	20.92	0.07	0.014	( 0.175)	0.007	0.007
252	21.00	0.07	0.014	( 0.174)	0.007	0.007
253	21.08	0.10	0.022	( 0.174)	0.011	0.011
254	21.17	0.10	0.022	( 0.173)	0.011	0.011
255	21.25	0.10	0.022	( 0.172)	0.011	0.011
256	21.33	0.07	0.014	( 0.172)	0.007	0.007
257	21.42	0.07	0.014	( 0.171)	0.007	0.007
258	21.50	0.07	0.014	( 0.170)	0.007	0.007
259	21.58	0.10	0.022	( 0.170)	0.011	0.011
260	21.67	0.10	0.022	( 0.169)	0.011	0.011
261	21.75	0.10	0.022	( 0.168)	0.011	0.011
262	21.83	0.07	0.014	( 0.168)	0.007	0.007
263	21.92	0.07	0.014	( 0.167)	0.007	0.007
264	22.00	0.07	0.014	( 0.167)	0.007	0.007
265	22.08	0.10	0.022	( 0.166)	0.011	0.011
266	22.17	0.10	0.022	( 0.166)	0.011	0.011
267	22.25	0.10	0.022	( 0.165)	0.011	0.011
268	22.33	0.07	0.014	( 0.165)	0.007	0.007
269	22.42	0.07	0.014	( 0.164)	0.007	0.007
270	22.50	0.07	0.014	( 0.164)	0.007	0.007
271	22.58	0.07	0.014	( 0.163)	0.007	0.007
272	22.67	0.07	0.014	( 0.163)	0.007	0.007
273	22.75	0.07	0.014	( 0.162)	0.007	0.007
274	22.83	0.07	0.014	( 0.162)	0.007	0.007
275	22.92	0.07	0.014	( 0.161)	0.007	0.007
276	23.00	0.07	0.014	( 0.161)	0.007	0.007
277	23.08	0.07	0.014	( 0.161)	0.007	0.007
278	23.17	0.07	0.014	( 0.160)	0.007	0.007
279	23.25	0.07	0.014	( 0.160)	0.007	0.007
280	23.33	0.07	0.014	( 0.160)	0.007	0.007
281	23.42	0.07	0.014	( 0.159)	0.007	0.007
282	23.50	0.07	0.014	( 0.159)	0.007	0.007
283	23.58	0.07	0.014	( 0.159)	0.007	0.007
284	23.67	0.07	0.014	( 0.158)	0.007	0.007
285	23.75	0.07	0.014	( 0.158)	0.007	0.007
286	23.83	0.07	0.014	( 0.158)	0.007	0.007
287	23.92	0.07	0.014	( 0.158)	0.007	0.007
288	24.00	0.07	0.014	( 0.158)	0.007	0.007

Sum = 100.0 (Loss Rate Not Used) Sum = 10.8

Flood volume = Effective rainfall 0.90(In)  
times area 51.8(Ac.)/[(In)/(Ft.)] = 3.9(Ac.Ft)  
Total soil loss = 0.90(In)  
Total soil loss = 3.885(Ac.Ft)  
Total rainfall = 1.80(In)  
Flood volume = 169213.5 Cubic Feet  
Total soil loss = 169213.5 Cubic Feet

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Peak flow rate of this hydrograph = 6.393(CFS)  
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24 - H O U R S T O R M  
R u n o f f H y d r o g r a p h

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 Hydrograph in 5 Minute intervals ((CFS))  
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Time(h+m)	Volume	Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0008		0.11	Q				
0+10	0.0028		0.29	VQ				
0+15	0.0051		0.34	VQ				
0+20	0.0079		0.41	VQ				
0+25	0.0114		0.51	V Q				
0+30	0.0152		0.54	V Q				
0+35	0.0190		0.55	V Q				
0+40	0.0229		0.56	V Q				
0+45	0.0268		0.56	V Q				
0+50	0.0310		0.62	V Q				
0+55	0.0359		0.71	V Q				
1+ 0	0.0409		0.73	V Q				
1+ 5	0.0457		0.69	V Q				
1+10	0.0498		0.60	V Q				
1+15	0.0539		0.58	V Q				
1+20	0.0578		0.57	V Q				
1+25	0.0617		0.57	V Q				
1+30	0.0656		0.56	V Q				
1+35	0.0695		0.56	V Q				
1+40	0.0734		0.56	V Q				
1+45	0.0773		0.56	V Q				
1+50	0.0815		0.62	V Q				
1+55	0.0864		0.71	V Q				
2+ 0	0.0914		0.73	V Q				
2+ 5	0.0966		0.74	V Q				
2+10	0.1017		0.75	VQ				
2+15	0.1069		0.75	V Q				
2+20	0.1121		0.75	V Q				
2+25	0.1172		0.75	V Q				
2+30	0.1224		0.75	V Q				
2+35	0.1280		0.81	V Q				
2+40	0.1342		0.90	V Q				
2+45	0.1405		0.92	V Q				
2+50	0.1469		0.93	V Q				
2+55	0.1534		0.94	V Q				
3+ 0	0.1598		0.94	V Q				
3+ 5	0.1663		0.94	V Q				
3+10	0.1728		0.94	V Q				
3+15	0.1793		0.94	V Q				
3+20	0.1857		0.94	V Q				
3+25	0.1922		0.94	V Q				
3+30	0.1987		0.94	VQ				
3+35	0.2052		0.94	VQ				
3+40	0.2116		0.94	VQ				
3+45	0.2181		0.94	VQ				
3+50	0.2250		1.00	VQ				
3+55	0.2324		1.09	V Q				
4+ 0	0.2401		1.11	V Q				
4+ 5	0.2478		1.12	V Q				
4+10	0.2555		1.12	V Q				
4+15	0.2633		1.13	V Q				
4+20	0.2714		1.18	V Q				
4+25	0.2802		1.27	V Q				
4+30	0.2891		1.30	V Q				
4+35	0.2981		1.31	V Q				
4+40	0.3072		1.31	V Q				
4+45	0.3162		1.32	V Q				
4+50	0.3257		1.37	V Q				
4+55	0.3357		1.46	V Q				
5+ 0	0.3459		1.48	V Q				
5+ 5	0.3555		1.38	V Q				
5+10	0.3638		1.21	VQ				
5+15	0.3719		1.17	VQ				
5+20	0.3801		1.20	VQ				
5+25	0.3890		1.28	VQ				
5+30	0.3979		1.30	VQ				
5+35	0.4073		1.36	VQ				
5+40	0.4173		1.46	VQ				
5+45	0.4275		1.48	VQ				
5+50	0.4378		1.49	VQ				
5+55	0.4481		1.50	V Q				
6+ 0	0.4585		1.50	V Q				
6+ 5	0.4692		1.56	V Q				
6+10	0.4806		1.65	V Q				
6+15	0.4921		1.67	VQ				

6+20	0.5037	1.68	VQ			
6+25	0.5153	1.69	VQ			
6+30	0.5270	1.69	VQ			
6+35	0.5390	1.75	VQ			
6+40	0.5517	1.84	V Q			
6+45	0.5645	1.86	V Q			
6+50	0.5774	1.87	V Q			
6+55	0.5903	1.88	VQ			
7+ 0	0.6032	1.88	VQ			
7+ 5	0.6162	1.88	VQ			
7+10	0.6291	1.88	VQ			
7+15	0.6421	1.88	VQ			
7+20	0.6554	1.94	VQ			
7+25	0.6694	2.03	V Q			
7+30	0.6835	2.05	VQ			
7+35	0.6980	2.11	VQ			
7+40	0.7132	2.21	VQ			
7+45	0.7286	2.24	VQ			
7+50	0.7445	2.30	V Q			
7+55	0.7610	2.40	V Q			
8+ 0	0.7777	2.42	VQ			
8+ 5	0.7952	2.54	V Q			
8+10	0.8140	2.73	V Q			
8+15	0.8332	2.78	V Q			
8+20	0.8525	2.80	V Q			
8+25	0.8718	2.81	V Q			
8+30	0.8913	2.82	V Q			
8+35	0.9111	2.88	V Q			
8+40	0.9315	2.97	V Q			
8+45	0.9521	2.99	V Q			
8+50	0.9731	3.05	V Q			
8+55	0.9948	3.15	V Q			
9+ 0	1.0167	3.18	V Q			
9+ 5	1.0394	3.30	V Q			
9+10	1.0634	3.48	V Q			
9+15	1.0877	3.53	V Q			
9+20	1.1125	3.61	V Q			
9+25	1.1381	3.71	V Q			
9+30	1.1638	3.74	V Q			
9+35	1.1901	3.81	V Q			
9+40	1.2169	3.90	V Q			
9+45	1.2440	3.93	V Q			
9+50	1.2715	3.99	V Q			
9+55	1.2996	4.09	V Q			
10+ 0	1.3280	4.12	V Q			
10+ 5	1.3538	3.74	VQ			
10+10	1.3752	3.11	Q V			
10+15	1.3956	2.96	Q V			
10+20	1.4155	2.89	Q V			
10+25	1.4351	2.85	Q V			
10+30	1.4545	2.82	Q V			
10+35	1.4758	3.10	Q V			
10+40	1.5003	3.55	QV			
10+45	1.5255	3.66	QV			
10+50	1.5511	3.71	QV			
10+55	1.5768	3.74	Q V			
11+ 0	1.6027	3.76	Q V			
11+ 5	1.6282	3.71	Q V			
11+10	1.6531	3.61	Q Q			
11+15	1.6779	3.59	Q Q			
11+20	1.7025	3.58	Q Q			
11+25	1.7272	3.58	Q Q			
11+30	1.7518	3.57	Q Q			
11+35	1.7756	3.46	Q Q			
11+40	1.7982	3.28	Q Q			
11+45	1.8205	3.24	Q Q			
11+50	1.8430	3.27	Q Q			
11+55	1.8661	3.35	Q Q			
12+ 0	1.8893	3.36	Q Q			
12+ 5	1.9152	3.76	Q Q			
12+10	1.9454	4.40	Q Q			
12+15	1.9769	4.56	Q Q			
12+20	2.0091	4.69	Q Q			
12+25	2.0423	4.82	Q Q			
12+30	2.0758	4.87	Q Q			
12+35	2.1102	4.99	Q Q			
12+40	2.1458	5.17	Q V			
12+45	2.1818	5.22	Q V			
12+50	2.2183	5.30	Q V			
12+55	2.2555	5.40	Q V			
13+ 0	2.2929	5.43	Q V			

13+ 5	2.3323	5.72				
13+10	2.3749	6.17				
13+15	2.4182	6.29				
13+20	2.4619	6.34				
13+25	2.5058	6.37				
13+30	2.5498	6.39				
13+35	2.5897	5.79				
13+40	2.6227	4.79				
13+45	2.6540	4.54				
13+50	2.6845	4.43				
13+55	2.7146	4.37				
14+ 0	2.7443	4.32				
14+ 5	2.7756	4.54				
14+10	2.8094	4.91				
14+15	2.8438	5.00				
14+20	2.8782	4.98				
14+25	2.9120	4.91				
14+30	2.9458	4.91				
14+35	2.9795	4.90				
14+40	3.0132	4.89				
14+45	3.0469	4.89				
14+50	3.0802	4.83				
14+55	3.1129	4.74				
15+ 0	3.1454	4.72				
15+ 5	3.1774	4.66				
15+10	3.2088	4.56				
15+15	3.2400	4.53				
15+20	3.2708	4.47				
15+25	3.3009	4.37				
15+30	3.3308	4.34				
15+35	3.3592	4.11				
15+40	3.3850	3.75				
15+45	3.4101	3.65				
15+50	3.4350	3.61				
15+55	3.4597	3.59				
16+ 0	3.4843	3.57				
16+ 5	3.5032	2.75				
16+10	3.5128	1.39				
16+15	3.5200	1.05				
16+20	3.5262	0.90				
16+25	3.5318	0.81				
16+30	3.5370	0.75				
16+35	3.5418	0.70				
16+40	3.5460	0.61				
16+45	3.5500	0.58				
16+50	3.5539	0.57				
16+55	3.5579	0.57				
17+ 0	3.5617	0.56				
17+ 5	3.5664	0.67				
17+10	3.5723	0.85				
17+15	3.5785	0.90				
17+20	3.5848	0.92				
17+25	3.5912	0.93				
17+30	3.5977	0.94				
17+35	3.6042	0.94				
17+40	3.6107	0.94				
17+45	3.6171	0.94				
17+50	3.6232	0.89				
17+55	3.6287	0.79				
18+ 0	3.6340	0.77				
18+ 5	3.6393	0.76				
18+10	3.6445	0.76				
18+15	3.6496	0.75				
18+20	3.6548	0.75				
18+25	3.6600	0.75				
18+30	3.6652	0.75				
18+35	3.6700	0.70				
18+40	3.6742	0.61				
18+45	3.6782	0.58				
18+50	3.6818	0.52				
18+55	3.6847	0.42				
19+ 0	3.6874	0.40				
19+ 5	3.6904	0.44				
19+10	3.6941	0.53				
19+15	3.6978	0.54				
19+20	3.7020	0.61				
19+25	3.7069	0.71				
19+30	3.7119	0.73				
19+35	3.7166	0.69				
19+40	3.7208	0.60				
19+45	3.7248	0.58				

19+50	3.7284	0.52	Q				V
19+55	3.7313	0.42	Q				V
20+ 0	3.7340	0.40	Q				V
20+ 5	3.7370	0.44	Q				V
20+10	3.7407	0.53	Q				V
20+15	3.7444	0.54	Q				V
20+20	3.7482	0.55	Q				V
20+25	3.7521	0.56	Q				V
20+30	3.7560	0.56	Q				V
20+35	3.7599	0.56	Q				V
20+40	3.7637	0.56	Q				V
20+45	3.7676	0.56	Q				V
20+50	3.7711	0.51	Q				V
20+55	3.7740	0.42	Q				V
21+ 0	3.7767	0.40	Q				V
21+ 5	3.7798	0.44	Q				V
21+10	3.7834	0.53	Q				V
21+15	3.7871	0.54	Q				V
21+20	3.7906	0.50	Q				V
21+25	3.7934	0.41	Q				V
21+30	3.7962	0.40	Q				V
21+35	3.7992	0.44	Q				V
21+40	3.8028	0.53	Q				V
21+45	3.8066	0.54	Q				V
21+50	3.8100	0.50	Q				V
21+55	3.8129	0.41	Q				V
22+ 0	3.8156	0.40	Q				V
22+ 5	3.8186	0.44	Q				V
22+10	3.8222	0.53	Q				V
22+15	3.8260	0.54	Q				V
22+20	3.8294	0.50	Q				V
22+25	3.8323	0.41	Q				V
22+30	3.8350	0.40	Q				V
22+35	3.8377	0.39	Q				V
22+40	3.8403	0.38	Q				V
22+45	3.8429	0.38	Q				V
22+50	3.8455	0.38	Q				V
22+55	3.8481	0.38	Q				V
23+ 0	3.8506	0.38	Q				V
23+ 5	3.8532	0.38	Q				V
23+10	3.8558	0.38	Q				V
23+15	3.8584	0.38	Q				V
23+20	3.8610	0.38	Q				V
23+25	3.8636	0.38	Q				V
23+30	3.8662	0.38	Q				V
23+35	3.8688	0.38	Q				V
23+40	3.8714	0.38	Q				V
23+45	3.8740	0.38	Q				V
23+50	3.8765	0.38	Q				V
23+55	3.8791	0.38	Q				V
24+ 0	3.8817	0.38	Q				V
24+ 5	3.8836	0.27	Q				V
24+10	3.8841	0.09	Q				V
24+15	3.8844	0.04	Q				V
24+20	3.8846	0.02	Q				V
24+25	3.8846	0.01	Q				V

Section 7.6 – Basin 3 – Proposed 2 Year- 24 Hour Hydrograph

Unit Hydrograph Analysis

Copyright (C) CIVILCADD/CIVILDESIGN, 1989 - 2008, Version 8.1
Study date 04/22/24 File: pro32242.out

Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 5006

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

Drainage Area = 7.79(Ac.) = 0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 7.79(Ac.) = 0.012 Sq. Mi.
Length along longest watercourse = 2225.00(Ft.)
Length along longest watercourse measured to centroid = 1113.00(Ft.)
Length along longest watercourse = 0.421 Mi.
Length along longest watercourse measured to centroid = 0.211 Mi.
Difference in elevation = 82.00(Ft.)
Slope along watercourse = 194.5888 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time = 0.053 Hr.
Lag time = 3.16 Min.
25% of lag time = 0.79 Min.
40% of lag time = 1.26 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1] Rainfall(In)[2] weighting[1\*2]
7.79 1.80 14.02

100 YEAR Area rainfall data:

Area(Ac.)[1] Rainfall(In)[2] weighting[1\*2]
7.79 5.00 38.95

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 1.800(In)
Area Averaged 100-Year Rainfall = 5.000(In)

Point rain (area averaged) = 1.800(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 1.800(In)

Sub-Area Data:
Area(Ac.) Runoff Index Impervious %
7.790 69.00 0.500
Total Area Entered = 7.79(Ac.)

RI RI Infil. Rate Impervious Adj. Infil. Rate Area% F
AMC2 AMC-1 (In/Hr) (Dec.%) (In/Hr) (Dec.) (In/Hr)
69.0 49.8 0.574 0.500 0.316 1.000 0.316
Sum (F) = 0.316

Area averaged mean soil loss (F) (In/Hr) = 0.316
Minimum soil loss rate ((In/Hr)) = 0.158
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

Unit Hydrograph
VALLEY S-Curve

Unit Hydrograph Data

Unit time period Time % of lag Distribution Unit Hydrograph
(hrs) Graph % (CFS)

1	0.083	158.124	35.084	2.754
2	0.167	316.247	46.408	3.643
3	0.250	474.371	10.730	0.842
4	0.333	632.495	4.637	0.364
5	0.417	790.618	2.252	0.177
6	0.500	948.742	0.888	0.070
			Sum = 100.000	Sum= 7.851

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

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr)		Effective (In/Hr)
				Max	Low	
1	0.08	0.07	0.014	( 0.560)	0.007	0.007
2	0.17	0.07	0.014	( 0.557)	0.007	0.007
3	0.25	0.07	0.014	( 0.555)	0.007	0.007
4	0.33	0.10	0.022	( 0.553)	0.011	0.011
5	0.42	0.10	0.022	( 0.551)	0.011	0.011
6	0.50	0.10	0.022	( 0.549)	0.011	0.011
7	0.58	0.10	0.022	( 0.547)	0.011	0.011
8	0.67	0.10	0.022	( 0.545)	0.011	0.011
9	0.75	0.10	0.022	( 0.542)	0.011	0.011
10	0.83	0.13	0.029	( 0.540)	0.014	0.014
11	0.92	0.13	0.029	( 0.538)	0.014	0.014
12	1.00	0.13	0.029	( 0.536)	0.014	0.014
13	1.08	0.10	0.022	( 0.534)	0.011	0.011
14	1.17	0.10	0.022	( 0.532)	0.011	0.011
15	1.25	0.10	0.022	( 0.530)	0.011	0.011
16	1.33	0.10	0.022	( 0.528)	0.011	0.011
17	1.42	0.10	0.022	( 0.525)	0.011	0.011
18	1.50	0.10	0.022	( 0.523)	0.011	0.011
19	1.58	0.10	0.022	( 0.521)	0.011	0.011
20	1.67	0.10	0.022	( 0.519)	0.011	0.011
21	1.75	0.10	0.022	( 0.517)	0.011	0.011
22	1.83	0.13	0.029	( 0.515)	0.014	0.014
23	1.92	0.13	0.029	( 0.513)	0.014	0.014
24	2.00	0.13	0.029	( 0.511)	0.014	0.014
25	2.08	0.13	0.029	( 0.509)	0.014	0.014
26	2.17	0.13	0.029	( 0.507)	0.014	0.014
27	2.25	0.13	0.029	( 0.505)	0.014	0.014
28	2.33	0.13	0.029	( 0.503)	0.014	0.014
29	2.42	0.13	0.029	( 0.501)	0.014	0.014
30	2.50	0.13	0.029	( 0.499)	0.014	0.014
31	2.58	0.17	0.036	( 0.497)	0.018	0.018
32	2.67	0.17	0.036	( 0.494)	0.018	0.018
33	2.75	0.17	0.036	( 0.492)	0.018	0.018
34	2.83	0.17	0.036	( 0.490)	0.018	0.018
35	2.92	0.17	0.036	( 0.488)	0.018	0.018
36	3.00	0.17	0.036	( 0.486)	0.018	0.018
37	3.08	0.17	0.036	( 0.484)	0.018	0.018
38	3.17	0.17	0.036	( 0.482)	0.018	0.018
39	3.25	0.17	0.036	( 0.480)	0.018	0.018
40	3.33	0.17	0.036	( 0.478)	0.018	0.018
41	3.42	0.17	0.036	( 0.476)	0.018	0.018
42	3.50	0.17	0.036	( 0.474)	0.018	0.018
43	3.58	0.17	0.036	( 0.472)	0.018	0.018
44	3.67	0.17	0.036	( 0.470)	0.018	0.018
45	3.75	0.17	0.036	( 0.468)	0.018	0.018
46	3.83	0.20	0.043	( 0.466)	0.022	0.022
47	3.92	0.20	0.043	( 0.464)	0.022	0.022
48	4.00	0.20	0.043	( 0.463)	0.022	0.022
49	4.08	0.20	0.043	( 0.461)	0.022	0.022
50	4.17	0.20	0.043	( 0.459)	0.022	0.022
51	4.25	0.20	0.043	( 0.457)	0.022	0.022
52	4.33	0.23	0.050	( 0.455)	0.025	0.025
53	4.42	0.23	0.050	( 0.453)	0.025	0.025
54	4.50	0.23	0.050	( 0.451)	0.025	0.025
55	4.58	0.23	0.050	( 0.449)	0.025	0.025
56	4.67	0.23	0.050	( 0.447)	0.025	0.025
57	4.75	0.23	0.050	( 0.445)	0.025	0.025
58	4.83	0.27	0.058	( 0.443)	0.029	0.029
59	4.92	0.27	0.058	( 0.441)	0.029	0.029
60	5.00	0.27	0.058	( 0.439)	0.029	0.029
61	5.08	0.20	0.043	( 0.437)	0.022	0.022
62	5.17	0.20	0.043	( 0.435)	0.022	0.022
63	5.25	0.20	0.043	( 0.434)	0.022	0.022
64	5.33	0.23	0.050	( 0.432)	0.025	0.025
65	5.42	0.23	0.050	( 0.430)	0.025	0.025
66	5.50	0.23	0.050	( 0.428)	0.025	0.025
67	5.58	0.27	0.058	( 0.426)	0.029	0.029
68	5.67	0.27	0.058	( 0.424)	0.029	0.029
69	5.75	0.27	0.058	( 0.422)	0.029	0.029
70	5.83	0.27	0.058	( 0.420)	0.029	0.029

71	5.92	0.27	0.058	( 0.419)	0.029	0.029
72	6.00	0.27	0.058	( 0.417)	0.029	0.029
73	6.08	0.30	0.065	( 0.415)	0.032	0.032
74	6.17	0.30	0.065	( 0.413)	0.032	0.032
75	6.25	0.30	0.065	( 0.411)	0.032	0.032
76	6.33	0.30	0.065	( 0.409)	0.032	0.032
77	6.42	0.30	0.065	( 0.407)	0.032	0.032
78	6.50	0.30	0.065	( 0.406)	0.032	0.032
79	6.58	0.33	0.072	( 0.404)	0.036	0.036
80	6.67	0.33	0.072	( 0.402)	0.036	0.036
81	6.75	0.33	0.072	( 0.400)	0.036	0.036
82	6.83	0.33	0.072	( 0.398)	0.036	0.036
83	6.92	0.33	0.072	( 0.397)	0.036	0.036
84	7.00	0.33	0.072	( 0.395)	0.036	0.036
85	7.08	0.33	0.072	( 0.393)	0.036	0.036
86	7.17	0.33	0.072	( 0.391)	0.036	0.036
87	7.25	0.33	0.072	( 0.389)	0.036	0.036
88	7.33	0.37	0.079	( 0.388)	0.040	0.040
89	7.42	0.37	0.079	( 0.386)	0.040	0.040
90	7.50	0.37	0.079	( 0.384)	0.040	0.040
91	7.58	0.40	0.086	( 0.382)	0.043	0.043
92	7.67	0.40	0.086	( 0.381)	0.043	0.043
93	7.75	0.40	0.086	( 0.379)	0.043	0.043
94	7.83	0.43	0.094	( 0.377)	0.047	0.047
95	7.92	0.43	0.094	( 0.375)	0.047	0.047
96	8.00	0.43	0.094	( 0.374)	0.047	0.047
97	8.08	0.50	0.108	( 0.372)	0.054	0.054
98	8.17	0.50	0.108	( 0.370)	0.054	0.054
99	8.25	0.50	0.108	( 0.368)	0.054	0.054
100	8.33	0.50	0.108	( 0.367)	0.054	0.054
101	8.42	0.50	0.108	( 0.365)	0.054	0.054
102	8.50	0.50	0.108	( 0.363)	0.054	0.054
103	8.58	0.53	0.115	( 0.362)	0.058	0.058
104	8.67	0.53	0.115	( 0.360)	0.058	0.058
105	8.75	0.53	0.115	( 0.358)	0.058	0.058
106	8.83	0.57	0.122	( 0.356)	0.061	0.061
107	8.92	0.57	0.122	( 0.355)	0.061	0.061
108	9.00	0.57	0.122	( 0.353)	0.061	0.061
109	9.08	0.63	0.137	( 0.351)	0.068	0.068
110	9.17	0.63	0.137	( 0.350)	0.068	0.068
111	9.25	0.63	0.137	( 0.348)	0.068	0.068
112	9.33	0.67	0.144	( 0.346)	0.072	0.072
113	9.42	0.67	0.144	( 0.345)	0.072	0.072
114	9.50	0.67	0.144	( 0.343)	0.072	0.072
115	9.58	0.70	0.151	( 0.341)	0.076	0.076
116	9.67	0.70	0.151	( 0.340)	0.076	0.076
117	9.75	0.70	0.151	( 0.338)	0.076	0.076
118	9.83	0.73	0.158	( 0.337)	0.079	0.079
119	9.92	0.73	0.158	( 0.335)	0.079	0.079
120	10.00	0.73	0.158	( 0.333)	0.079	0.079
121	10.08	0.50	0.108	( 0.332)	0.054	0.054
122	10.17	0.50	0.108	( 0.330)	0.054	0.054
123	10.25	0.50	0.108	( 0.329)	0.054	0.054
124	10.33	0.50	0.108	( 0.327)	0.054	0.054
125	10.42	0.50	0.108	( 0.325)	0.054	0.054
126	10.50	0.50	0.108	( 0.324)	0.054	0.054
127	10.58	0.67	0.144	( 0.322)	0.072	0.072
128	10.67	0.67	0.144	( 0.321)	0.072	0.072
129	10.75	0.67	0.144	( 0.319)	0.072	0.072
130	10.83	0.67	0.144	( 0.317)	0.072	0.072
131	10.92	0.67	0.144	( 0.316)	0.072	0.072
132	11.00	0.67	0.144	( 0.314)	0.072	0.072
133	11.08	0.63	0.137	( 0.313)	0.068	0.068
134	11.17	0.63	0.137	( 0.311)	0.068	0.068
135	11.25	0.63	0.137	( 0.310)	0.068	0.068
136	11.33	0.63	0.137	( 0.308)	0.068	0.068
137	11.42	0.63	0.137	( 0.307)	0.068	0.068
138	11.50	0.63	0.137	( 0.305)	0.068	0.068
139	11.58	0.57	0.122	( 0.304)	0.061	0.061
140	11.67	0.57	0.122	( 0.302)	0.061	0.061
141	11.75	0.57	0.122	( 0.301)	0.061	0.061
142	11.83	0.60	0.130	( 0.299)	0.065	0.065
143	11.92	0.60	0.130	( 0.298)	0.065	0.065
144	12.00	0.60	0.130	( 0.296)	0.065	0.065
145	12.08	0.83	0.180	( 0.295)	0.090	0.090
146	12.17	0.83	0.180	( 0.293)	0.090	0.090
147	12.25	0.83	0.180	( 0.292)	0.090	0.090
148	12.33	0.87	0.187	( 0.290)	0.094	0.094
149	12.42	0.87	0.187	( 0.289)	0.094	0.094
150	12.50	0.87	0.187	( 0.287)	0.094	0.094
151	12.58	0.93	0.202	( 0.286)	0.101	0.101
152	12.67	0.93	0.202	( 0.284)	0.101	0.101
153	12.75	0.93	0.202	( 0.283)	0.101	0.101
154	12.83	0.97	0.209	( 0.282)	0.104	0.104
155	12.92	0.97	0.209	( 0.280)	0.104	0.104
156	13.00	0.97	0.209	( 0.279)	0.104	0.104

157	13.08	1.13	0.245	( 0.277)	0.122	0.122
158	13.17	1.13	0.245	( 0.276)	0.122	0.122
159	13.25	1.13	0.245	( 0.275)	0.122	0.122
160	13.33	1.13	0.245	( 0.273)	0.122	0.122
161	13.42	1.13	0.245	( 0.272)	0.122	0.122
162	13.50	1.13	0.245	( 0.270)	0.122	0.122
163	13.58	0.77	0.166	( 0.269)	0.083	0.083
164	13.67	0.77	0.166	( 0.268)	0.083	0.083
165	13.75	0.77	0.166	( 0.266)	0.083	0.083
166	13.83	0.77	0.166	( 0.265)	0.083	0.083
167	13.92	0.77	0.166	( 0.264)	0.083	0.083
168	14.00	0.77	0.166	( 0.262)	0.083	0.083
169	14.08	0.90	0.194	( 0.261)	0.097	0.097
170	14.17	0.90	0.194	( 0.260)	0.097	0.097
171	14.25	0.90	0.194	( 0.258)	0.097	0.097
172	14.33	0.87	0.187	( 0.257)	0.094	0.094
173	14.42	0.87	0.187	( 0.256)	0.094	0.094
174	14.50	0.87	0.187	( 0.254)	0.094	0.094
175	14.58	0.87	0.187	( 0.253)	0.094	0.094
176	14.67	0.87	0.187	( 0.252)	0.094	0.094
177	14.75	0.87	0.187	( 0.250)	0.094	0.094
178	14.83	0.83	0.180	( 0.249)	0.090	0.090
179	14.92	0.83	0.180	( 0.248)	0.090	0.090
180	15.00	0.83	0.180	( 0.247)	0.090	0.090
181	15.08	0.80	0.173	( 0.245)	0.086	0.086
182	15.17	0.80	0.173	( 0.244)	0.086	0.086
183	15.25	0.80	0.173	( 0.243)	0.086	0.086
184	15.33	0.77	0.166	( 0.242)	0.083	0.083
185	15.42	0.77	0.166	( 0.240)	0.083	0.083
186	15.50	0.77	0.166	( 0.239)	0.083	0.083
187	15.58	0.63	0.137	( 0.238)	0.068	0.068
188	15.67	0.63	0.137	( 0.237)	0.068	0.068
189	15.75	0.63	0.137	( 0.235)	0.068	0.068
190	15.83	0.63	0.137	( 0.234)	0.068	0.068
191	15.92	0.63	0.137	( 0.233)	0.068	0.068
192	16.00	0.63	0.137	( 0.232)	0.068	0.068
193	16.08	0.13	0.029	( 0.231)	0.014	0.014
194	16.17	0.13	0.029	( 0.229)	0.014	0.014
195	16.25	0.13	0.029	( 0.228)	0.014	0.014
196	16.33	0.13	0.029	( 0.227)	0.014	0.014
197	16.42	0.13	0.029	( 0.226)	0.014	0.014
198	16.50	0.13	0.029	( 0.225)	0.014	0.014
199	16.58	0.10	0.022	( 0.224)	0.011	0.011
200	16.67	0.10	0.022	( 0.223)	0.011	0.011
201	16.75	0.10	0.022	( 0.221)	0.011	0.011
202	16.83	0.10	0.022	( 0.220)	0.011	0.011
203	16.92	0.10	0.022	( 0.219)	0.011	0.011
204	17.00	0.10	0.022	( 0.218)	0.011	0.011
205	17.08	0.17	0.036	( 0.217)	0.018	0.018
206	17.17	0.17	0.036	( 0.216)	0.018	0.018
207	17.25	0.17	0.036	( 0.215)	0.018	0.018
208	17.33	0.17	0.036	( 0.214)	0.018	0.018
209	17.42	0.17	0.036	( 0.213)	0.018	0.018
210	17.50	0.17	0.036	( 0.212)	0.018	0.018
211	17.58	0.17	0.036	( 0.211)	0.018	0.018
212	17.67	0.17	0.036	( 0.209)	0.018	0.018
213	17.75	0.17	0.036	( 0.208)	0.018	0.018
214	17.83	0.13	0.029	( 0.207)	0.014	0.014
215	17.92	0.13	0.029	( 0.206)	0.014	0.014
216	18.00	0.13	0.029	( 0.205)	0.014	0.014
217	18.08	0.13	0.029	( 0.204)	0.014	0.014
218	18.17	0.13	0.029	( 0.203)	0.014	0.014
219	18.25	0.13	0.029	( 0.202)	0.014	0.014
220	18.33	0.13	0.029	( 0.201)	0.014	0.014
221	18.42	0.13	0.029	( 0.200)	0.014	0.014
222	18.50	0.13	0.029	( 0.199)	0.014	0.014
223	18.58	0.10	0.022	( 0.198)	0.011	0.011
224	18.67	0.10	0.022	( 0.197)	0.011	0.011
225	18.75	0.10	0.022	( 0.197)	0.011	0.011
226	18.83	0.07	0.014	( 0.196)	0.007	0.007
227	18.92	0.07	0.014	( 0.195)	0.007	0.007
228	19.00	0.07	0.014	( 0.194)	0.007	0.007
229	19.08	0.10	0.022	( 0.193)	0.011	0.011
230	19.17	0.10	0.022	( 0.192)	0.011	0.011
231	19.25	0.10	0.022	( 0.191)	0.011	0.011
232	19.33	0.13	0.029	( 0.190)	0.014	0.014
233	19.42	0.13	0.029	( 0.189)	0.014	0.014
234	19.50	0.13	0.029	( 0.188)	0.014	0.014
235	19.58	0.10	0.022	( 0.187)	0.011	0.011
236	19.67	0.10	0.022	( 0.187)	0.011	0.011
237	19.75	0.10	0.022	( 0.186)	0.011	0.011
238	19.83	0.07	0.014	( 0.185)	0.007	0.007
239	19.92	0.07	0.014	( 0.184)	0.007	0.007
240	20.00	0.07	0.014	( 0.183)	0.007	0.007
241	20.08	0.10	0.022	( 0.182)	0.011	0.011
242	20.17	0.10	0.022	( 0.182)	0.011	0.011



1+40	0.0111	0.08	Q				
1+45	0.0117	0.08	Q				
1+50	0.0124	0.09	Q				
1+55	0.0131	0.11	Q				
2+ 0	0.0139	0.11	Q				
2+ 5	0.0146	0.11	QV				
2+10	0.0154	0.11	QV				
2+15	0.0162	0.11	QV				
2+20	0.0170	0.11	QV				
2+25	0.0178	0.11	QV				
2+30	0.0185	0.11	QV				
2+35	0.0194	0.12	QV				
2+40	0.0203	0.14	QV				
2+45	0.0213	0.14	QV				
2+50	0.0222	0.14	QV				
2+55	0.0232	0.14	QV				
3+ 0	0.0242	0.14	QV				
3+ 5	0.0252	0.14	QV				
3+10	0.0261	0.14	QV				
3+15	0.0271	0.14	QV				
3+20	0.0281	0.14	QV				
3+25	0.0291	0.14	QV				
3+30	0.0300	0.14	Q V				
3+35	0.0310	0.14	Q V				
3+40	0.0320	0.14	Q V				
3+45	0.0330	0.14	Q V				
3+50	0.0340	0.15	Q V				
3+55	0.0351	0.16	Q V				
4+ 0	0.0363	0.17	Q V				
4+ 5	0.0374	0.17	Q V				
4+10	0.0386	0.17	Q V				
4+15	0.0398	0.17	Q V				
4+20	0.0410	0.18	Q V				
4+25	0.0423	0.19	Q V				
4+30	0.0437	0.20	Q V				
4+35	0.0451	0.20	Q V				
4+40	0.0464	0.20	Q V				
4+45	0.0478	0.20	Q V				
4+50	0.0492	0.21	Q V				
4+55	0.0507	0.22	Q V				
5+ 0	0.0523	0.22	Q V				
5+ 5	0.0537	0.21	Q V				
5+10	0.0549	0.18	Q V				
5+15	0.0561	0.17	Q V				
5+20	0.0574	0.18	Q V				
5+25	0.0587	0.19	Q V				
5+30	0.0601	0.20	Q V				
5+35	0.0615	0.21	Q V				
5+40	0.0630	0.22	Q V				
5+45	0.0645	0.22	Q V				
5+50	0.0661	0.23	Q V				
5+55	0.0677	0.23	Q V				
6+ 0	0.0692	0.23	Q V				
6+ 5	0.0708	0.24	Q V				
6+10	0.0726	0.25	Q V				
6+15	0.0743	0.25	Q V				
6+20	0.0760	0.25	Q V				
6+25	0.0778	0.25	Q V				
6+30	0.0795	0.25	Q V				
6+35	0.0814	0.26	Q V				
6+40	0.0833	0.28	Q V				
6+45	0.0852	0.28	Q V				
6+50	0.0871	0.28	Q V				
6+55	0.0891	0.28	Q V				
7+ 0	0.0910	0.28	Q V				
7+ 5	0.0930	0.28	Q V				
7+10	0.0949	0.28	Q V				
7+15	0.0969	0.28	Q V				
7+20	0.0989	0.29	Q V				
7+25	0.1010	0.31	Q V				
7+30	0.1031	0.31	Q V				
7+35	0.1053	0.32	Q V				
7+40	0.1076	0.33	Q V				
7+45	0.1100	0.34	Q V				
7+50	0.1124	0.35	Q V				
7+55	0.1148	0.36	Q V				
8+ 0	0.1174	0.37	Q V				
8+ 5	0.1200	0.39	Q V				
8+10	0.1229	0.41	Q V				
8+15	0.1258	0.42	Q V				
8+20	0.1287	0.42	Q V				
8+25	0.1316	0.42	Q V				
8+30	0.1345	0.42	Q V				
8+35	0.1375	0.43	Q V				
8+40	0.1406	0.45	Q V				
8+45	0.1437	0.45	Q V				

8+50	0.1469	0.46	Q	V		
8+55	0.1501	0.48	Q	V		
9+ 0	0.1534	0.48	Q	V		
9+ 5	0.1569	0.50	Q	V		
9+10	0.1605	0.53	Q	V		
9+15	0.1642	0.53	Q	V		
9+20	0.1679	0.55	Q	V		
9+25	0.1718	0.56	Q	V		
9+30	0.1757	0.56	Q	V		
9+35	0.1796	0.57	Q	V		
9+40	0.1837	0.59	Q	V		
9+45	0.1877	0.59	Q	V		
9+50	0.1919	0.60	Q	V		
9+55	0.1961	0.62	Q	V		
10+ 0	0.2004	0.62	Q	V		
10+ 5	0.2042	0.55	Q	V		
10+10	0.2074	0.46	Q	V		
10+15	0.2104	0.44	Q	V		
10+20	0.2134	0.43	Q	V		
10+25	0.2163	0.43	Q	V		
10+30	0.2192	0.42	Q	V		
10+35	0.2225	0.47	Q	V		
10+40	0.2262	0.54	Q	V		
10+45	0.2300	0.55	Q	V		
10+50	0.2339	0.56	Q	V		
10+55	0.2378	0.56	Q	V		
11+ 0	0.2417	0.57	Q	V		
11+ 5	0.2455	0.56	Q	V		
11+10	0.2492	0.54	Q	V		
11+15	0.2530	0.54	Q	V		
11+20	0.2567	0.54	Q	V		
11+25	0.2604	0.54	Q	V		
11+30	0.2641	0.54	Q	V		
11+35	0.2676	0.52	Q	V		
11+40	0.2710	0.49	Q	V		
11+45	0.2743	0.49	Q	V		
11+50	0.2777	0.49	Q	V		
11+55	0.2812	0.50	Q	V		
12+ 0	0.2847	0.51	Q	V		
12+ 5	0.2887	0.58	Q	V		
12+10	0.2933	0.67	Q	V		
12+15	0.2981	0.69	Q	V		
12+20	0.3029	0.71	Q	V		
12+25	0.3080	0.73	Q	V		
12+30	0.3130	0.73	Q	V		
12+35	0.3182	0.75	Q	V		
12+40	0.3236	0.78	Q	V		
12+45	0.3290	0.79	Q	V		
12+50	0.3345	0.80	Q	V		
12+55	0.3401	0.81	Q	V		
13+ 0	0.3458	0.82	Q	V		
13+ 5	0.3517	0.87	Q	V		
13+10	0.3582	0.94	Q	V		
13+15	0.3647	0.95	Q	V		
13+20	0.3713	0.96	Q	V		
13+25	0.3779	0.96	Q	V		
13+30	0.3846	0.96	Q	V		
13+35	0.3904	0.85	Q	V		
13+40	0.3953	0.71	Q	V		
13+45	0.3999	0.67	Q	V		
13+50	0.4045	0.66	Q	V		
13+55	0.4090	0.65	Q	V		
14+ 0	0.4135	0.65	Q	V		
14+ 5	0.4182	0.69	Q	V		
14+10	0.4233	0.74	Q	V		
14+15	0.4285	0.75	Q	V		
14+20	0.4337	0.75	Q	V		
14+25	0.4388	0.74	Q	V		
14+30	0.4439	0.74	Q	V		
14+35	0.4489	0.74	Q	V		
14+40	0.4540	0.74	Q	V		
14+45	0.4591	0.74	Q	V		
14+50	0.4641	0.73	Q	V		
14+55	0.4690	0.71	Q	V		
15+ 0	0.4738	0.71	Q	V		
15+ 5	0.4787	0.70	Q	V		
15+10	0.4834	0.68	Q	V		
15+15	0.4881	0.68	Q	V		
15+20	0.4927	0.67	Q	V		
15+25	0.4972	0.66	Q	V		
15+30	0.5017	0.65	Q	V		
15+35	0.5059	0.61	Q	V		
15+40	0.5097	0.56	Q	V		
15+45	0.5135	0.55	Q	V		
15+50	0.5172	0.54	Q	V		
15+55	0.5209	0.54	Q	V		

16+ 0	0.5246	0.54		Q	V
16+ 5	0.5273	0.39		Q	V
16+10	0.5286	0.19		Q	V
16+15	0.5296	0.15		Q	V
16+20	0.5305	0.13		Q	V
16+25	0.5313	0.12		Q	V
16+30	0.5321	0.11		Q	V
16+35	0.5328	0.10		Q	V
16+40	0.5334	0.09		Q	V
16+45	0.5340	0.09		Q	V
16+50	0.5346	0.09		Q	V
16+55	0.5352	0.09		Q	V
17+ 0	0.5358	0.08		Q	V
17+ 5	0.5365	0.10		Q	V
17+10	0.5374	0.13		Q	V
17+15	0.5383	0.14		Q	V
17+20	0.5393	0.14		Q	V
17+25	0.5403	0.14		Q	V
17+30	0.5412	0.14		Q	V
17+35	0.5422	0.14		Q	V
17+40	0.5432	0.14		Q	V
17+45	0.5442	0.14		Q	V
17+50	0.5451	0.13		Q	V
17+55	0.5459	0.12		Q	V
18+ 0	0.5467	0.12		Q	V
18+ 5	0.5475	0.11		Q	V
18+10	0.5483	0.11		Q	V
18+15	0.5490	0.11		Q	V
18+20	0.5498	0.11		Q	V
18+25	0.5506	0.11		Q	V
18+30	0.5514	0.11		Q	V
18+35	0.5521	0.10		Q	V
18+40	0.5527	0.09		Q	V
18+45	0.5533	0.09		Q	V
18+50	0.5538	0.08		Q	V
18+55	0.5542	0.06		Q	V
19+ 0	0.5547	0.06		Q	V
19+ 5	0.5551	0.07		Q	V
19+10	0.5557	0.08		Q	V
19+15	0.5562	0.08		Q	V
19+20	0.5569	0.09		Q	V
19+25	0.5576	0.11		Q	V
19+30	0.5584	0.11		Q	V
19+35	0.5591	0.10		Q	V
19+40	0.5597	0.09		Q	V
19+45	0.5603	0.09		Q	V
19+50	0.5608	0.08		Q	V
19+55	0.5613	0.06		Q	V
20+ 0	0.5617	0.06		Q	V
20+ 5	0.5621	0.07		Q	V
20+10	0.5627	0.08		Q	V
20+15	0.5632	0.08		Q	V
20+20	0.5638	0.08		Q	V
20+25	0.5644	0.08		Q	V
20+30	0.5650	0.08		Q	V
20+35	0.5656	0.08		Q	V
20+40	0.5662	0.08		Q	V
20+45	0.5667	0.08		Q	V
20+50	0.5673	0.07		Q	V
20+55	0.5677	0.06		Q	V
21+ 0	0.5681	0.06		Q	V
21+ 5	0.5686	0.07		Q	V
21+10	0.5691	0.08		Q	V
21+15	0.5697	0.08		Q	V
21+20	0.5702	0.07		Q	V
21+25	0.5706	0.06		Q	V
21+30	0.5710	0.06		Q	V
21+35	0.5715	0.07		Q	V
21+40	0.5720	0.08		Q	V
21+45	0.5726	0.08		Q	V
21+50	0.5731	0.07		Q	V
21+55	0.5735	0.06		Q	V
22+ 0	0.5739	0.06		Q	V
22+ 5	0.5744	0.07		Q	V
22+10	0.5749	0.08		Q	V
22+15	0.5755	0.08		Q	V
22+20	0.5760	0.07		Q	V
22+25	0.5764	0.06		Q	V
22+30	0.5769	0.06		Q	V
22+35	0.5772	0.06		Q	V
22+40	0.5776	0.06		Q	V
22+45	0.5780	0.06		Q	V
22+50	0.5784	0.06		Q	V
22+55	0.5788	0.06		Q	V
23+ 0	0.5792	0.06		Q	V
23+ 5	0.5796	0.06		Q	V

23+10	0.5800	0.06	Q				V
23+15	0.5804	0.06	Q				V
23+20	0.5808	0.06	Q				V
23+25	0.5811	0.06	Q				V
23+30	0.5815	0.06	Q				V
23+35	0.5819	0.06	Q				V
23+40	0.5823	0.06	Q				V
23+45	0.5827	0.06	Q				V
23+50	0.5831	0.06	Q				V
23+55	0.5835	0.06	Q				V
24+ 0	0.5839	0.06	Q				V
24+ 5	0.5841	0.04	Q				V
24+10	0.5842	0.01	Q				V
24+15	0.5842	0.00	Q				V
24+20	0.5842	0.00	Q				V
24+25	0.5842	0.00	Q				V

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Section 7.7 – Basin 1 – Routed 2 Year- 24 Hour Hydrograph

# Basin 1 Size and Flow Calculations

## BASIN 1

Horiz. : Vert.

4 : 1 = Basin Side Slope

Basin Elevation	BASIN PARAMETERS					OUTLET								
	Depth	Area S.F.	Volume C.F.	Volume AC-FT	Effective Volume AC-FT	Q <sub>1</sub> Orrifice Plate (cfs)	Q <sub>2</sub> Orrifice Plate (cfs)	Q <sub>3</sub> Orrifice Plate (cfs)	Q <sub>4</sub> Orrifice Plate (cfs)	Q <sub>5</sub> Orrifice Plate (cfs)	Q <sub>6</sub> Orrifice Plate (cfs)	Q <sub>7</sub> Orrifice Plate (cfs)	Q Weir 1 (cfs)	Q Total (cfs)
1305.00	0.00	30,759.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1306.00	1.00	33,957.00	32,358.00	0.743	0.743	0.218	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.218
1307.00	2.00	37,229.00	67,988.00	1.561	1.561	0.339	0.329	0.000	0.000	0.000	0.000	0.000	0.000	0.668
1308.00	3.00	40,552.00	106,966.50	2.456	2.456	0.427	1.091	0.000	0.000	0.000	0.000	0.000	0.000	1.518
1308.50	3.50	42,193.00	127,666.00	2.931	2.931	0.465	1.315	0.000	0.000	0.000	0.000	0.000	56.569	58.349
1309.00	4.00	43,834.00	149,186.00	3.425	3.425	0.500	1.507	0.000	0.000	0.000	0.000	0.000	160.000	162.007

### SUPPORTING DESIGN PARAMETERS

Orifice Coefficient	0.66	Dia of Orrifice	3.00	6.00					
Gravimetric Constant	32.2 ft/s <sup>2</sup>	Eff Dia of Orrifice	0.2500	0.5000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of Rows		Area of Orrifice	0.0491	0.1963	0.0000	0.0000	0.0000	0.0000	0.0000
Minimum Orrifice Plate Height		Number of Orrifices	1	1	1	1	1	1	1
Minimum Orrifice Plate Width		Elev	1305.3	1306.9					
		Weir						Sharp Crest Weir Coefficient	4
								Length of Weir	40.00
								Elev. at Crest of Weir	1308

Q100 Elevation Weir Calc	
Basin 1 Weir Calc	
Crest Wier Elev.	1308.00
Q100	55.22 cfs
Weir Length	40
Weir Coeff.	4
H Weir	0.49202
<b>Q100 Elevation</b>	<b>1308.49</b>

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 Program License Serial Number 5006

\*\*\*\*\* HYDROGRAPH INFORMATION \*\*\*\*\*

From study/file name: pro12242.rte  
 \*\*\*\*\*HYDROGRAPH DATA\*\*\*\*\*  
 Number of intervals = 293  
 Time interval = 5.0 (Min.)  
 Maximum/Peak flow rate = 3.455 (CFS)  
 Total volume = 2.011 (Ac.Ft)  
 Status of hydrographs being held in storage  
 Stream 1 Stream 2 Stream 3 Stream 4 Stream 5  
 Peak (CFS) 0.000 0.000 0.000 0.000 0.000  
 Vol (Ac.Ft) 0.000 0.000 0.000 0.000 0.000  
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 Process from Point/Station 1.000 to Point/Station 2.000  
 \*\*\*\* RETARDING BASIN ROUTING \*\*\*\*

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 User entry of depth-outflow-storage data

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 Total number of inflow hydrograph intervals = 293  
 Hydrograph time unit = 5.000 (Min.)  
 Initial depth in storage basin = 0.00(Ft.)  
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 Initial basin depth = 0.00 (Ft.)  
 Initial basin storage = 0.00 (Ac.Ft)  
 Initial basin outflow = 0.00 (CFS)  
 -----

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 Depth vs. Storage and Depth vs. Discharge data:  
 Basin Depth Storage Outflow (S-O\*dt/2) (S+O\*dt/2)  
 (Ft.) (Ac.Ft) (CFS) (Ac.Ft) (Ac.Ft)  
 -----  

0.000	0.000	0.000	0.000	0.000
1.000	0.743	0.218	0.742	0.744
2.000	1.561	0.668	1.559	1.563
3.000	2.456	1.518	2.451	2.461
3.500	2.931	58.349	2.730	3.132
4.000	3.425	162.007	2.867	3.983

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 Hydrograph Detention Basin Routing  
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Graph values: 'I'= unit inflow; 'O'=outflow at time shown

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Time (Hours)	Inflow (CFS)	Outflow (CFS)	Storage (Ac.Ft)	.0	0.9	1.73	2.59	3.45	Depth (Ft.)
0.083	0.06	0.00	0.000	O					0.00
0.167	0.15	0.00	0.001	O I					0.00
0.250	0.18	0.00	0.002	O I					0.00
0.333	0.22	0.00	0.003	O I					0.00
0.417	0.27	0.00	0.005	O I					0.01
0.500	0.28	0.00	0.007	O I					0.01
0.583	0.29	0.00	0.009	O I					0.01
0.667	0.29	0.00	0.011	O I					0.01
0.750	0.29	0.00	0.013	O I					0.02
0.833	0.32	0.00	0.015	O I					0.02
0.917	0.37	0.01	0.017	O I					0.02
1.000	0.38	0.01	0.020	O I					0.03
1.083	0.35	0.01	0.022	O I					0.03
1.167	0.31	0.01	0.025	O I					0.03
1.250	0.30	0.01	0.027	O I					0.04
1.333	0.30	0.01	0.029	O I					0.04
1.417	0.29	0.01	0.031	O I					0.04
1.500	0.29	0.01	0.033	O I					0.04
1.583	0.29	0.01	0.034	O I					0.05
1.667	0.29	0.01	0.036	O I					0.05
1.750	0.29	0.01	0.038	O I					0.05

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1.833	0.32	0.01	0.040	0	I					0.05
1.917	0.37	0.01	0.043	0	I					0.06
2.000	0.38	0.01	0.045	0	I					0.06
2.083	0.38	0.01	0.048	0	I					0.06
2.167	0.39	0.01	0.050	0	I					0.07
2.250	0.39	0.02	0.053	0	I					0.07
2.333	0.39	0.02	0.055	0	I					0.07
2.417	0.39	0.02	0.058	0	I					0.08
2.500	0.39	0.02	0.060	0	I					0.08
2.583	0.42	0.02	0.063	0	I					0.08
2.667	0.47	0.02	0.066	0	I					0.09
2.750	0.48	0.02	0.069	0	I					0.09
2.833	0.48	0.02	0.072	0	I					0.10
2.917	0.48	0.02	0.075	0	I					0.10
3.000	0.49	0.02	0.079	0	I					0.11
3.083	0.49	0.02	0.082	0	I					0.11
3.167	0.49	0.02	0.085	0	I					0.11
3.250	0.49	0.03	0.088	0	I					0.12
3.333	0.49	0.03	0.091	0	I					0.12
3.417	0.49	0.03	0.095	0	I					0.13
3.500	0.49	0.03	0.098	0	I					0.13
3.583	0.49	0.03	0.101	0	I					0.14
3.667	0.49	0.03	0.104	0	I					0.14
3.750	0.49	0.03	0.107	0	I					0.14
3.833	0.52	0.03	0.110	0	I					0.15
3.917	0.56	0.03	0.114	0	I					0.15
4.000	0.57	0.03	0.117	0	I					0.16
4.083	0.58	0.04	0.121	0	I					0.16
4.167	0.58	0.04	0.125	0	I					0.17
4.250	0.58	0.04	0.129	0	I					0.17
4.333	0.61	0.04	0.133	0	I					0.18
4.417	0.66	0.04	0.137	0	I					0.18
4.500	0.67	0.04	0.141	0	I					0.19
4.583	0.68	0.04	0.145	0	I					0.20
4.667	0.68	0.04	0.150	0	I					0.20
4.750	0.68	0.05	0.154	0	I					0.21
4.833	0.71	0.05	0.159	0	I					0.21
4.917	0.76	0.05	0.163	0	I					0.22
5.000	0.77	0.05	0.168	0	I					0.23
5.083	0.71	0.05	0.173	0	I					0.23
5.167	0.62	0.05	0.177	0	I					0.24
5.250	0.60	0.05	0.181	0	I					0.24
5.333	0.62	0.05	0.185	0	I					0.25
5.417	0.66	0.06	0.189	0	I					0.25
5.500	0.67	0.06	0.193	0	I					0.26
5.583	0.71	0.06	0.197	0	I					0.27
5.667	0.76	0.06	0.202	0	I					0.27
5.750	0.77	0.06	0.207	0	I					0.28
5.833	0.77	0.06	0.212	0	I					0.28
5.917	0.78	0.06	0.217	0	I					0.29
6.000	0.78	0.07	0.222	0	I					0.30
6.083	0.81	0.07	0.227	0	I					0.30
6.167	0.85	0.07	0.232	0	I					0.31
6.250	0.86	0.07	0.237	0	I					0.32
6.333	0.87	0.07	0.243	0	I					0.33
6.417	0.87	0.07	0.248	0	I					0.33
6.500	0.87	0.07	0.254	0	I					0.34
6.583	0.91	0.08	0.259	0	I					0.35
6.667	0.95	0.08	0.265	0	I					0.36
6.750	0.96	0.08	0.271	0	I					0.37
6.833	0.97	0.08	0.277	0	I					0.37
6.917	0.97	0.08	0.283	0	I					0.38
7.000	0.97	0.08	0.290	0	I					0.39
7.083	0.97	0.09	0.296	0	I					0.40
7.167	0.97	0.09	0.302	0	I					0.41
7.250	0.97	0.09	0.308	0	I					0.41
7.333	1.00	0.09	0.314	0	I					0.42
7.417	1.05	0.09	0.320	0	I					0.43
7.500	1.06	0.10	0.327	0	I					0.44
7.583	1.10	0.10	0.334	0	I					0.45
7.667	1.14	0.10	0.341	0	I					0.46
7.750	1.16	0.10	0.348	0	I					0.47
7.833	1.19	0.10	0.355	0	I					0.48
7.917	1.24	0.11	0.363	0	I					0.49
8.000	1.25	0.11	0.371	0	I					0.50
8.083	1.32	0.11	0.379	0	I					0.51
8.167	1.42	0.11	0.388	0	I					0.52
8.250	1.44	0.12	0.397	0	I					0.53
8.333	1.45	0.12	0.406	0	I					0.55
8.417	1.45	0.12	0.415	0	I					0.56
8.500	1.46	0.12	0.424	0	I					0.57
8.583	1.49	0.13	0.433	0	I					0.58
8.667	1.53	0.13	0.443	0	I					0.60
8.750	1.54	0.13	0.453	0	I					0.61
8.833	1.58	0.14	0.462	0	I					0.62
8.917	1.63	0.14	0.473	0	I					0.64

9.000	1.64	0.14	0.483	0	I				0.65
9.083	1.71	0.14	0.493	0	I				0.66
9.167	1.80	0.15	0.504	0	I				0.68
9.250	1.83	0.15	0.516	0	I				0.69
9.333	1.87	0.15	0.528	0	I				0.71
9.417	1.92	0.16	0.540	0	I				0.73
9.500	1.93	0.16	0.552	0	I				0.74
9.583	1.97	0.17	0.564	0	I				0.76
9.667	2.02	0.17	0.577	0	I				0.78
9.750	2.03	0.17	0.589	0	I				0.79
9.833	2.07	0.18	0.602	0	I				0.81
9.917	2.11	0.18	0.615	0	I				0.83
10.000	2.13	0.18	0.629	0	I				0.85
10.083	1.91	0.19	0.641	0	I				0.86
10.167	1.59	0.19	0.652	0	I				0.88
10.250	1.52	0.19	0.662	0	I				0.89
10.333	1.48	0.20	0.670	0	I				0.90
10.417	1.47	0.20	0.679	0	I				0.91
10.500	1.46	0.20	0.688	0	I				0.93
10.583	1.61	0.20	0.697	0	I				0.94
10.667	1.84	0.21	0.708	0	I				0.95
10.750	1.90	0.21	0.719	0	I				0.97
10.833	1.92	0.21	0.731	0	I				0.98
10.917	1.93	0.22	0.743	0	I				1.00
11.000	1.94	0.22	0.754	0	I				1.01
11.083	1.91	0.23	0.766	0	I				1.03
11.167	1.86	0.24	0.777	0	I				1.04
11.250	1.85	0.24	0.789	0	I				1.06
11.333	1.85	0.25	0.800	0	I				1.07
11.417	1.85	0.26	0.811	0	I				1.08
11.500	1.84	0.26	0.822	0	I				1.10
11.583	1.78	0.27	0.832	0	I				1.11
11.667	1.69	0.27	0.842	0	I				1.12
11.750	1.67	0.28	0.852	0	I				1.13
11.833	1.69	0.28	0.862	0	I				1.14
11.917	1.73	0.29	0.871	0	I				1.16
12.000	1.74	0.29	0.881	0	I				1.17
12.083	1.96	0.30	0.892	0	I				1.18
12.167	2.29	0.31	0.905	0	I				1.20
12.250	2.37	0.31	0.918	0	I				1.21
12.333	2.43	0.32	0.933	0	I				1.23
12.417	2.49	0.33	0.947	0	I				1.25
12.500	2.51	0.34	0.962	0	I				1.27
12.583	2.58	0.35	0.978	0	I				1.29
12.667	2.68	0.36	0.993	0	I				1.31
12.750	2.70	0.36	1.009	0	I				1.33
12.833	2.74	0.37	1.026	0	I				1.35
12.917	2.79	0.38	1.042	0	I				1.37
13.000	2.81	0.39	1.059	0	I				1.39
13.083	3.00	0.40	1.076	0	I				1.41
13.167	3.28	0.41	1.095	0	I				1.43
13.250	3.36	0.42	1.115	0	I				1.45
13.333	3.40	0.43	1.135	0	I				1.48
13.417	3.43	0.44	1.155	0	I				1.50
13.500	3.45	0.46	1.176	0	I				1.53
13.583	3.06	0.47	1.195	0	I				1.55
13.667	2.48	0.48	1.211	0	I				1.57
13.750	2.34	0.48	1.225	0	I				1.59
13.833	2.28	0.49	1.237	0	I				1.60
13.917	2.25	0.50	1.249	0	I				1.62
14.000	2.23	0.50	1.261	0	I				1.63
14.083	2.36	0.51	1.274	0	I				1.65
14.167	2.54	0.52	1.287	0	I				1.66
14.250	2.59	0.52	1.301	0	I				1.68
14.333	2.57	0.53	1.315	0	I				1.70
14.417	2.54	0.54	1.329	0	I				1.72
14.500	2.53	0.55	1.343	0	I				1.73
14.583	2.53	0.56	1.356	0	I				1.75
14.667	2.52	0.56	1.370	0	I				1.77
14.750	2.52	0.57	1.383	0	I				1.78
14.833	2.49	0.58	1.397	0	I				1.80
14.917	2.45	0.58	1.410	0	I				1.82
15.000	2.44	0.59	1.422	0	I				1.83
15.083	2.40	0.60	1.435	0	I				1.85
15.167	2.35	0.61	1.447	0	I				1.86
15.250	2.34	0.61	1.459	0	I				1.88
15.333	2.30	0.62	1.471	0	I				1.89
15.417	2.25	0.62	1.482	0	I				1.90
15.500	2.24	0.63	1.493	0	I				1.92
15.583	2.11	0.64	1.504	0	I				1.93
15.667	1.92	0.64	1.514	0	I				1.94
15.750	1.88	0.65	1.522	0	I				1.95
15.833	1.86	0.65	1.531	0	I				1.96
15.917	1.85	0.66	1.539	0	I				1.97
16.000	1.84	0.66	1.547	0	I				1.98
16.083	1.37	0.66	1.554	0	I				1.99

16.167	0.68	0.67	1.556	I	0	1.99
16.250	0.52	0.67	1.556	I	0	1.99
16.333	0.45	0.66	1.554	I	0	1.99
16.417	0.41	0.66	1.553	I	0	1.99
16.500	0.39	0.66	1.551	I	0	1.99
16.583	0.36	0.66	1.549	I	0	1.99
16.667	0.31	0.66	1.547	I	0	1.98
16.750	0.30	0.66	1.544	I	0	1.98
16.833	0.30	0.66	1.542	I	0	1.98
16.917	0.29	0.66	1.539	I	0	1.97
17.000	0.29	0.65	1.537	I	0	1.97
17.083	0.35	0.65	1.535	I	0	1.97
17.167	0.45	0.65	1.533	I	0	1.97
17.250	0.47	0.65	1.531	I	0	1.96
17.333	0.48	0.65	1.530	I	0	1.96
17.417	0.48	0.65	1.529	I	0	1.96
17.500	0.49	0.65	1.528	I	0	1.96
17.583	0.49	0.65	1.527	I	0	1.96
17.667	0.49	0.65	1.526	I	0	1.96
17.750	0.49	0.65	1.525	I	0	1.96
17.833	0.45	0.65	1.523	I	0	1.95
17.917	0.41	0.65	1.522	I	0	1.95
18.000	0.40	0.65	1.520	I	0	1.95
18.083	0.39	0.64	1.518	I	0	1.95
18.167	0.39	0.64	1.517	I	0	1.95
18.250	0.39	0.64	1.515	I	0	1.94
18.333	0.39	0.64	1.513	I	0	1.94
18.417	0.39	0.64	1.511	I	0	1.94
18.500	0.39	0.64	1.510	I	0	1.94
18.583	0.36	0.64	1.508	I	0	1.94
18.667	0.31	0.64	1.506	I	0	1.93
18.750	0.30	0.64	1.503	I	0	1.93
18.833	0.26	0.64	1.501	I	0	1.93
18.917	0.22	0.63	1.498	I	0	1.92
19.000	0.20	0.63	1.495	I	0	1.92
19.083	0.23	0.63	1.493	I	0	1.92
19.167	0.27	0.63	1.490	I	0	1.91
19.250	0.28	0.63	1.488	I	0	1.91
19.333	0.32	0.63	1.485	I	0	1.91
19.417	0.37	0.63	1.483	I	0	1.91
19.500	0.38	0.62	1.482	I	0	1.90
19.583	0.35	0.62	1.480	I	0	1.90
19.667	0.31	0.62	1.478	I	0	1.90
19.750	0.30	0.62	1.476	I	0	1.90
19.833	0.26	0.62	1.473	I	0	1.89
19.917	0.22	0.62	1.471	I	0	1.89
20.000	0.20	0.62	1.468	I	0	1.89
20.083	0.23	0.62	1.465	I	0	1.88
20.167	0.27	0.61	1.463	I	0	1.88
20.250	0.28	0.61	1.460	I	0	1.88
20.333	0.29	0.61	1.458	I	0	1.87
20.417	0.29	0.61	1.456	I	0	1.87
20.500	0.29	0.61	1.454	I	0	1.87
20.583	0.29	0.61	1.451	I	0	1.87
20.667	0.29	0.61	1.449	I	0	1.86
20.750	0.29	0.61	1.447	I	0	1.86
20.833	0.26	0.60	1.445	I	0	1.86
20.917	0.21	0.60	1.442	I	0	1.85
21.000	0.20	0.60	1.440	I	0	1.85
21.083	0.23	0.60	1.437	I	0	1.85
21.167	0.27	0.60	1.435	I	0	1.85
21.250	0.28	0.60	1.432	I	0	1.84
21.333	0.26	0.60	1.430	I	0	1.84
21.417	0.21	0.59	1.428	I	0	1.84
21.500	0.20	0.59	1.425	I	0	1.83
21.583	0.23	0.59	1.422	I	0	1.83
21.667	0.27	0.59	1.420	I	0	1.83
21.750	0.28	0.59	1.418	I	0	1.83
21.833	0.26	0.59	1.416	I	0	1.82
21.917	0.21	0.59	1.413	I	0	1.82
22.000	0.20	0.59	1.411	I	0	1.82
22.083	0.23	0.58	1.408	I	0	1.81
22.167	0.27	0.58	1.406	I	0	1.81
22.250	0.28	0.58	1.404	I	0	1.81
22.333	0.26	0.58	1.402	I	0	1.81
22.417	0.21	0.58	1.399	I	0	1.80
22.500	0.20	0.58	1.397	I	0	1.80
22.583	0.20	0.58	1.394	I	0	1.80
22.667	0.20	0.57	1.391	I	0	1.79
22.750	0.19	0.57	1.389	I	0	1.79
22.833	0.19	0.57	1.386	I	0	1.79
22.917	0.19	0.57	1.384	I	0	1.78
23.000	0.19	0.57	1.381	I	0	1.78
23.083	0.19	0.57	1.378	I	0	1.78
23.167	0.19	0.57	1.376	I	0	1.77
23.250	0.19	0.56	1.373	I	0	1.77

23.333	0.19	0.56	1.371	I	0	1.77
23.417	0.19	0.56	1.368	I	0	1.76
23.500	0.19	0.56	1.366	I	0	1.76
23.583	0.19	0.56	1.363	I	0	1.76
23.667	0.19	0.56	1.361	I	0	1.76
23.750	0.19	0.56	1.358	I	0	1.75
23.833	0.19	0.56	1.356	I	0	1.75
23.917	0.19	0.55	1.353	I	0	1.75
24.000	0.19	0.55	1.351	I	0	1.74
24.083	0.13	0.55	1.348	I	0	1.74
24.167	0.04	0.55	1.345	I	0	1.74
24.250	0.02	0.55	1.341	I	0	1.73
24.333	0.01	0.55	1.338	I	0	1.73
24.417	0.00	0.54	1.334	I	0	1.72
24.500	0.00	0.54	1.330	I	0	1.72
24.583	0.00	0.54	1.326	I	0	1.71
24.667	0.00	0.54	1.323	I	0	1.71
24.750	0.00	0.53	1.319	I	0	1.70
24.833	0.00	0.53	1.315	I	0	1.70
24.917	0.00	0.53	1.312	I	0	1.70
25.000	0.00	0.53	1.308	I	0	1.69
25.083	0.00	0.53	1.304	I	0	1.69
25.167	0.00	0.52	1.301	I	0	1.68
25.250	0.00	0.52	1.297	I	0	1.68
25.333	0.00	0.52	1.294	I	0	1.67
25.417	0.00	0.52	1.290	I	0	1.67
25.500	0.00	0.52	1.286	I	0	1.66
25.583	0.00	0.52	1.283	I	0	1.66
25.667	0.00	0.51	1.279	I	0	1.66
25.750	0.00	0.51	1.276	I	0	1.65
25.833	0.00	0.51	1.272	I	0	1.65
25.917	0.00	0.51	1.269	I	0	1.64
26.000	0.00	0.51	1.265	I	0	1.64
26.083	0.00	0.50	1.262	I	0	1.63
26.167	0.00	0.50	1.258	I	0	1.63
26.250	0.00	0.50	1.255	I	0	1.63
26.333	0.00	0.50	1.252	I	0	1.62
26.417	0.00	0.50	1.248	I	0	1.62
26.500	0.00	0.49	1.245	I	0	1.61
26.583	0.00	0.49	1.241	I	0	1.61
26.667	0.00	0.49	1.238	I	0	1.61
26.750	0.00	0.49	1.235	I	0	1.60
26.833	0.00	0.49	1.231	I	0	1.60
26.917	0.00	0.48	1.228	I	0	1.59
27.000	0.00	0.48	1.225	I	0	1.59
27.083	0.00	0.48	1.221	I	0	1.58
27.167	0.00	0.48	1.218	I	0	1.58
27.250	0.00	0.48	1.215	I	0	1.58
27.333	0.00	0.48	1.211	I	0	1.57
27.417	0.00	0.47	1.208	I	0	1.57
27.500	0.00	0.47	1.205	I	0	1.56
27.583	0.00	0.47	1.202	I	0	1.56
27.667	0.00	0.47	1.198	I	0	1.56
27.750	0.00	0.47	1.195	I	0	1.55
27.833	0.00	0.46	1.192	I	0	1.55
27.917	0.00	0.46	1.189	I	0	1.54
28.000	0.00	0.46	1.186	I	0	1.54
28.083	0.00	0.46	1.182	I	0	1.54
28.167	0.00	0.46	1.179	I	0	1.53
28.250	0.00	0.46	1.176	I	0	1.53
28.333	0.00	0.45	1.173	I	0	1.53
28.417	0.00	0.45	1.170	I	0	1.52
28.500	0.00	0.45	1.167	I	0	1.52
28.583	0.00	0.45	1.164	I	0	1.51
28.667	0.00	0.45	1.160	I	0	1.51
28.750	0.00	0.45	1.157	I	0	1.51
28.833	0.00	0.44	1.154	I	0	1.50
28.917	0.00	0.44	1.151	I	0	1.50
29.000	0.00	0.44	1.148	I	0	1.50
29.083	0.00	0.44	1.145	I	0	1.49
29.167	0.00	0.44	1.142	I	0	1.49
29.250	0.00	0.44	1.139	I	0	1.48
29.333	0.00	0.43	1.136	I	0	1.48
29.417	0.00	0.43	1.133	I	0	1.48
29.500	0.00	0.43	1.130	I	0	1.47
29.583	0.00	0.43	1.127	I	0	1.47
29.667	0.00	0.43	1.124	I	0	1.47
29.750	0.00	0.43	1.121	I	0	1.46
29.833	0.00	0.42	1.118	I	0	1.46
29.917	0.00	0.42	1.116	I	0	1.46
30.000	0.00	0.42	1.113	I	0	1.45
30.083	0.00	0.42	1.110	I	0	1.45
30.167	0.00	0.42	1.107	I	0	1.44
30.250	0.00	0.42	1.104	I	0	1.44
30.333	0.00	0.41	1.101	I	0	1.44
30.417	0.00	0.41	1.098	I	0	1.43

37.667	0.00	0.30	0.887	I O	1.18
37.750	0.00	0.30	0.885	I O	1.17
37.833	0.00	0.30	0.883	I O	1.17
37.917	0.00	0.29	0.881	I O	1.17
38.000	0.00	0.29	0.879	I O	1.17
38.083	0.00	0.29	0.877	I O	1.16
38.167	0.00	0.29	0.875	I O	1.16
38.250	0.00	0.29	0.873	I O	1.16
38.333	0.00	0.29	0.871	I O	1.16
38.417	0.00	0.29	0.869	I O	1.15
38.500	0.00	0.29	0.867	I O	1.15
38.583	0.00	0.29	0.865	I O	1.15
38.667	0.00	0.28	0.863	I O	1.15
38.750	0.00	0.28	0.861	I O	1.14
38.833	0.00	0.28	0.859	I O	1.14
38.917	0.00	0.28	0.857	I O	1.14
39.000	0.00	0.28	0.855	I O	1.14
39.083	0.00	0.28	0.853	I O	1.14
39.167	0.00	0.28	0.852	I O	1.13
39.250	0.00	0.28	0.850	I O	1.13
39.333	0.00	0.28	0.848	I O	1.13
39.417	0.00	0.27	0.846	I O	1.13
39.500	0.00	0.27	0.844	I O	1.12
39.583	0.00	0.27	0.842	I O	1.12
39.667	0.00	0.27	0.840	I O	1.12
39.750	0.00	0.27	0.838	I O	1.12
39.833	0.00	0.27	0.837	I O	1.11
39.917	0.00	0.27	0.835	I O	1.11
40.000	0.00	0.27	0.833	I O	1.11
40.083	0.00	0.27	0.831	I O	1.11
40.167	0.00	0.27	0.829	I O	1.11
40.250	0.00	0.26	0.827	I O	1.10
40.333	0.00	0.26	0.825	I O	1.10
40.417	0.00	0.26	0.824	I O	1.10
40.500	0.00	0.26	0.822	I O	1.10
40.583	0.00	0.26	0.820	I O	1.09
40.667	0.00	0.26	0.818	I O	1.09
40.750	0.00	0.26	0.817	I O	1.09
40.833	0.00	0.26	0.815	I O	1.09
40.917	0.00	0.26	0.813	I O	1.09
41.000	0.00	0.26	0.811	I O	1.08
41.083	0.00	0.25	0.809	I O	1.08
41.167	0.00	0.25	0.808	I O	1.08
41.250	0.00	0.25	0.806	I O	1.08
41.333	0.00	0.25	0.804	I O	1.07
41.417	0.00	0.25	0.802	I O	1.07
41.500	0.00	0.25	0.801	I O	1.07
41.583	0.00	0.25	0.799	I O	1.07
41.667	0.00	0.25	0.797	I O	1.07
41.750	0.00	0.25	0.796	I O	1.06
41.833	0.00	0.25	0.794	I O	1.06
41.917	0.00	0.25	0.792	I O	1.06
42.000	0.00	0.24	0.791	I O	1.06
42.083	0.00	0.24	0.789	I O	1.06
42.167	0.00	0.24	0.787	I O	1.05
42.250	0.00	0.24	0.786	I O	1.05
42.333	0.00	0.24	0.784	I O	1.05
42.417	0.00	0.24	0.782	I O	1.05
42.500	0.00	0.24	0.781	I O	1.05
42.583	0.00	0.24	0.779	I O	1.04
42.667	0.00	0.24	0.777	I O	1.04
42.750	0.00	0.24	0.776	I O	1.04
42.833	0.00	0.24	0.774	I O	1.04
42.917	0.00	0.23	0.772	I O	1.04
43.000	0.00	0.23	0.771	I O	1.03
43.083	0.00	0.23	0.769	I O	1.03
43.167	0.00	0.23	0.768	I O	1.03
43.250	0.00	0.23	0.766	I O	1.03
43.333	0.00	0.23	0.764	I O	1.03
43.417	0.00	0.23	0.763	I O	1.02
43.500	0.00	0.23	0.761	I O	1.02
43.583	0.00	0.23	0.760	I O	1.02
43.667	0.00	0.23	0.758	I O	1.02
43.750	0.00	0.23	0.757	I O	1.02
43.833	0.00	0.22	0.755	I O	1.01
43.917	0.00	0.22	0.754	I O	1.01
44.000	0.00	0.22	0.752	I O	1.01
44.083	0.00	0.22	0.750	I O	1.01
44.167	0.00	0.22	0.749	I O	1.01
44.250	0.00	0.22	0.747	I O	1.01
44.333	0.00	0.22	0.746	I O	1.00
44.417	0.00	0.22	0.744	I O	1.00
44.500	0.00	0.22	0.743	I O	1.00
44.583	0.00	0.22	0.741	I O	1.00
44.667	0.00	0.22	0.740	I O	1.00
44.750	0.00	0.22	0.738	I O	0.99

44.833	0.00	0.22	0.737	I O	0.99
44.917	0.00	0.22	0.735	IO	0.99
45.000	0.00	0.22	0.734	IO	0.99
45.083	0.00	0.21	0.732	IO	0.99
45.167	0.00	0.21	0.731	IO	0.98
45.250	0.00	0.21	0.729	IO	0.98
45.333	0.00	0.21	0.728	IO	0.98
45.417	0.00	0.21	0.727	IO	0.98
45.500	0.00	0.21	0.725	IO	0.98
45.583	0.00	0.21	0.724	IO	0.97
45.667	0.00	0.21	0.722	IO	0.97
45.750	0.00	0.21	0.721	IO	0.97
45.833	0.00	0.21	0.719	IO	0.97
45.917	0.00	0.21	0.718	IO	0.97
46.000	0.00	0.21	0.716	IO	0.96
46.083	0.00	0.21	0.715	IO	0.96
46.167	0.00	0.21	0.713	IO	0.96
46.250	0.00	0.21	0.712	IO	0.96
46.333	0.00	0.21	0.711	IO	0.96
46.417	0.00	0.21	0.709	IO	0.95
46.500	0.00	0.21	0.708	IO	0.95
46.583	0.00	0.21	0.706	IO	0.95
46.667	0.00	0.21	0.705	IO	0.95
46.750	0.00	0.21	0.703	IO	0.95
46.833	0.00	0.21	0.702	IO	0.94
46.917	0.00	0.21	0.701	IO	0.94
47.000	0.00	0.21	0.699	IO	0.94
47.083	0.00	0.20	0.698	IO	0.94
47.167	0.00	0.20	0.696	IO	0.94
47.250	0.00	0.20	0.695	IO	0.94
47.333	0.00	0.20	0.694	IO	0.93
47.417	0.00	0.20	0.692	IO	0.93
47.500	0.00	0.20	0.691	IO	0.93
47.583	0.00	0.20	0.689	IO	0.93
47.667	0.00	0.20	0.688	IO	0.93
47.750	0.00	0.20	0.687	IO	0.92
47.833	0.00	0.20	0.685	IO	0.92
47.917	0.00	0.20	0.684	IO	0.92
48.000	0.00	0.20	0.682	IO	0.92
48.083	0.00	0.20	0.681	IO	0.92
48.167	0.00	0.20	0.680	IO	0.91
48.250	0.00	0.20	0.678	IO	0.91
48.333	0.00	0.20	0.677	IO	0.91
48.417	0.00	0.20	0.676	IO	0.91
48.500	0.00	0.20	0.674	IO	0.91
48.583	0.00	0.20	0.673	IO	0.91
48.667	0.00	0.20	0.671	IO	0.90
48.750	0.00	0.20	0.670	IO	0.90
48.833	0.00	0.20	0.669	IO	0.90
48.917	0.00	0.20	0.667	IO	0.90
49.000	0.00	0.20	0.666	IO	0.90
49.083	0.00	0.20	0.665	IO	0.89
49.167	0.00	0.19	0.663	IO	0.89
49.250	0.00	0.19	0.662	IO	0.89
49.333	0.00	0.19	0.661	IO	0.89
49.417	0.00	0.19	0.659	IO	0.89
49.500	0.00	0.19	0.658	IO	0.89
49.583	0.00	0.19	0.657	IO	0.88
49.667	0.00	0.19	0.655	IO	0.88
49.750	0.00	0.19	0.654	IO	0.88
49.833	0.00	0.19	0.653	IO	0.88
49.917	0.00	0.19	0.651	IO	0.88
50.000	0.00	0.19	0.650	IO	0.87
50.083	0.00	0.19	0.649	IO	0.87
50.167	0.00	0.19	0.647	IO	0.87
50.250	0.00	0.19	0.646	IO	0.87
50.333	0.00	0.19	0.645	IO	0.87
50.417	0.00	0.19	0.644	IO	0.87
50.500	0.00	0.19	0.642	IO	0.86
50.583	0.00	0.19	0.641	IO	0.86
50.667	0.00	0.19	0.640	IO	0.86
50.750	0.00	0.19	0.638	IO	0.86
50.833	0.00	0.19	0.637	IO	0.86
50.917	0.00	0.19	0.636	IO	0.86
51.000	0.00	0.19	0.635	IO	0.85
51.083	0.00	0.19	0.633	IO	0.85
51.167	0.00	0.19	0.632	IO	0.85
51.250	0.00	0.19	0.631	IO	0.85
51.333	0.00	0.18	0.629	IO	0.85
51.417	0.00	0.18	0.628	IO	0.85
51.500	0.00	0.18	0.627	IO	0.84
51.583	0.00	0.18	0.626	IO	0.84
51.667	0.00	0.18	0.624	IO	0.84
51.750	0.00	0.18	0.623	IO	0.84
51.833	0.00	0.18	0.622	IO	0.84
51.917	0.00	0.18	0.621	IO	0.84

52.000	0.00	0.18	0.619	IO	0.83
52.083	0.00	0.18	0.618	IO	0.83
52.167	0.00	0.18	0.617	IO	0.83
52.250	0.00	0.18	0.616	IO	0.83
52.333	0.00	0.18	0.614	IO	0.83
52.417	0.00	0.18	0.613	IO	0.83
52.500	0.00	0.18	0.612	IO	0.82
52.583	0.00	0.18	0.611	IO	0.82
52.667	0.00	0.18	0.609	IO	0.82
52.750	0.00	0.18	0.608	IO	0.82
52.833	0.00	0.18	0.607	IO	0.82
52.917	0.00	0.18	0.606	IO	0.82
53.000	0.00	0.18	0.605	IO	0.81
53.083	0.00	0.18	0.603	IO	0.81
53.167	0.00	0.18	0.602	IO	0.81
53.250	0.00	0.18	0.601	IO	0.81
53.333	0.00	0.18	0.600	IO	0.81
53.417	0.00	0.18	0.598	IO	0.81
53.500	0.00	0.18	0.597	IO	0.80
53.583	0.00	0.17	0.596	IO	0.80
53.667	0.00	0.17	0.595	IO	0.80
53.750	0.00	0.17	0.594	IO	0.80
53.833	0.00	0.17	0.592	IO	0.80
53.917	0.00	0.17	0.591	IO	0.80
54.000	0.00	0.17	0.590	IO	0.79
54.083	0.00	0.17	0.589	IO	0.79
54.167	0.00	0.17	0.588	IO	0.79
54.250	0.00	0.17	0.586	IO	0.79
54.333	0.00	0.17	0.585	IO	0.79
54.417	0.00	0.17	0.584	IO	0.79
54.500	0.00	0.17	0.583	IO	0.78
54.583	0.00	0.17	0.582	IO	0.78
54.667	0.00	0.17	0.581	IO	0.78
54.750	0.00	0.17	0.579	IO	0.78
54.833	0.00	0.17	0.578	IO	0.78
54.917	0.00	0.17	0.577	IO	0.78
55.000	0.00	0.17	0.576	IO	0.78
55.083	0.00	0.17	0.575	IO	0.77
55.167	0.00	0.17	0.574	IO	0.77
55.250	0.00	0.17	0.572	IO	0.77
55.333	0.00	0.17	0.571	IO	0.77
55.417	0.00	0.17	0.570	IO	0.77
55.500	0.00	0.17	0.569	IO	0.77
55.583	0.00	0.17	0.568	IO	0.76
55.667	0.00	0.17	0.567	IO	0.76
55.750	0.00	0.17	0.566	IO	0.76
55.833	0.00	0.17	0.564	IO	0.76
55.917	0.00	0.17	0.563	IO	0.76
56.000	0.00	0.16	0.562	IO	0.76
56.083	0.00	0.16	0.561	IO	0.75
56.167	0.00	0.16	0.560	IO	0.75
56.250	0.00	0.16	0.559	IO	0.75
56.333	0.00	0.16	0.558	IO	0.75
56.417	0.00	0.16	0.556	IO	0.75
56.500	0.00	0.16	0.555	IO	0.75
56.583	0.00	0.16	0.554	IO	0.75
56.667	0.00	0.16	0.553	IO	0.74
56.750	0.00	0.16	0.552	IO	0.74
56.833	0.00	0.16	0.551	IO	0.74
56.917	0.00	0.16	0.550	IO	0.74
57.000	0.00	0.16	0.549	IO	0.74
57.083	0.00	0.16	0.548	IO	0.74
57.167	0.00	0.16	0.546	IO	0.74
57.250	0.00	0.16	0.545	IO	0.73
57.333	0.00	0.16	0.544	IO	0.73
57.417	0.00	0.16	0.543	IO	0.73
57.500	0.00	0.16	0.542	IO	0.73
57.583	0.00	0.16	0.541	IO	0.73
57.667	0.00	0.16	0.540	IO	0.73
57.750	0.00	0.16	0.539	IO	0.73
57.833	0.00	0.16	0.538	IO	0.72
57.917	0.00	0.16	0.537	IO	0.72
58.000	0.00	0.16	0.535	IO	0.72
58.083	0.00	0.16	0.534	IO	0.72
58.167	0.00	0.16	0.533	IO	0.72
58.250	0.00	0.16	0.532	IO	0.72
58.333	0.00	0.16	0.531	IO	0.71
58.417	0.00	0.16	0.530	IO	0.71
58.500	0.00	0.16	0.529	IO	0.71
58.583	0.00	0.15	0.528	IO	0.71
58.667	0.00	0.15	0.527	IO	0.71
58.750	0.00	0.15	0.526	IO	0.71
58.833	0.00	0.15	0.525	IO	0.71
58.917	0.00	0.15	0.524	IO	0.70
59.000	0.00	0.15	0.523	IO	0.70
59.083	0.00	0.15	0.522	IO	0.70

59.167	0.00	0.15	0.521	IO	0.70
59.250	0.00	0.15	0.519	IO	0.70
59.333	0.00	0.15	0.518	IO	0.70
59.417	0.00	0.15	0.517	IO	0.70
59.500	0.00	0.15	0.516	IO	0.69
59.583	0.00	0.15	0.515	IO	0.69
59.667	0.00	0.15	0.514	IO	0.69
59.750	0.00	0.15	0.513	IO	0.69
59.833	0.00	0.15	0.512	IO	0.69
59.917	0.00	0.15	0.511	IO	0.69
60.000	0.00	0.15	0.510	IO	0.69
60.083	0.00	0.15	0.509	IO	0.69
60.167	0.00	0.15	0.508	IO	0.68
60.250	0.00	0.15	0.507	IO	0.68
60.333	0.00	0.15	0.506	IO	0.68
60.417	0.00	0.15	0.505	IO	0.68
60.500	0.00	0.15	0.504	IO	0.68
60.583	0.00	0.15	0.503	IO	0.68
60.667	0.00	0.15	0.502	IO	0.68
60.750	0.00	0.15	0.501	IO	0.67
60.833	0.00	0.15	0.500	IO	0.67
60.917	0.00	0.15	0.499	IO	0.67
61.000	0.00	0.15	0.498	IO	0.67
61.083	0.00	0.15	0.497	IO	0.67
61.167	0.00	0.15	0.496	IO	0.67
61.250	0.00	0.15	0.495	IO	0.67
61.333	0.00	0.14	0.494	IO	0.66
61.417	0.00	0.14	0.493	IO	0.66
61.500	0.00	0.14	0.492	IO	0.66
61.583	0.00	0.14	0.491	IO	0.66
61.667	0.00	0.14	0.490	IO	0.66
61.750	0.00	0.14	0.489	IO	0.66
61.833	0.00	0.14	0.488	IO	0.66
61.917	0.00	0.14	0.487	IO	0.66
62.000	0.00	0.14	0.486	IO	0.65
62.083	0.00	0.14	0.485	IO	0.65
62.167	0.00	0.14	0.484	IO	0.65
62.250	0.00	0.14	0.483	IO	0.65
62.333	0.00	0.14	0.482	IO	0.65
62.417	0.00	0.14	0.481	IO	0.65
62.500	0.00	0.14	0.480	IO	0.65
62.583	0.00	0.14	0.479	IO	0.64
62.667	0.00	0.14	0.478	IO	0.64
62.750	0.00	0.14	0.477	IO	0.64
62.833	0.00	0.14	0.476	IO	0.64
62.917	0.00	0.14	0.475	IO	0.64
63.000	0.00	0.14	0.474	IO	0.64
63.083	0.00	0.14	0.473	IO	0.64
63.167	0.00	0.14	0.472	IO	0.64
63.250	0.00	0.14	0.471	IO	0.63
63.333	0.00	0.14	0.471	IO	0.63
63.417	0.00	0.14	0.470	IO	0.63
63.500	0.00	0.14	0.469	IO	0.63
63.583	0.00	0.14	0.468	IO	0.63
63.667	0.00	0.14	0.467	IO	0.63
63.750	0.00	0.14	0.466	IO	0.63
63.833	0.00	0.14	0.465	IO	0.63
63.917	0.00	0.14	0.464	IO	0.62
64.000	0.00	0.14	0.463	IO	0.62
64.083	0.00	0.14	0.462	IO	0.62
64.167	0.00	0.14	0.461	IO	0.62
64.250	0.00	0.14	0.460	IO	0.62
64.333	0.00	0.13	0.459	IO	0.62
64.417	0.00	0.13	0.458	IO	0.62
64.500	0.00	0.13	0.457	IO	0.62
64.583	0.00	0.13	0.456	IO	0.61
64.667	0.00	0.13	0.456	IO	0.61
64.750	0.00	0.13	0.455	IO	0.61
64.833	0.00	0.13	0.454	IO	0.61
64.917	0.00	0.13	0.453	IO	0.61
65.000	0.00	0.13	0.452	IO	0.61
65.083	0.00	0.13	0.451	IO	0.61
65.167	0.00	0.13	0.450	IO	0.61
65.250	0.00	0.13	0.449	IO	0.60
65.333	0.00	0.13	0.448	IO	0.60
65.417	0.00	0.13	0.447	IO	0.60
65.500	0.00	0.13	0.446	IO	0.60
65.583	0.00	0.13	0.446	IO	0.60
65.667	0.00	0.13	0.445	IO	0.60
65.750	0.00	0.13	0.444	IO	0.60
65.833	0.00	0.13	0.443	IO	0.60
65.917	0.00	0.13	0.442	IO	0.59
66.000	0.00	0.13	0.441	IO	0.59
66.083	0.00	0.13	0.440	IO	0.59
66.167	0.00	0.13	0.439	IO	0.59
66.250	0.00	0.13	0.438	IO	0.59

66.333	0.00	0.13	0.438	IO	0.59
66.417	0.00	0.13	0.437	IO	0.59
66.500	0.00	0.13	0.436	IO	0.59
66.583	0.00	0.13	0.435	IO	0.59
66.667	0.00	0.13	0.434	IO	0.58
66.750	0.00	0.13	0.433	IO	0.58
66.833	0.00	0.13	0.432	IO	0.58
66.917	0.00	0.13	0.431	IO	0.58
67.000	0.00	0.13	0.430	IO	0.58
67.083	0.00	0.13	0.430	IO	0.58
67.167	0.00	0.13	0.429	IO	0.58
67.250	0.00	0.13	0.428	IO	0.58
67.333	0.00	0.13	0.427	IO	0.57
67.417	0.00	0.13	0.426	IO	0.57
67.500	0.00	0.12	0.425	IO	0.57
67.583	0.00	0.12	0.424	IO	0.57
67.667	0.00	0.12	0.424	IO	0.57
67.750	0.00	0.12	0.423	IO	0.57
67.833	0.00	0.12	0.422	IO	0.57
67.917	0.00	0.12	0.421	IO	0.57
68.000	0.00	0.12	0.420	IO	0.57
68.083	0.00	0.12	0.419	IO	0.56
68.167	0.00	0.12	0.418	IO	0.56
68.250	0.00	0.12	0.418	IO	0.56
68.333	0.00	0.12	0.417	IO	0.56
68.417	0.00	0.12	0.416	IO	0.56
68.500	0.00	0.12	0.415	IO	0.56
68.583	0.00	0.12	0.414	IO	0.56
68.667	0.00	0.12	0.413	IO	0.56
68.750	0.00	0.12	0.413	IO	0.56
68.833	0.00	0.12	0.412	IO	0.55
68.917	0.00	0.12	0.411	IO	0.55
69.000	0.00	0.12	0.410	IO	0.55
69.083	0.00	0.12	0.409	IO	0.55
69.167	0.00	0.12	0.408	IO	0.55
69.250	0.00	0.12	0.408	IO	0.55
69.333	0.00	0.12	0.407	IO	0.55
69.417	0.00	0.12	0.406	IO	0.55
69.500	0.00	0.12	0.405	IO	0.55
69.583	0.00	0.12	0.404	IO	0.54
69.667	0.00	0.12	0.404	IO	0.54
69.750	0.00	0.12	0.403	IO	0.54
69.833	0.00	0.12	0.402	IO	0.54
69.917	0.00	0.12	0.401	IO	0.54
70.000	0.00	0.12	0.400	IO	0.54
70.083	0.00	0.12	0.399	IO	0.54
70.167	0.00	0.12	0.399	IO	0.54
70.250	0.00	0.12	0.398	IO	0.54
70.333	0.00	0.12	0.397	IO	0.53
70.417	0.00	0.12	0.396	IO	0.53
70.500	0.00	0.12	0.395	IO	0.53
70.583	0.00	0.12	0.395	IO	0.53
70.667	0.00	0.12	0.394	IO	0.53
70.750	0.00	0.12	0.393	IO	0.53
70.833	0.00	0.12	0.392	IO	0.53
70.917	0.00	0.11	0.391	IO	0.53
71.000	0.00	0.11	0.391	IO	0.53
71.083	0.00	0.11	0.390	IO	0.52
71.167	0.00	0.11	0.389	IO	0.52
71.250	0.00	0.11	0.388	IO	0.52
71.333	0.00	0.11	0.388	IO	0.52
71.417	0.00	0.11	0.387	IO	0.52
71.500	0.00	0.11	0.386	IO	0.52
71.583	0.00	0.11	0.385	IO	0.52
71.667	0.00	0.11	0.384	IO	0.52
71.750	0.00	0.11	0.384	IO	0.52
71.833	0.00	0.11	0.383	IO	0.52
71.917	0.00	0.11	0.382	IO	0.51
72.000	0.00	0.11	0.381	IO	0.51
72.083	0.00	0.11	0.381	IO	0.51
72.167	0.00	0.11	0.380	IO	0.51
72.250	0.00	0.11	0.379	IO	0.51
72.333	0.00	0.11	0.378	IO	0.51
72.417	0.00	0.11	0.378	IO	0.51
72.500	0.00	0.11	0.377	IO	0.51
72.583	0.00	0.11	0.376	IO	0.51
72.667	0.00	0.11	0.375	IO	0.51
72.750	0.00	0.11	0.374	IO	0.50
72.833	0.00	0.11	0.374	IO	0.50
72.917	0.00	0.11	0.373	IO	0.50
73.000	0.00	0.11	0.372	IO	0.50
73.083	0.00	0.11	0.371	IO	0.50
73.167	0.00	0.11	0.371	IO	0.50
73.250	0.00	0.11	0.370	IO	0.50
73.333	0.00	0.11	0.369	IO	0.50
73.417	0.00	0.11	0.368	IO	0.50

73.500	0.00	0.11	0.368	0					0.49
73.583	0.00	0.11	0.367	0					0.49
73.667	0.00	0.11	0.366	0					0.49
73.750	0.00	0.11	0.365	0					0.49
73.833	0.00	0.11	0.365	0					0.49
73.917	0.00	0.11	0.364	0					0.49
74.000	0.00	0.11	0.363	0					0.49
74.083	0.00	0.11	0.363	0					0.49
74.167	0.00	0.11	0.362	0					0.49
74.250	0.00	0.11	0.361	0					0.49
74.333	0.00	0.11	0.360	0					0.49
74.417	0.00	0.11	0.360	0					0.48
74.500	0.00	0.11	0.359	0					0.48
74.583	0.00	0.11	0.358	0					0.48
74.667	0.00	0.10	0.357	0					0.48
74.750	0.00	0.10	0.357	0					0.48
74.833	0.00	0.10	0.356	0					0.48
74.917	0.00	0.10	0.355	0					0.48
75.000	0.00	0.10	0.355	0					0.48
75.083	0.00	0.10	0.354	0					0.48
75.167	0.00	0.10	0.353	0					0.48
75.250	0.00	0.10	0.352	0					0.47
75.333	0.00	0.10	0.352	0					0.47
75.417	0.00	0.10	0.351	0					0.47
75.500	0.00	0.10	0.350	0					0.47
75.583	0.00	0.10	0.350	0					0.47
75.667	0.00	0.10	0.349	0					0.47
75.750	0.00	0.10	0.348	0					0.47
75.833	0.00	0.10	0.347	0					0.47
75.917	0.00	0.10	0.347	0					0.47
76.000	0.00	0.10	0.346	0					0.47
76.083	0.00	0.10	0.345	0					0.46
76.167	0.00	0.10	0.345	0					0.46
76.250	0.00	0.10	0.344	0					0.46
76.333	0.00	0.10	0.343	0					0.46
76.417	0.00	0.10	0.343	0					0.46
76.500	0.00	0.10	0.342	0					0.46
76.583	0.00	0.10	0.341	0					0.46
76.667	0.00	0.10	0.341	0					0.46

Remaining water in basin = 0.34 (Ac.Ft)

```

*****HYDROGRAPH DATA*****
      Number of intervals = 920
      Time interval = 5.0 (Min.)
      Maximum/Peak flow rate = 0.665 (CFS)
      Total volume = 1.671 (Ac.Ft)
      Status of hydrographs being held in storage
      Stream 1 Stream 2 Stream 3 Stream 4 Stream 5
      Peak (CFS) 0.000 0.000 0.000 0.000 0.000
      Vol (Ac.Ft) 0.000 0.000 0.000 0.000 0.000
*****

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Section 7.8 – Basin 2 – Routed 2 Year- 24 Hour Hydrograph

# Basin 2 Size and Flow Calculations

## BASIN 2

Horiz. : Vert.

4 : 1 = Basin Side Slope

Basin Elevation	BASIN PARAMETERS					OUTLET								
	Depth	Area S.F.	Volume C.F.	Volume AC-FT	Effective Volume AC-FT	Q1 Orifice Plate (cfs)	Q2 Orifice Plate (cfs)	Q3 Orifice Plate (cfs)	Q4 Orifice Plate (cfs)	Q5 Orifice Plate (cfs)	Q6 Orifice Plate (cfs)	Q7 Orifice Plate (cfs)	Q Weir 1 (cfs)	Q Total (cfs)
1289.00	0.00	17,745.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1290.00	1.00	19,839.00	18,792.00	0.431	0.431	0.225	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.225
1291.00	2.00	22,060.00	39,805.00	0.914	0.914	0.344	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.344
1292.00	3.00	24,708.00	63,189.00	1.451	1.451	0.431	0.559	0.000	0.000	0.000	0.000	0.000	0.000	0.991
1293.00	4.00	27,403.00	89,244.50	2.049	2.049	0.503	0.914	0.000	0.000	0.000	0.000	0.000	0.000	1.417
1294.00	5.00	30,344.00	118,118.00	2.712	2.712	0.567	1.165	0.000	0.000	0.000	0.000	0.000	0.000	1.731
1294.25	5.25	31,098.25	125,798.28	2.888	2.888	0.581	1.219	0.000	0.000	0.000	0.000	0.000	0.000	1.801
1294.50	5.50	31,852.50	133,667.13	3.069	3.069	0.596	1.272	0.000	0.000	0.000	0.000	0.000	15.179	17.046
1295.00	6.00	33,361.00	149,970.50	3.443	3.443	0.623	1.370	0.000	0.000	0.000	0.000	0.000	223.084	225.078

### SUPPORTING DESIGN PARAMETERS

Orifice Coefficient	0.66	Dia of Orifice	3.00	5.00					
Gravimetric Constant	32.2 ft/s <sup>2</sup>	Eff Dia of Orifice	0.2500	0.4167	0.0000	0.0000	0.0000	0.0000	0.0000
Number of Rows		Area of Orifice	0.0491	0.1364	0.0000	0.0000	0.0000	0.0000	0.0000
Minimum Orifice Plate Height		Number of Orifices	1	1	1	1	1	1	1
Minimum Orifice Plate Width		Elev	1289.25	1291.4	1293	1293.7			
		Weir					Sharp Crest Weir Coefficient	4	
							Length of Weir	120.00	
							Elev. at Crest of Weir	1294.4	

Q100 Elevation Weir Calc	
Basin 2 Weir Calc	
Crest Wier Elev.	1294.40
Q100	115.36 cfs
Weir Length	120
Weir Coeff.	4
H Weir	0.38655
<b>Q100 Elevation</b>	<b>1294.79</b>

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 Program License Serial Number 5006

\*\*\*\*\* HYDROGRAPH INFORMATION \*\*\*\*\*

From study/file name: pro22242.rte  
 \*\*\*\*\*HYDROGRAPH DATA\*\*\*\*\*  
 Number of intervals = 293  
 Time interval = 5.0 (Min.)  
 Maximum/Peak flow rate = 6.393 (CFS)  
 Total volume = 3.885 (Ac.Ft)  
 Status of hydrographs being held in storage  
 Stream 1 Stream 2 Stream 3 Stream 4 Stream 5  
 Peak (CFS) 0.000 0.000 0.000 0.000 0.000  
 Vol (Ac.Ft) 0.000 0.000 0.000 0.000 0.000  
 \*\*\*\*\*

+++++  
 Process from Point/Station 1.000 to Point/Station 2.000  
 \*\*\*\* RETARDING BASIN ROUTING \*\*\*\*

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 User entry of depth-outflow-storage data

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 Total number of inflow hydrograph intervals = 293  
 Hydrograph time unit = 5.000 (Min.)  
 Initial depth in storage basin = 0.00(Ft.)  
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 Initial basin depth = 0.00 (Ft.)  
 Initial basin storage = 0.00 (Ac.Ft)  
 Initial basin outflow = 0.00 (CFS)  
 -----

-----  
 Depth vs. Storage and Depth vs. Discharge data:  
 Basin Depth Storage Outflow (S-O\*dt/2) (S+O\*dt/2)  
 (Ft.) (Ac.Ft) (CFS) (Ac.Ft) (Ac.Ft)  
 -----  

0.000	0.000	0.000	0.000	0.000
1.000	0.474	0.225	0.473	0.475
2.000	0.996	0.344	0.995	0.997
3.000	1.570	0.431	1.569	1.571
4.000	2.199	0.503	2.197	2.201
5.000	2.885	1.486	2.880	2.890
5.250	3.065	1.680	3.059	3.071
5.500	3.250	17.026	3.191	3.309
6.000	3.630	225.215	2.854	4.406

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 Hydrograph Detention Basin Routing  
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Graph values: 'I'= unit inflow; 'O'=outflow at time shown

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Time (Hours)	Inflow (CFS)	Outflow (CFS)	Storage (Ac.Ft)	.0	1.6	3.20	4.79	6.39	Depth (Ft.)
0.083	0.11	0.00	0.000	O					0.00
0.167	0.29	0.00	0.002	OI					0.00
0.250	0.34	0.00	0.004	OI					0.01
0.333	0.41	0.00	0.006	O I					0.01
0.417	0.51	0.00	0.010	O I					0.02
0.500	0.54	0.01	0.013	O I					0.03
0.583	0.55	0.01	0.017	O I					0.04
0.667	0.56	0.01	0.021	O I					0.04
0.750	0.56	0.01	0.025	O I					0.05
0.833	0.62	0.01	0.029	O I					0.06
0.917	0.71	0.02	0.033	O I					0.07
1.000	0.73	0.02	0.038	O I					0.08
1.083	0.69	0.02	0.043	O I					0.09
1.167	0.60	0.02	0.047	O I					0.10
1.250	0.58	0.02	0.051	O I					0.11
1.333	0.57	0.03	0.055	O I					0.12
1.417	0.57	0.03	0.058	O I					0.12
1.500	0.56	0.03	0.062	O I					0.13

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8.750	2.99	0.31	0.845	O	I				1.71
8.833	3.05	0.31	0.863	O	I				1.75
8.917	3.15	0.32	0.883	O	I				1.78
9.000	3.18	0.32	0.902	O	I				1.82
9.083	3.30	0.33	0.922	O	I				1.86
9.167	3.48	0.33	0.943	O	I				1.90
9.250	3.53	0.34	0.965	O	I				1.94
9.333	3.61	0.34	0.987	O	I				1.98
9.417	3.71	0.35	1.010	O	I				2.02
9.500	3.74	0.35	1.034	O	I				2.07
9.583	3.81	0.35	1.057	O	I				2.11
9.667	3.90	0.36	1.081	O	I				2.15
9.750	3.93	0.36	1.106	O	I				2.19
9.833	3.99	0.36	1.130	O	I				2.23
9.917	4.09	0.37	1.156	O	I				2.28
10.000	4.12	0.37	1.181	O	I				2.32
10.083	3.74	0.38	1.206	O	I				2.37
10.167	3.11	0.38	1.227	O	I				2.40
10.250	2.96	0.38	1.245	O	I				2.43
10.333	2.89	0.38	1.263	O	I				2.46
10.417	2.85	0.39	1.280	O	I				2.49
10.500	2.82	0.39	1.297	O	I				2.52
10.583	3.10	0.39	1.314	O	I				2.55
10.667	3.55	0.40	1.335	O	I				2.59
10.750	3.66	0.40	1.357	O	I				2.63
10.833	3.71	0.40	1.379	O	I				2.67
10.917	3.74	0.41	1.402	O	I				2.71
11.000	3.76	0.41	1.425	O	I				2.75
11.083	3.71	0.41	1.448	O	I				2.79
11.167	3.61	0.42	1.470	O	I				2.83
11.250	3.59	0.42	1.492	O	I				2.86
11.333	3.58	0.42	1.514	O	I				2.90
11.417	3.58	0.43	1.536	O	I				2.94
11.500	3.57	0.43	1.558	O	I				2.98
11.583	3.46	0.43	1.579	O	I				3.01
11.667	3.28	0.43	1.599	O	I				3.05
11.750	3.24	0.44	1.618	O	I				3.08
11.833	3.27	0.44	1.638	O	I				3.11
11.917	3.35	0.44	1.658	O	I				3.14
12.000	3.36	0.44	1.678	O	I				3.17
12.083	3.76	0.45	1.699	O	I				3.21
12.167	4.40	0.45	1.724	O	I				3.25
12.250	4.56	0.45	1.752	O	I				3.29
12.333	4.69	0.46	1.781	O	I				3.33
12.417	4.82	0.46	1.810	O	I				3.38
12.500	4.87	0.46	1.840	O	I				3.43
12.583	4.99	0.47	1.871	O	I				3.48
12.667	5.17	0.47	1.903	O	I				3.53
12.750	5.22	0.47	1.936	O	I				3.58
12.833	5.30	0.48	1.969	O	I				3.63
12.917	5.40	0.48	2.002	O	I				3.69
13.000	5.43	0.48	2.036	O	I				3.74
13.083	5.72	0.49	2.071	O	I				3.80
13.167	6.17	0.49	2.109	O	I				3.86
13.250	6.29	0.50	2.148	O	I				3.92
13.333	6.34	0.50	2.188	O	I				3.98
13.417	6.37	0.55	2.228	O	I				4.04
13.500	6.39	0.60	2.268	O	I				4.10
13.583	5.79	0.66	2.306	O	I				4.16
13.667	4.79	0.70	2.338	O	I				4.20
13.750	4.54	0.74	2.365	O	I				4.24
13.833	4.43	0.78	2.391	O	I				4.28
13.917	4.37	0.81	2.416	O	I				4.32
14.000	4.32	0.85	2.440	O	I				4.35
14.083	4.54	0.88	2.464	O	I				4.39
14.167	4.91	0.92	2.491	O	I				4.43
14.250	5.00	0.96	2.518	O	I				4.47
14.333	4.98	1.00	2.546	O	I				4.51
14.417	4.91	1.04	2.573	O	I				4.55
14.500	4.91	1.08	2.599	O	I				4.58
14.583	4.90	1.11	2.626	O	I				4.62
14.667	4.89	1.15	2.652	O	I				4.66
14.750	4.89	1.19	2.677	O	I				4.70
14.833	4.83	1.22	2.702	O	I				4.73
14.917	4.74	1.26	2.727	O	I				4.77
15.000	4.72	1.29	2.751	O	I				4.80
15.083	4.66	1.33	2.774	O	I				4.84
15.167	4.56	1.36	2.796	O	I				4.87
15.250	4.53	1.39	2.818	O	I				4.90
15.333	4.47	1.42	2.840	O	I				4.93
15.417	4.37	1.45	2.860	O	I				4.96
15.500	4.34	1.48	2.880	O	I				4.99
15.583	4.11	1.50	2.899	O	I				5.02
15.667	3.75	1.52	2.916	O	I				5.04
15.750	3.65	1.54	2.930	O	I				5.06
15.833	3.61	1.55	2.945	O	I				5.08

15.917	3.59	1.57	2.959		O				5.10
16.000	3.57	1.58	2.973		O				5.12
16.083	2.75	1.59	2.984		O				5.14
16.167	1.39	1.60	2.987		IO				5.14
16.250	1.05	1.59	2.984		I O				5.14
16.333	0.90	1.59	2.980		I O				5.13
16.417	0.81	1.58	2.975		I O				5.13
16.500	0.75	1.58	2.970		I O				5.12
16.583	0.70	1.57	2.964		I O				5.11
16.667	0.61	1.56	2.957		I O				5.10
16.750	0.58	1.56	2.951		I O				5.09
16.833	0.57	1.55	2.944		I O				5.08
16.917	0.57	1.54	2.937		I O				5.07
17.000	0.56	1.54	2.931		I O				5.06
17.083	0.67	1.53	2.924		I O				5.05
17.167	0.85	1.52	2.919		I O				5.05
17.250	0.90	1.52	2.915		I O				5.04
17.333	0.92	1.51	2.910		I O				5.04
17.417	0.93	1.51	2.906		I O				5.03
17.500	0.94	1.50	2.903		I O				5.02
17.583	0.94	1.50	2.899		I O				5.02
17.667	0.94	1.50	2.895		I O				5.01
17.750	0.94	1.49	2.891		I O				5.01
17.833	0.89	1.49	2.887		I O				5.00
17.917	0.79	1.48	2.883		I O				5.00
18.000	0.77	1.48	2.878		I O				4.99
18.083	0.76	1.47	2.873		I O				4.98
18.167	0.76	1.46	2.868		I O				4.98
18.250	0.75	1.45	2.863		I O				4.97
18.333	0.75	1.45	2.858		I O				4.96
18.417	0.75	1.44	2.854		I O				4.95
18.500	0.75	1.43	2.849		I O				4.95
18.583	0.70	1.43	2.844		I O				4.94
18.667	0.61	1.42	2.839		I O				4.93
18.750	0.58	1.41	2.833		I O				4.92
18.833	0.52	1.40	2.827		I O				4.92
18.917	0.42	1.39	2.821		I O				4.91
19.000	0.40	1.38	2.814		I O				4.90
19.083	0.44	1.37	2.807		I O				4.89
19.167	0.53	1.37	2.801		I O				4.88
19.250	0.54	1.36	2.796		I O				4.87
19.333	0.61	1.35	2.790		I O				4.86
19.417	0.71	1.34	2.785		I O				4.85
19.500	0.73	1.34	2.781		I O				4.85
19.583	0.69	1.33	2.777		I O				4.84
19.667	0.60	1.32	2.772		I O				4.84
19.750	0.58	1.32	2.767		I O				4.83
19.833	0.52	1.31	2.762		I O				4.82
19.917	0.42	1.30	2.756		I O				4.81
20.000	0.40	1.29	2.750		I O				4.80
20.083	0.44	1.28	2.744		I O				4.79
20.167	0.53	1.28	2.739		I O				4.79
20.250	0.54	1.27	2.734		I O				4.78
20.333	0.55	1.26	2.729		I O				4.77
20.417	0.56	1.25	2.724		I O				4.76
20.500	0.56	1.25	2.719		I O				4.76
20.583	0.56	1.24	2.714		I O				4.75
20.667	0.56	1.23	2.710		I O				4.74
20.750	0.56	1.23	2.705		I O				4.74
20.833	0.51	1.22	2.700		I O				4.73
20.917	0.42	1.21	2.695		I O				4.72
21.000	0.40	1.21	2.690		I O				4.72
21.083	0.44	1.20	2.684		I O				4.71
21.167	0.53	1.19	2.679		I O				4.70
21.250	0.54	1.18	2.675		I O				4.69
21.333	0.50	1.18	2.670		I O				4.69
21.417	0.41	1.17	2.665		I O				4.68
21.500	0.40	1.16	2.660		I O				4.67
21.583	0.44	1.16	2.655		I O				4.66
21.667	0.53	1.15	2.650		I O				4.66
21.750	0.54	1.14	2.646		I O				4.65
21.833	0.50	1.14	2.642		I O				4.65
21.917	0.41	1.13	2.637		I O				4.64
22.000	0.40	1.12	2.632		I O				4.63
22.083	0.44	1.12	2.627		I O				4.62
22.167	0.53	1.11	2.623		I O				4.62
22.250	0.54	1.11	2.619		I O				4.61
22.333	0.50	1.10	2.615		I O				4.61
22.417	0.41	1.09	2.611		I O				4.60
22.500	0.40	1.09	2.606		I O				4.59
22.583	0.39	1.08	2.601		I O				4.59
22.667	0.38	1.07	2.596		I O				4.58
22.750	0.38	1.07	2.592		I O				4.57
22.833	0.38	1.06	2.587		I O				4.57
22.917	0.38	1.05	2.582		I O				4.56
23.000	0.38	1.05	2.578		I O				4.55

23.083	0.38	1.04	2.573	I	O	4.55
23.167	0.38	1.03	2.569	I	O	4.54
23.250	0.38	1.03	2.564	I	O	4.53
23.333	0.38	1.02	2.560	I	O	4.53
23.417	0.38	1.01	2.555	I	O	4.52
23.500	0.38	1.01	2.551	I	O	4.51
23.583	0.38	1.00	2.546	I	O	4.51
23.667	0.38	0.99	2.542	I	O	4.50
23.750	0.38	0.99	2.538	I	O	4.49
23.833	0.38	0.98	2.534	I	O	4.49
23.917	0.38	0.98	2.530	I	O	4.48
24.000	0.38	0.97	2.525	I	O	4.48
24.083	0.27	0.96	2.521	I	O	4.47
24.167	0.09	0.96	2.516	I	O	4.46
24.250	0.04	0.95	2.509	I	O	4.45
24.333	0.02	0.94	2.503	I	O	4.44
24.417	0.01	0.93	2.497	I	O	4.43
24.500	0.00	0.92	2.491	I	O	4.42
24.583	0.00	0.91	2.484	I	O	4.42
24.667	0.00	0.90	2.478	I	O	4.41
24.750	0.00	0.89	2.472	I	O	4.40
24.833	0.00	0.89	2.466	I	O	4.39
24.917	0.00	0.88	2.460	I	O	4.38
25.000	0.00	0.87	2.454	I	O	4.37
25.083	0.00	0.86	2.448	I	O	4.36
25.167	0.00	0.85	2.442	I	O	4.35
25.250	0.00	0.84	2.436	I	O	4.35
25.333	0.00	0.83	2.430	I	O	4.34
25.417	0.00	0.83	2.424	I	O	4.33
25.500	0.00	0.82	2.419	I	O	4.32
25.583	0.00	0.81	2.413	I	O	4.31
25.667	0.00	0.80	2.408	I	O	4.30
25.750	0.00	0.79	2.402	I	O	4.30
25.833	0.00	0.79	2.397	I	O	4.29
25.917	0.00	0.78	2.391	I	O	4.28
26.000	0.00	0.77	2.386	I	O	4.27
26.083	0.00	0.76	2.381	I	O	4.26
26.167	0.00	0.76	2.375	I	O	4.26
26.250	0.00	0.75	2.370	I	O	4.25
26.333	0.00	0.74	2.365	I	O	4.24
26.417	0.00	0.73	2.360	I	O	4.23
26.500	0.00	0.73	2.355	I	O	4.23
26.583	0.00	0.72	2.350	I	O	4.22
26.667	0.00	0.71	2.345	I	O	4.21
26.750	0.00	0.71	2.340	I	O	4.21
26.833	0.00	0.70	2.335	I	O	4.20
26.917	0.00	0.69	2.331	I	O	4.19
27.000	0.00	0.68	2.326	I	O	4.18
27.083	0.00	0.68	2.321	I	O	4.18
27.167	0.00	0.67	2.317	I	O	4.17
27.250	0.00	0.66	2.312	I	O	4.16
27.333	0.00	0.66	2.307	I	O	4.16
27.417	0.00	0.65	2.303	I	O	4.15
27.500	0.00	0.65	2.298	I	O	4.14
27.583	0.00	0.64	2.294	I	O	4.14
27.667	0.00	0.63	2.290	I	O	4.13
27.750	0.00	0.63	2.285	I	O	4.13
27.833	0.00	0.62	2.281	I	O	4.12
27.917	0.00	0.61	2.277	I	O	4.11
28.000	0.00	0.61	2.272	I	O	4.11
28.083	0.00	0.60	2.268	I	O	4.10
28.167	0.00	0.60	2.264	I	O	4.10
28.250	0.00	0.59	2.260	I	O	4.09
28.333	0.00	0.58	2.256	I	O	4.08
28.417	0.00	0.58	2.252	I	O	4.08
28.500	0.00	0.57	2.248	I	O	4.07
28.583	0.00	0.57	2.244	I	O	4.07
28.667	0.00	0.56	2.240	I	O	4.06
28.750	0.00	0.56	2.236	I	O	4.05
28.833	0.00	0.55	2.233	I	O	4.05
28.917	0.00	0.55	2.229	I	O	4.04
29.000	0.00	0.54	2.225	I	O	4.04
29.083	0.00	0.54	2.221	I	O	4.03
29.167	0.00	0.53	2.218	I	O	4.03
29.250	0.00	0.52	2.214	I	O	4.02
29.333	0.00	0.52	2.210	I	O	4.02
29.417	0.00	0.51	2.207	I	O	4.01
29.500	0.00	0.51	2.203	I	O	4.01
29.583	0.00	0.50	2.200	I	O	4.00
29.667	0.00	0.50	2.196	I	O	4.00
29.750	0.00	0.50	2.193	I	O	3.99
29.833	0.00	0.50	2.190	I	O	3.98
29.917	0.00	0.50	2.186	I	O	3.98
30.000	0.00	0.50	2.183	I	O	3.97
30.083	0.00	0.50	2.179	I	O	3.97
30.167	0.00	0.50	2.176	I	O	3.96

30.250	0.00	0.50	2.172	I O					3.96
30.333	0.00	0.50	2.169	I O					3.95
30.417	0.00	0.50	2.165	I O					3.95
30.500	0.00	0.50	2.162	I O					3.94
30.583	0.00	0.50	2.159	I O					3.94
30.667	0.00	0.50	2.155	I O					3.93
30.750	0.00	0.50	2.152	I O					3.92
30.833	0.00	0.50	2.148	I O					3.92
30.917	0.00	0.50	2.145	I O					3.91
31.000	0.00	0.50	2.141	I O					3.91
31.083	0.00	0.50	2.138	I O					3.90
31.167	0.00	0.50	2.135	I O					3.90
31.250	0.00	0.50	2.131	I O					3.89
31.333	0.00	0.49	2.128	I O					3.89
31.417	0.00	0.49	2.124	I O					3.88
31.500	0.00	0.49	2.121	I O					3.88
31.583	0.00	0.49	2.118	I O					3.87
31.667	0.00	0.49	2.114	I O					3.87
31.750	0.00	0.49	2.111	I O					3.86
31.833	0.00	0.49	2.107	I O					3.85
31.917	0.00	0.49	2.104	I O					3.85
32.000	0.00	0.49	2.101	I O					3.84
32.083	0.00	0.49	2.097	I O					3.84
32.167	0.00	0.49	2.094	I O					3.83
32.250	0.00	0.49	2.090	I O					3.83
32.333	0.00	0.49	2.087	I O					3.82
32.417	0.00	0.49	2.084	I O					3.82
32.500	0.00	0.49	2.080	I O					3.81
32.583	0.00	0.49	2.077	I O					3.81
32.667	0.00	0.49	2.074	I O					3.80
32.750	0.00	0.49	2.070	I O					3.80
32.833	0.00	0.49	2.067	I O					3.79
32.917	0.00	0.49	2.063	I O					3.78
33.000	0.00	0.49	2.060	I O					3.78
33.083	0.00	0.49	2.057	I O					3.77
33.167	0.00	0.49	2.053	I O					3.77
33.250	0.00	0.49	2.050	I O					3.76
33.333	0.00	0.49	2.047	I O					3.76
33.417	0.00	0.49	2.043	I O					3.75
33.500	0.00	0.48	2.040	I O					3.75
33.583	0.00	0.48	2.037	I O					3.74
33.667	0.00	0.48	2.033	I O					3.74
33.750	0.00	0.48	2.030	I O					3.73
33.833	0.00	0.48	2.027	I O					3.73
33.917	0.00	0.48	2.023	I O					3.72
34.000	0.00	0.48	2.020	I O					3.72
34.083	0.00	0.48	2.017	I O					3.71
34.167	0.00	0.48	2.013	I O					3.70
34.250	0.00	0.48	2.010	I O					3.70
34.333	0.00	0.48	2.007	I O					3.69
34.417	0.00	0.48	2.003	I O					3.69
34.500	0.00	0.48	2.000	I O					3.68
34.583	0.00	0.48	1.997	I O					3.68
34.667	0.00	0.48	1.994	I O					3.67
34.750	0.00	0.48	1.990	I O					3.67
34.833	0.00	0.48	1.987	I O					3.66
34.917	0.00	0.48	1.984	I O					3.66
35.000	0.00	0.48	1.980	I O					3.65
35.083	0.00	0.48	1.977	I O					3.65
35.167	0.00	0.48	1.974	I O					3.64
35.250	0.00	0.48	1.970	I O					3.64
35.333	0.00	0.48	1.967	I O					3.63
35.417	0.00	0.48	1.964	I O					3.63
35.500	0.00	0.48	1.961	I O					3.62
35.583	0.00	0.48	1.957	I O					3.62
35.667	0.00	0.47	1.954	I O					3.61
35.750	0.00	0.47	1.951	I O					3.61
35.833	0.00	0.47	1.948	I O					3.60
35.917	0.00	0.47	1.944	I O					3.60
36.000	0.00	0.47	1.941	I O					3.59
36.083	0.00	0.47	1.938	I O					3.58
36.167	0.00	0.47	1.935	I O					3.58
36.250	0.00	0.47	1.931	I O					3.57
36.333	0.00	0.47	1.928	I O					3.57
36.417	0.00	0.47	1.925	I O					3.56
36.500	0.00	0.47	1.922	I O					3.56
36.583	0.00	0.47	1.918	I O					3.55
36.667	0.00	0.47	1.915	I O					3.55
36.750	0.00	0.47	1.912	I O					3.54
36.833	0.00	0.47	1.909	I O					3.54
36.917	0.00	0.47	1.905	I O					3.53
37.000	0.00	0.47	1.902	I O					3.53
37.083	0.00	0.47	1.899	I O					3.52
37.167	0.00	0.47	1.896	I O					3.52
37.250	0.00	0.47	1.892	I O					3.51
37.333	0.00	0.47	1.889	I O					3.51

37.417	0.00	0.47	1.886	I	O	3.50
37.500	0.00	0.47	1.883	I	O	3.50
37.583	0.00	0.47	1.880	I	O	3.49
37.667	0.00	0.47	1.876	I	O	3.49
37.750	0.00	0.47	1.873	I	O	3.48
37.833	0.00	0.47	1.870	I	O	3.48
37.917	0.00	0.46	1.867	I	O	3.47
38.000	0.00	0.46	1.864	I	O	3.47
38.083	0.00	0.46	1.860	I	O	3.46
38.167	0.00	0.46	1.857	I	O	3.46
38.250	0.00	0.46	1.854	I	O	3.45
38.333	0.00	0.46	1.851	I	O	3.45
38.417	0.00	0.46	1.848	I	O	3.44
38.500	0.00	0.46	1.844	I	O	3.44
38.583	0.00	0.46	1.841	I	O	3.43
38.667	0.00	0.46	1.838	I	O	3.43
38.750	0.00	0.46	1.835	I	O	3.42
38.833	0.00	0.46	1.832	I	O	3.42
38.917	0.00	0.46	1.828	I	O	3.41
39.000	0.00	0.46	1.825	I	O	3.41
39.083	0.00	0.46	1.822	I	O	3.40
39.167	0.00	0.46	1.819	I	O	3.40
39.250	0.00	0.46	1.816	I	O	3.39
39.333	0.00	0.46	1.813	I	O	3.39
39.417	0.00	0.46	1.809	I	O	3.38
39.500	0.00	0.46	1.806	I	O	3.38
39.583	0.00	0.46	1.803	I	O	3.37
39.667	0.00	0.46	1.800	I	O	3.37
39.750	0.00	0.46	1.797	I	O	3.36
39.833	0.00	0.46	1.794	I	O	3.36
39.917	0.00	0.46	1.791	I	O	3.35
40.000	0.00	0.46	1.787	I	O	3.35
40.083	0.00	0.46	1.784	I	O	3.34
40.167	0.00	0.46	1.781	I	O	3.34
40.250	0.00	0.45	1.778	I	O	3.33
40.333	0.00	0.45	1.775	I	O	3.33
40.417	0.00	0.45	1.772	I	O	3.32
40.500	0.00	0.45	1.769	I	O	3.32
40.583	0.00	0.45	1.766	I	O	3.31
40.667	0.00	0.45	1.762	I	O	3.31
40.750	0.00	0.45	1.759	I	O	3.30
40.833	0.00	0.45	1.756	I	O	3.30
40.917	0.00	0.45	1.753	I	O	3.29
41.000	0.00	0.45	1.750	I	O	3.29
41.083	0.00	0.45	1.747	I	O	3.28
41.167	0.00	0.45	1.744	I	O	3.28
41.250	0.00	0.45	1.741	I	O	3.27
41.333	0.00	0.45	1.738	I	O	3.27
41.417	0.00	0.45	1.734	I	O	3.26
41.500	0.00	0.45	1.731	I	O	3.26
41.583	0.00	0.45	1.728	I	O	3.25
41.667	0.00	0.45	1.725	I	O	3.25
41.750	0.00	0.45	1.722	I	O	3.24
41.833	0.00	0.45	1.719	I	O	3.24
41.917	0.00	0.45	1.716	I	O	3.23
42.000	0.00	0.45	1.713	I	O	3.23
42.083	0.00	0.45	1.710	I	O	3.22
42.167	0.00	0.45	1.707	I	O	3.22
42.250	0.00	0.45	1.704	I	O	3.21
42.333	0.00	0.45	1.700	I	O	3.21
42.417	0.00	0.45	1.697	I	O	3.20
42.500	0.00	0.45	1.694	I	O	3.20
42.583	0.00	0.44	1.691	I	O	3.19
42.667	0.00	0.44	1.688	I	O	3.19
42.750	0.00	0.44	1.685	I	O	3.18
42.833	0.00	0.44	1.682	I	O	3.18
42.917	0.00	0.44	1.679	I	O	3.17
43.000	0.00	0.44	1.676	I	O	3.17
43.083	0.00	0.44	1.673	I	O	3.16
43.167	0.00	0.44	1.670	I	O	3.16
43.250	0.00	0.44	1.667	I	O	3.15
43.333	0.00	0.44	1.664	I	O	3.15
43.417	0.00	0.44	1.661	I	O	3.14
43.500	0.00	0.44	1.658	I	O	3.14
43.583	0.00	0.44	1.655	I	O	3.13
43.667	0.00	0.44	1.652	I	O	3.13
43.750	0.00	0.44	1.649	I	O	3.13
43.833	0.00	0.44	1.646	I	O	3.12
43.917	0.00	0.44	1.643	I	O	3.12
44.000	0.00	0.44	1.640	I	O	3.11
44.083	0.00	0.44	1.637	I	O	3.11
44.167	0.00	0.44	1.634	I	O	3.10
44.250	0.00	0.44	1.630	I	O	3.10
44.333	0.00	0.44	1.627	I	O	3.09
44.417	0.00	0.44	1.624	I	O	3.09
44.500	0.00	0.44	1.621	I	O	3.08

44.583	0.00	0.44	1.618	I O					3.08
44.667	0.00	0.44	1.615	I O					3.07
44.750	0.00	0.44	1.612	I O					3.07
44.833	0.00	0.44	1.609	I O					3.06
44.917	0.00	0.44	1.606	I O					3.06
45.000	0.00	0.43	1.603	I O					3.05
45.083	0.00	0.43	1.600	I O					3.05
45.167	0.00	0.43	1.597	I O					3.04
45.250	0.00	0.43	1.594	I O					3.04
45.333	0.00	0.43	1.591	I O					3.03
45.417	0.00	0.43	1.589	I O					3.03
45.500	0.00	0.43	1.586	I O					3.02
45.583	0.00	0.43	1.583	I O					3.02
45.667	0.00	0.43	1.580	I O					3.02
45.750	0.00	0.43	1.577	I O					3.01
45.833	0.00	0.43	1.574	I O					3.01
45.917	0.00	0.43	1.571	I O					3.00
46.000	0.00	0.43	1.568	I O					3.00
46.083	0.00	0.43	1.565	I O					2.99
46.167	0.00	0.43	1.562	I O					2.99
46.250	0.00	0.43	1.559	I O					2.98
46.333	0.00	0.43	1.556	I O					2.98
46.417	0.00	0.43	1.553	I O					2.97
46.500	0.00	0.43	1.550	I O					2.97
46.583	0.00	0.43	1.547	I O					2.96
46.667	0.00	0.43	1.544	I O					2.95
46.750	0.00	0.43	1.541	I O					2.95
46.833	0.00	0.43	1.538	I O					2.94
46.917	0.00	0.43	1.535	I O					2.94
47.000	0.00	0.43	1.532	I O					2.93
47.083	0.00	0.42	1.529	I O					2.93
47.167	0.00	0.42	1.526	I O					2.92
47.250	0.00	0.42	1.524	I O					2.92
47.333	0.00	0.42	1.521	I O					2.91
47.417	0.00	0.42	1.518	I O					2.91
47.500	0.00	0.42	1.515	I O					2.90
47.583	0.00	0.42	1.512	I O					2.90
47.667	0.00	0.42	1.509	I O					2.89
47.750	0.00	0.42	1.506	I O					2.89
47.833	0.00	0.42	1.503	I O					2.88
47.917	0.00	0.42	1.500	I O					2.88
48.000	0.00	0.42	1.497	I O					2.87
48.083	0.00	0.42	1.494	I O					2.87
48.167	0.00	0.42	1.492	I O					2.86
48.250	0.00	0.42	1.489	I O					2.86
48.333	0.00	0.42	1.486	I O					2.85
48.417	0.00	0.42	1.483	I O					2.85
48.500	0.00	0.42	1.480	I O					2.84
48.583	0.00	0.42	1.477	I O					2.84
48.667	0.00	0.42	1.474	I O					2.83
48.750	0.00	0.42	1.471	I O					2.83
48.833	0.00	0.42	1.469	I O					2.82
48.917	0.00	0.42	1.466	I O					2.82
49.000	0.00	0.41	1.463	I O					2.81
49.083	0.00	0.41	1.460	I O					2.81
49.167	0.00	0.41	1.457	I O					2.80
49.250	0.00	0.41	1.454	I O					2.80
49.333	0.00	0.41	1.451	I O					2.79
49.417	0.00	0.41	1.449	I O					2.79
49.500	0.00	0.41	1.446	I O					2.78
49.583	0.00	0.41	1.443	I O					2.78
49.667	0.00	0.41	1.440	I O					2.77
49.750	0.00	0.41	1.437	I O					2.77
49.833	0.00	0.41	1.434	I O					2.76
49.917	0.00	0.41	1.432	I O					2.76
50.000	0.00	0.41	1.429	I O					2.75
50.083	0.00	0.41	1.426	I O					2.75
50.167	0.00	0.41	1.423	I O					2.74
50.250	0.00	0.41	1.420	I O					2.74
50.333	0.00	0.41	1.418	I O					2.73
50.417	0.00	0.41	1.415	I O					2.73
50.500	0.00	0.41	1.412	I O					2.72
50.583	0.00	0.41	1.409	I O					2.72
50.667	0.00	0.41	1.406	I O					2.71
50.750	0.00	0.41	1.404	I O					2.71
50.833	0.00	0.41	1.401	I O					2.71
50.917	0.00	0.40	1.398	I O					2.70
51.000	0.00	0.40	1.395	I O					2.70
51.083	0.00	0.40	1.392	I O					2.69
51.167	0.00	0.40	1.390	I O					2.69
51.250	0.00	0.40	1.387	I O					2.68
51.333	0.00	0.40	1.384	I O					2.68
51.417	0.00	0.40	1.381	I O					2.67
51.500	0.00	0.40	1.379	I O					2.67
51.583	0.00	0.40	1.376	I O					2.66
51.667	0.00	0.40	1.373	I O					2.66

51.750	0.00	0.40	1.370	I O	2.65
51.833	0.00	0.40	1.367	I O	2.65
51.917	0.00	0.40	1.365	I O	2.64
52.000	0.00	0.40	1.362	IO	2.64
52.083	0.00	0.40	1.359	IO	2.63
52.167	0.00	0.40	1.356	IO	2.63
52.250	0.00	0.40	1.354	IO	2.62
52.333	0.00	0.40	1.351	IO	2.62
52.417	0.00	0.40	1.348	IO	2.61
52.500	0.00	0.40	1.346	IO	2.61
52.583	0.00	0.40	1.343	IO	2.60
52.667	0.00	0.40	1.340	IO	2.60
52.750	0.00	0.40	1.337	IO	2.59
52.833	0.00	0.40	1.335	IO	2.59
52.917	0.00	0.39	1.332	IO	2.59
53.000	0.00	0.39	1.329	IO	2.58
53.083	0.00	0.39	1.326	IO	2.58
53.167	0.00	0.39	1.324	IO	2.57
53.250	0.00	0.39	1.321	IO	2.57
53.333	0.00	0.39	1.318	IO	2.56
53.417	0.00	0.39	1.316	IO	2.56
53.500	0.00	0.39	1.313	IO	2.55
53.583	0.00	0.39	1.310	IO	2.55
53.667	0.00	0.39	1.308	IO	2.54
53.750	0.00	0.39	1.305	IO	2.54
53.833	0.00	0.39	1.302	IO	2.53
53.917	0.00	0.39	1.299	IO	2.53
54.000	0.00	0.39	1.297	IO	2.52
54.083	0.00	0.39	1.294	IO	2.52
54.167	0.00	0.39	1.291	IO	2.51
54.250	0.00	0.39	1.289	IO	2.51
54.333	0.00	0.39	1.286	IO	2.51
54.417	0.00	0.39	1.283	IO	2.50
54.500	0.00	0.39	1.281	IO	2.50
54.583	0.00	0.39	1.278	IO	2.49
54.667	0.00	0.39	1.275	IO	2.49
54.750	0.00	0.39	1.273	IO	2.48
54.833	0.00	0.39	1.270	IO	2.48
54.917	0.00	0.39	1.267	IO	2.47
55.000	0.00	0.38	1.265	IO	2.47
55.083	0.00	0.38	1.262	IO	2.46
55.167	0.00	0.38	1.259	IO	2.46
55.250	0.00	0.38	1.257	IO	2.45
55.333	0.00	0.38	1.254	IO	2.45
55.417	0.00	0.38	1.252	IO	2.45
55.500	0.00	0.38	1.249	IO	2.44
55.583	0.00	0.38	1.246	IO	2.44
55.667	0.00	0.38	1.244	IO	2.43
55.750	0.00	0.38	1.241	IO	2.43
55.833	0.00	0.38	1.238	IO	2.42
55.917	0.00	0.38	1.236	IO	2.42
56.000	0.00	0.38	1.233	IO	2.41
56.083	0.00	0.38	1.231	IO	2.41
56.167	0.00	0.38	1.228	IO	2.40
56.250	0.00	0.38	1.225	IO	2.40
56.333	0.00	0.38	1.223	IO	2.39
56.417	0.00	0.38	1.220	IO	2.39
56.500	0.00	0.38	1.218	IO	2.39
56.583	0.00	0.38	1.215	IO	2.38
56.667	0.00	0.38	1.212	IO	2.38
56.750	0.00	0.38	1.210	IO	2.37
56.833	0.00	0.38	1.207	IO	2.37
56.917	0.00	0.38	1.205	IO	2.36
57.000	0.00	0.38	1.202	IO	2.36
57.083	0.00	0.37	1.199	IO	2.35
57.167	0.00	0.37	1.197	IO	2.35
57.250	0.00	0.37	1.194	IO	2.35
57.333	0.00	0.37	1.192	IO	2.34
57.417	0.00	0.37	1.189	IO	2.34
57.500	0.00	0.37	1.186	IO	2.33
57.583	0.00	0.37	1.184	IO	2.33
57.667	0.00	0.37	1.181	IO	2.32
57.750	0.00	0.37	1.179	IO	2.32
57.833	0.00	0.37	1.176	IO	2.31
57.917	0.00	0.37	1.174	IO	2.31
58.000	0.00	0.37	1.171	IO	2.31
58.083	0.00	0.37	1.169	IO	2.30
58.167	0.00	0.37	1.166	IO	2.30
58.250	0.00	0.37	1.163	IO	2.29
58.333	0.00	0.37	1.161	IO	2.29
58.417	0.00	0.37	1.158	IO	2.28
58.500	0.00	0.37	1.156	IO	2.28
58.583	0.00	0.37	1.153	IO	2.27
58.667	0.00	0.37	1.151	IO	2.27
58.750	0.00	0.37	1.148	IO	2.27
58.833	0.00	0.37	1.146	IO	2.26

58.917	0.00	0.37	1.143	IO	2.26
59.000	0.00	0.37	1.141	IO	2.25
59.083	0.00	0.37	1.138	IO	2.25
59.167	0.00	0.37	1.136	IO	2.24
59.250	0.00	0.36	1.133	IO	2.24
59.333	0.00	0.36	1.131	IO	2.23
59.417	0.00	0.36	1.128	IO	2.23
59.500	0.00	0.36	1.126	IO	2.23
59.583	0.00	0.36	1.123	IO	2.22
59.667	0.00	0.36	1.121	IO	2.22
59.750	0.00	0.36	1.118	IO	2.21
59.833	0.00	0.36	1.116	IO	2.21
59.917	0.00	0.36	1.113	IO	2.20
60.000	0.00	0.36	1.111	IO	2.20
60.083	0.00	0.36	1.108	IO	2.20
60.167	0.00	0.36	1.106	IO	2.19
60.250	0.00	0.36	1.103	IO	2.19
60.333	0.00	0.36	1.101	IO	2.18
60.417	0.00	0.36	1.098	IO	2.18
60.500	0.00	0.36	1.096	IO	2.17
60.583	0.00	0.36	1.093	IO	2.17
60.667	0.00	0.36	1.091	IO	2.17
60.750	0.00	0.36	1.088	IO	2.16
60.833	0.00	0.36	1.086	IO	2.16
60.917	0.00	0.36	1.083	IO	2.15
61.000	0.00	0.36	1.081	IO	2.15
61.083	0.00	0.36	1.079	IO	2.14
61.167	0.00	0.36	1.076	IO	2.14
61.250	0.00	0.36	1.074	IO	2.14
61.333	0.00	0.36	1.071	IO	2.13
61.417	0.00	0.36	1.069	IO	2.13
61.500	0.00	0.35	1.066	IO	2.12
61.583	0.00	0.35	1.064	IO	2.12
61.667	0.00	0.35	1.061	IO	2.11
61.750	0.00	0.35	1.059	IO	2.11
61.833	0.00	0.35	1.057	IO	2.11
61.917	0.00	0.35	1.054	IO	2.10
62.000	0.00	0.35	1.052	IO	2.10
62.083	0.00	0.35	1.049	IO	2.09
62.167	0.00	0.35	1.047	IO	2.09
62.250	0.00	0.35	1.044	IO	2.08
62.333	0.00	0.35	1.042	IO	2.08
62.417	0.00	0.35	1.040	IO	2.08
62.500	0.00	0.35	1.037	IO	2.07
62.583	0.00	0.35	1.035	IO	2.07
62.667	0.00	0.35	1.032	IO	2.06
62.750	0.00	0.35	1.030	IO	2.06
62.833	0.00	0.35	1.028	IO	2.05
62.917	0.00	0.35	1.025	IO	2.05
63.000	0.00	0.35	1.023	IO	2.05
63.083	0.00	0.35	1.020	IO	2.04
63.167	0.00	0.35	1.018	IO	2.04
63.250	0.00	0.35	1.016	IO	2.03
63.333	0.00	0.35	1.013	IO	2.03
63.417	0.00	0.35	1.011	IO	2.03
63.500	0.00	0.35	1.008	IO	2.02
63.583	0.00	0.35	1.006	IO	2.02
63.667	0.00	0.35	1.004	IO	2.01
63.750	0.00	0.34	1.001	IO	2.01
63.833	0.00	0.34	0.999	IO	2.01
63.917	0.00	0.34	0.997	IO	2.00
64.000	0.00	0.34	0.994	IO	2.00
64.083	0.00	0.34	0.992	IO	1.99
64.167	0.00	0.34	0.989	IO	1.99
64.250	0.00	0.34	0.987	IO	1.98
64.333	0.00	0.34	0.985	IO	1.98
64.417	0.00	0.34	0.982	IO	1.97
64.500	0.00	0.34	0.980	IO	1.97
64.583	0.00	0.34	0.978	IO	1.96
64.667	0.00	0.34	0.975	IO	1.96
64.750	0.00	0.34	0.973	IO	1.96
64.833	0.00	0.34	0.971	IO	1.95
64.917	0.00	0.34	0.968	IO	1.95
65.000	0.00	0.34	0.966	IO	1.94
65.083	0.00	0.34	0.964	IO	1.94
65.167	0.00	0.34	0.961	IO	1.93
65.250	0.00	0.34	0.959	IO	1.93
65.333	0.00	0.34	0.957	IO	1.92
65.417	0.00	0.33	0.954	IO	1.92
65.500	0.00	0.33	0.952	IO	1.92
65.583	0.00	0.33	0.950	IO	1.91
65.667	0.00	0.33	0.948	IO	1.91
65.750	0.00	0.33	0.945	IO	1.90
65.833	0.00	0.33	0.943	IO	1.90
65.917	0.00	0.33	0.941	IO	1.89
66.000	0.00	0.33	0.938	IO	1.89

66.083	0.00	0.33	0.936	IO	1.89
66.167	0.00	0.33	0.934	IO	1.88
66.250	0.00	0.33	0.932	IO	1.88
66.333	0.00	0.33	0.929	IO	1.87
66.417	0.00	0.33	0.927	IO	1.87
66.500	0.00	0.33	0.925	IO	1.86
66.583	0.00	0.33	0.923	IO	1.86
66.667	0.00	0.33	0.920	IO	1.85
66.750	0.00	0.33	0.918	IO	1.85
66.833	0.00	0.33	0.916	IO	1.85
66.917	0.00	0.33	0.914	IO	1.84
67.000	0.00	0.32	0.911	IO	1.84
67.083	0.00	0.32	0.909	IO	1.83
67.167	0.00	0.32	0.907	IO	1.83
67.250	0.00	0.32	0.905	IO	1.82
67.333	0.00	0.32	0.902	IO	1.82
67.417	0.00	0.32	0.900	IO	1.82
67.500	0.00	0.32	0.898	IO	1.81
67.583	0.00	0.32	0.896	IO	1.81
67.667	0.00	0.32	0.894	IO	1.80
67.750	0.00	0.32	0.891	IO	1.80
67.833	0.00	0.32	0.889	IO	1.80
67.917	0.00	0.32	0.887	IO	1.79
68.000	0.00	0.32	0.885	IO	1.79
68.083	0.00	0.32	0.883	IO	1.78
68.167	0.00	0.32	0.880	IO	1.78
68.250	0.00	0.32	0.878	IO	1.77
68.333	0.00	0.32	0.876	IO	1.77
68.417	0.00	0.32	0.874	IO	1.77
68.500	0.00	0.32	0.872	IO	1.76
68.583	0.00	0.32	0.869	IO	1.76
68.667	0.00	0.31	0.867	IO	1.75
68.750	0.00	0.31	0.865	IO	1.75
68.833	0.00	0.31	0.863	IO	1.75
68.917	0.00	0.31	0.861	IO	1.74
69.000	0.00	0.31	0.859	IO	1.74
69.083	0.00	0.31	0.856	IO	1.73
69.167	0.00	0.31	0.854	IO	1.73
69.250	0.00	0.31	0.852	IO	1.72
69.333	0.00	0.31	0.850	IO	1.72
69.417	0.00	0.31	0.848	IO	1.72
69.500	0.00	0.31	0.846	IO	1.71
69.583	0.00	0.31	0.844	IO	1.71
69.667	0.00	0.31	0.842	IO	1.70
69.750	0.00	0.31	0.839	IO	1.70
69.833	0.00	0.31	0.837	IO	1.70
69.917	0.00	0.31	0.835	IO	1.69
70.000	0.00	0.31	0.833	IO	1.69
70.083	0.00	0.31	0.831	IO	1.68
70.167	0.00	0.31	0.829	IO	1.68
70.250	0.00	0.31	0.827	IO	1.68
70.333	0.00	0.30	0.825	IO	1.67
70.417	0.00	0.30	0.823	IO	1.67
70.500	0.00	0.30	0.820	IO	1.66
70.583	0.00	0.30	0.818	IO	1.66
70.667	0.00	0.30	0.816	IO	1.66
70.750	0.00	0.30	0.814	IO	1.65
70.833	0.00	0.30	0.812	IO	1.65
70.917	0.00	0.30	0.810	IO	1.64
71.000	0.00	0.30	0.808	IO	1.64
71.083	0.00	0.30	0.806	IO	1.64
71.167	0.00	0.30	0.804	IO	1.63
71.250	0.00	0.30	0.802	IO	1.63
71.333	0.00	0.30	0.800	IO	1.62
71.417	0.00	0.30	0.798	IO	1.62
71.500	0.00	0.30	0.796	IO	1.62
71.583	0.00	0.30	0.793	IO	1.61
71.667	0.00	0.30	0.791	IO	1.61
71.750	0.00	0.30	0.789	IO	1.60
71.833	0.00	0.30	0.787	IO	1.60
71.917	0.00	0.30	0.785	IO	1.60
72.000	0.00	0.30	0.783	IO	1.59
72.083	0.00	0.30	0.781	IO	1.59
72.167	0.00	0.29	0.779	IO	1.58
72.250	0.00	0.29	0.777	IO	1.58
72.333	0.00	0.29	0.775	IO	1.58
72.417	0.00	0.29	0.773	IO	1.57
72.500	0.00	0.29	0.771	IO	1.57
72.583	0.00	0.29	0.769	IO	1.57
72.667	0.00	0.29	0.767	IO	1.56
72.750	0.00	0.29	0.765	IO	1.56
72.833	0.00	0.29	0.763	IO	1.55
72.917	0.00	0.29	0.761	IO	1.55
73.000	0.00	0.29	0.759	IO	1.55
73.083	0.00	0.29	0.757	IO	1.54
73.167	0.00	0.29	0.755	IO	1.54

73.250	0.00	0.29	0.753	IO	1.53
73.333	0.00	0.29	0.751	IO	1.53
73.417	0.00	0.29	0.749	IO	1.53
73.500	0.00	0.29	0.747	IO	1.52
73.583	0.00	0.29	0.745	IO	1.52
73.667	0.00	0.29	0.743	IO	1.52
73.750	0.00	0.29	0.741	IO	1.51
73.833	0.00	0.29	0.739	IO	1.51
73.917	0.00	0.29	0.737	IO	1.50
74.000	0.00	0.28	0.735	IO	1.50
74.083	0.00	0.28	0.733	IO	1.50
74.167	0.00	0.28	0.731	IO	1.49
74.250	0.00	0.28	0.729	IO	1.49
74.333	0.00	0.28	0.728	IO	1.49
74.417	0.00	0.28	0.726	IO	1.48
74.500	0.00	0.28	0.724	IO	1.48
74.583	0.00	0.28	0.722	IO	1.47
74.667	0.00	0.28	0.720	IO	1.47
74.750	0.00	0.28	0.718	IO	1.47
74.833	0.00	0.28	0.716	IO	1.46
74.917	0.00	0.28	0.714	IO	1.46
75.000	0.00	0.28	0.712	IO	1.46
75.083	0.00	0.28	0.710	IO	1.45
75.167	0.00	0.28	0.708	IO	1.45
75.250	0.00	0.28	0.706	IO	1.44
75.333	0.00	0.28	0.704	IO	1.44
75.417	0.00	0.28	0.702	IO	1.44
75.500	0.00	0.28	0.701	IO	1.43
75.583	0.00	0.28	0.699	IO	1.43
75.667	0.00	0.28	0.697	IO	1.43
75.750	0.00	0.28	0.695	IO	1.42
75.833	0.00	0.27	0.693	IO	1.42
75.917	0.00	0.27	0.691	IO	1.42
76.000	0.00	0.27	0.689	IO	1.41
76.083	0.00	0.27	0.687	IO	1.41
76.167	0.00	0.27	0.685	IO	1.40
76.250	0.00	0.27	0.684	IO	1.40
76.333	0.00	0.27	0.682	IO	1.40
76.417	0.00	0.27	0.680	IO	1.39
76.500	0.00	0.27	0.678	IO	1.39
76.583	0.00	0.27	0.676	IO	1.39
76.667	0.00	0.27	0.674	IO	1.38
76.750	0.00	0.27	0.672	IO	1.38
76.833	0.00	0.27	0.670	IO	1.38
76.917	0.00	0.27	0.669	IO	1.37
77.000	0.00	0.27	0.667	IO	1.37
77.083	0.00	0.27	0.665	IO	1.37
77.167	0.00	0.27	0.663	IO	1.36
77.250	0.00	0.27	0.661	IO	1.36
77.333	0.00	0.27	0.659	IO	1.36
77.417	0.00	0.27	0.658	IO	1.35
77.500	0.00	0.27	0.656	IO	1.35
77.583	0.00	0.27	0.654	IO	1.34
77.667	0.00	0.27	0.652	IO	1.34
77.750	0.00	0.27	0.650	IO	1.34
77.833	0.00	0.26	0.648	IO	1.33
77.917	0.00	0.26	0.647	IO	1.33
78.000	0.00	0.26	0.645	IO	1.33
78.083	0.00	0.26	0.643	IO	1.32
78.167	0.00	0.26	0.641	IO	1.32
78.250	0.00	0.26	0.639	IO	1.32
78.333	0.00	0.26	0.637	IO	1.31
78.417	0.00	0.26	0.636	IO	1.31
78.500	0.00	0.26	0.634	IO	1.31
78.583	0.00	0.26	0.632	IO	1.30
78.667	0.00	0.26	0.630	IO	1.30
78.750	0.00	0.26	0.628	IO	1.30
78.833	0.00	0.26	0.627	IO	1.29
78.917	0.00	0.26	0.625	IO	1.29
79.000	0.00	0.26	0.623	IO	1.29
79.083	0.00	0.26	0.621	IO	1.28
79.167	0.00	0.26	0.620	IO	1.28
79.250	0.00	0.26	0.618	IO	1.28
79.333	0.00	0.26	0.616	IO	1.27
79.417	0.00	0.26	0.614	IO	1.27
79.500	0.00	0.26	0.612	IO	1.27
79.583	0.00	0.26	0.611	IO	1.26
79.667	0.00	0.26	0.609	IO	1.26
79.750	0.00	0.26	0.607	IO	1.26
79.833	0.00	0.25	0.605	IO	1.25
79.917	0.00	0.25	0.604	IO	1.25
80.000	0.00	0.25	0.602	IO	1.25
80.083	0.00	0.25	0.600	IO	1.24
80.167	0.00	0.25	0.598	IO	1.24
80.250	0.00	0.25	0.597	IO	1.23
80.333	0.00	0.25	0.595	IO	1.23

80.417	0.00	0.25	0.593	IO	1.23
80.500	0.00	0.25	0.591	IO	1.23
80.583	0.00	0.25	0.590	IO	1.22
80.667	0.00	0.25	0.588	IO	1.22
80.750	0.00	0.25	0.586	IO	1.22
80.833	0.00	0.25	0.585	IO	1.21
80.917	0.00	0.25	0.583	IO	1.21
81.000	0.00	0.25	0.581	IO	1.21
81.083	0.00	0.25	0.579	IO	1.20
81.167	0.00	0.25	0.578	IO	1.20
81.250	0.00	0.25	0.576	IO	1.20
81.333	0.00	0.25	0.574	IO	1.19
81.417	0.00	0.25	0.573	IO	1.19
81.500	0.00	0.25	0.571	IO	1.19
81.583	0.00	0.25	0.569	IO	1.18
81.667	0.00	0.25	0.567	IO	1.18
81.750	0.00	0.25	0.566	IO	1.18
81.833	0.00	0.25	0.564	IO	1.17
81.917	0.00	0.25	0.562	IO	1.17
82.000	0.00	0.24	0.561	IO	1.17
82.083	0.00	0.24	0.559	IO	1.16
82.167	0.00	0.24	0.557	IO	1.16
82.250	0.00	0.24	0.556	IO	1.16
82.333	0.00	0.24	0.554	IO	1.15
82.417	0.00	0.24	0.552	IO	1.15
82.500	0.00	0.24	0.551	IO	1.15
82.583	0.00	0.24	0.549	IO	1.14
82.667	0.00	0.24	0.547	IO	1.14
82.750	0.00	0.24	0.546	IO	1.14
82.833	0.00	0.24	0.544	IO	1.13
82.917	0.00	0.24	0.542	IO	1.13
83.000	0.00	0.24	0.541	IO	1.13
83.083	0.00	0.24	0.539	IO	1.12
83.167	0.00	0.24	0.537	IO	1.12
83.250	0.00	0.24	0.536	IO	1.12
83.333	0.00	0.24	0.534	IO	1.12
83.417	0.00	0.24	0.532	IO	1.11
83.500	0.00	0.24	0.531	IO	1.11
83.583	0.00	0.24	0.529	IO	1.11
83.667	0.00	0.24	0.527	IO	1.10
83.750	0.00	0.24	0.526	IO	1.10
83.833	0.00	0.24	0.524	IO	1.10
83.917	0.00	0.24	0.523	IO	1.09
84.000	0.00	0.24	0.521	IO	1.09
84.083	0.00	0.24	0.519	IO	1.09
84.167	0.00	0.23	0.518	IO	1.08
84.250	0.00	0.23	0.516	IO	1.08
84.333	0.00	0.23	0.514	IO	1.08
84.417	0.00	0.23	0.513	IO	1.07
84.500	0.00	0.23	0.511	IO	1.07
84.583	0.00	0.23	0.510	IO	1.07
84.667	0.00	0.23	0.508	IO	1.07
84.750	0.00	0.23	0.506	IO	1.06
84.833	0.00	0.23	0.505	IO	1.06
84.917	0.00	0.23	0.503	IO	1.06
85.000	0.00	0.23	0.502	IO	1.05
85.083	0.00	0.23	0.500	IO	1.05
85.167	0.00	0.23	0.498	IO	1.05
85.250	0.00	0.23	0.497	IO	1.04
85.333	0.00	0.23	0.495	IO	1.04
85.417	0.00	0.23	0.494	IO	1.04
85.500	0.00	0.23	0.492	IO	1.03
85.583	0.00	0.23	0.491	IO	1.03
85.667	0.00	0.23	0.489	IO	1.03
85.750	0.00	0.23	0.487	IO	1.03
85.833	0.00	0.23	0.486	IO	1.02
85.917	0.00	0.23	0.484	IO	1.02
86.000	0.00	0.23	0.483	IO	1.02
86.083	0.00	0.23	0.481	IO	1.01
86.167	0.00	0.23	0.480	IO	1.01
86.250	0.00	0.23	0.478	IO	1.01
86.333	0.00	0.23	0.477	IO	1.00
86.417	0.00	0.23	0.475	IO	1.00
86.500	0.00	0.22	0.473	IO	1.00
86.583	0.00	0.22	0.472	IO	1.00
86.667	0.00	0.22	0.470	IO	0.99
86.750	0.00	0.22	0.469	IO	0.99
86.833	0.00	0.22	0.467	IO	0.99
86.917	0.00	0.22	0.466	IO	0.98
87.000	0.00	0.22	0.464	IO	0.98
87.083	0.00	0.22	0.463	IO	0.98
87.167	0.00	0.22	0.461	IO	0.97
87.250	0.00	0.22	0.460	IO	0.97
87.333	0.00	0.22	0.458	IO	0.97
87.417	0.00	0.22	0.457	IO	0.96
87.500	0.00	0.22	0.455	IO	0.96

87.583	0.00	0.22	0.454	IO	0.96
87.667	0.00	0.21	0.452	IO	0.95
87.750	0.00	0.21	0.451	IO	0.95
87.833	0.00	0.21	0.449	IO	0.95
87.917	0.00	0.21	0.448	IO	0.94
88.000	0.00	0.21	0.446	IO	0.94
88.083	0.00	0.21	0.445	IO	0.94
88.167	0.00	0.21	0.443	IO	0.94
88.250	0.00	0.21	0.442	IO	0.93
88.333	0.00	0.21	0.441	IO	0.93
88.417	0.00	0.21	0.439	IO	0.93
88.500	0.00	0.21	0.438	IO	0.92
88.583	0.00	0.21	0.436	IO	0.92
88.667	0.00	0.21	0.435	IO	0.92
88.750	0.00	0.21	0.433	IO	0.91
88.833	0.00	0.21	0.432	IO	0.91
88.917	0.00	0.20	0.431	IO	0.91
89.000	0.00	0.20	0.429	IO	0.91
89.083	0.00	0.20	0.428	IO	0.90
89.167	0.00	0.20	0.426	IO	0.90
89.250	0.00	0.20	0.425	IO	0.90
89.333	0.00	0.20	0.424	IO	0.89
89.417	0.00	0.20	0.422	IO	0.89
89.500	0.00	0.20	0.421	IO	0.89
89.583	0.00	0.20	0.419	O	0.88
89.667	0.00	0.20	0.418	O	0.88
89.750	0.00	0.20	0.417	O	0.88
89.833	0.00	0.20	0.415	O	0.88
89.917	0.00	0.20	0.414	O	0.87
90.000	0.00	0.20	0.413	O	0.87
90.083	0.00	0.20	0.411	O	0.87
90.167	0.00	0.19	0.410	O	0.86
90.250	0.00	0.19	0.409	O	0.86
90.333	0.00	0.19	0.407	O	0.86
90.417	0.00	0.19	0.406	O	0.86
90.500	0.00	0.19	0.405	O	0.85
90.583	0.00	0.19	0.403	O	0.85
90.667	0.00	0.19	0.402	O	0.85
90.750	0.00	0.19	0.401	O	0.85
90.833	0.00	0.19	0.399	O	0.84
90.917	0.00	0.19	0.398	O	0.84
91.000	0.00	0.19	0.397	O	0.84
91.083	0.00	0.19	0.395	O	0.83
91.167	0.00	0.19	0.394	O	0.83
91.250	0.00	0.19	0.393	O	0.83
91.333	0.00	0.19	0.392	O	0.83
91.417	0.00	0.19	0.390	O	0.82
91.500	0.00	0.18	0.389	O	0.82
91.583	0.00	0.18	0.388	O	0.82
91.667	0.00	0.18	0.387	O	0.82
91.750	0.00	0.18	0.385	O	0.81
91.833	0.00	0.18	0.384	O	0.81
91.917	0.00	0.18	0.383	O	0.81
92.000	0.00	0.18	0.382	O	0.80
92.083	0.00	0.18	0.380	O	0.80
92.167	0.00	0.18	0.379	O	0.80
92.250	0.00	0.18	0.378	O	0.80
92.333	0.00	0.18	0.377	O	0.79
92.417	0.00	0.18	0.375	O	0.79
92.500	0.00	0.18	0.374	O	0.79
92.583	0.00	0.18	0.373	O	0.79
92.667	0.00	0.18	0.372	O	0.78
92.750	0.00	0.18	0.370	O	0.78
92.833	0.00	0.18	0.369	O	0.78
92.917	0.00	0.17	0.368	O	0.78
93.000	0.00	0.17	0.367	O	0.77
93.083	0.00	0.17	0.366	O	0.77
93.167	0.00	0.17	0.364	O	0.77
93.250	0.00	0.17	0.363	O	0.77
93.333	0.00	0.17	0.362	O	0.76
93.417	0.00	0.17	0.361	O	0.76
93.500	0.00	0.17	0.360	O	0.76
93.583	0.00	0.17	0.359	O	0.76
93.667	0.00	0.17	0.357	O	0.75
93.750	0.00	0.17	0.356	O	0.75
93.833	0.00	0.17	0.355	O	0.75
93.917	0.00	0.17	0.354	O	0.75
94.000	0.00	0.17	0.353	O	0.74
94.083	0.00	0.17	0.352	O	0.74
94.167	0.00	0.17	0.350	O	0.74
94.250	0.00	0.17	0.349	O	0.74
94.333	0.00	0.17	0.348	O	0.73
94.417	0.00	0.16	0.347	O	0.73
94.500	0.00	0.16	0.346	O	0.73
94.583	0.00	0.16	0.345	O	0.73
94.667	0.00	0.16	0.344	O	0.72

94.750	0.00	0.16	0.343	0	0.72
94.833	0.00	0.16	0.341	0	0.72
94.917	0.00	0.16	0.340	0	0.72
95.000	0.00	0.16	0.339	0	0.72
95.083	0.00	0.16	0.338	0	0.71
95.167	0.00	0.16	0.337	0	0.71
95.250	0.00	0.16	0.336	0	0.71
95.333	0.00	0.16	0.335	0	0.71
95.417	0.00	0.16	0.334	0	0.70
95.500	0.00	0.16	0.333	0	0.70
95.583	0.00	0.16	0.331	0	0.70
95.667	0.00	0.16	0.330	0	0.70
95.750	0.00	0.16	0.329	0	0.69
95.833	0.00	0.16	0.328	0	0.69
95.917	0.00	0.16	0.327	0	0.69
96.000	0.00	0.15	0.326	0	0.69
96.083	0.00	0.15	0.325	0	0.69
96.167	0.00	0.15	0.324	0	0.68
96.250	0.00	0.15	0.323	0	0.68
96.333	0.00	0.15	0.322	0	0.68
96.417	0.00	0.15	0.321	0	0.68
96.500	0.00	0.15	0.320	0	0.67
96.583	0.00	0.15	0.319	0	0.67
96.667	0.00	0.15	0.318	0	0.67
96.750	0.00	0.15	0.317	0	0.67
96.833	0.00	0.15	0.316	0	0.67
96.917	0.00	0.15	0.315	0	0.66
97.000	0.00	0.15	0.314	0	0.66
97.083	0.00	0.15	0.313	0	0.66
97.167	0.00	0.15	0.312	0	0.66
97.250	0.00	0.15	0.311	0	0.66
97.333	0.00	0.15	0.309	0	0.65
97.417	0.00	0.15	0.308	0	0.65
97.500	0.00	0.15	0.307	0	0.65
97.583	0.00	0.15	0.306	0	0.65
97.667	0.00	0.15	0.305	0	0.64
97.750	0.00	0.14	0.304	0	0.64
97.833	0.00	0.14	0.303	0	0.64
97.917	0.00	0.14	0.302	0	0.64
98.000	0.00	0.14	0.302	0	0.64
98.083	0.00	0.14	0.301	0	0.63
98.167	0.00	0.14	0.300	0	0.63
98.250	0.00	0.14	0.299	0	0.63
98.333	0.00	0.14	0.298	0	0.63
98.417	0.00	0.14	0.297	0	0.63
98.500	0.00	0.14	0.296	0	0.62
98.583	0.00	0.14	0.295	0	0.62
98.667	0.00	0.14	0.294	0	0.62
98.750	0.00	0.14	0.293	0	0.62
98.833	0.00	0.14	0.292	0	0.62
98.917	0.00	0.14	0.291	0	0.61
99.000	0.00	0.14	0.290	0	0.61
99.083	0.00	0.14	0.289	0	0.61
99.167	0.00	0.14	0.288	0	0.61
99.250	0.00	0.14	0.287	0	0.61
99.333	0.00	0.14	0.286	0	0.60
99.417	0.00	0.14	0.285	0	0.60
99.500	0.00	0.13	0.284	0	0.60
99.583	0.00	0.13	0.283	0	0.60
99.667	0.00	0.13	0.282	0	0.60
99.750	0.00	0.13	0.282	0	0.59
99.833	0.00	0.13	0.281	0	0.59
99.917	0.00	0.13	0.280	0	0.59
100.000	0.00	0.13	0.279	0	0.59
100.083	0.00	0.13	0.278	0	0.59
100.167	0.00	0.13	0.277	0	0.58
100.250	0.00	0.13	0.276	0	0.58
100.333	0.00	0.13	0.275	0	0.58
100.417	0.00	0.13	0.274	0	0.58
100.500	0.00	0.13	0.273	0	0.58
100.583	0.00	0.13	0.272	0	0.57
100.667	0.00	0.13	0.272	0	0.57
100.750	0.00	0.13	0.271	0	0.57
100.833	0.00	0.13	0.270	0	0.57
100.917	0.00	0.13	0.269	0	0.57
101.000	0.00	0.13	0.268	0	0.57
101.083	0.00	0.13	0.267	0	0.56
101.167	0.00	0.13	0.266	0	0.56
101.250	0.00	0.13	0.265	0	0.56
101.333	0.00	0.13	0.265	0	0.56
101.417	0.00	0.13	0.264	0	0.56
101.500	0.00	0.12	0.263	0	0.55
101.583	0.00	0.12	0.262	0	0.55
101.667	0.00	0.12	0.261	0	0.55
101.750	0.00	0.12	0.260	0	0.55
101.833	0.00	0.12	0.259	0	0.55

101.917	0.00	0.12	0.259	0					0.55
102.000	0.00	0.12	0.258	0					0.54
102.083	0.00	0.12	0.257	0					0.54
102.167	0.00	0.12	0.256	0					0.54
102.250	0.00	0.12	0.255	0					0.54
102.333	0.00	0.12	0.254	0					0.54
102.417	0.00	0.12	0.254	0					0.53
102.500	0.00	0.12	0.253	0					0.53
102.583	0.00	0.12	0.252	0					0.53
102.667	0.00	0.12	0.251	0					0.53
102.750	0.00	0.12	0.250	0					0.53
102.833	0.00	0.12	0.249	0					0.53
102.917	0.00	0.12	0.249	0					0.52
103.000	0.00	0.12	0.248	0					0.52
103.083	0.00	0.12	0.247	0					0.52
103.167	0.00	0.12	0.246	0					0.52
103.250	0.00	0.12	0.245	0					0.52
103.333	0.00	0.12	0.245	0					0.52
103.417	0.00	0.12	0.244	0					0.51
103.500	0.00	0.12	0.243	0					0.51
103.583	0.00	0.11	0.242	0					0.51
103.667	0.00	0.11	0.241	0					0.51
103.750	0.00	0.11	0.241	0					0.51
103.833	0.00	0.11	0.240	0					0.51
103.917	0.00	0.11	0.239	0					0.50
104.000	0.00	0.11	0.238	0					0.50
104.083	0.00	0.11	0.237	0					0.50
104.167	0.00	0.11	0.237	0					0.50
104.250	0.00	0.11	0.236	0					0.50
104.333	0.00	0.11	0.235	0					0.50
104.417	0.00	0.11	0.234	0					0.49
104.500	0.00	0.11	0.234	0					0.49
104.583	0.00	0.11	0.233	0					0.49
104.667	0.00	0.11	0.232	0					0.49
104.750	0.00	0.11	0.231	0					0.49
104.833	0.00	0.11	0.231	0					0.49
104.917	0.00	0.11	0.230	0					0.48
105.000	0.00	0.11	0.229	0					0.48
105.083	0.00	0.11	0.228	0					0.48
105.167	0.00	0.11	0.228	0					0.48
105.250	0.00	0.11	0.227	0					0.48
105.333	0.00	0.11	0.226	0					0.48
105.417	0.00	0.11	0.225	0					0.48
105.500	0.00	0.11	0.225	0					0.47
105.583	0.00	0.11	0.224	0					0.47
105.667	0.00	0.11	0.223	0					0.47
105.750	0.00	0.11	0.222	0					0.47
105.833	0.00	0.11	0.222	0					0.47
105.917	0.00	0.10	0.221	0					0.47
106.000	0.00	0.10	0.220	0					0.46
106.083	0.00	0.10	0.220	0					0.46
106.167	0.00	0.10	0.219	0					0.46
106.250	0.00	0.10	0.218	0					0.46
106.333	0.00	0.10	0.217	0					0.46
106.417	0.00	0.10	0.217	0					0.46
106.500	0.00	0.10	0.216	0					0.46
106.583	0.00	0.10	0.215	0					0.45
106.667	0.00	0.10	0.215	0					0.45
106.750	0.00	0.10	0.214	0					0.45
106.833	0.00	0.10	0.213	0					0.45
106.917	0.00	0.10	0.213	0					0.45
107.000	0.00	0.10	0.212	0					0.45
107.083	0.00	0.10	0.211	0					0.45
107.167	0.00	0.10	0.210	0					0.44

Remaining water in basin = 0.21 (Ac.Ft)

\*\*\*\*\*HYDROGRAPH DATA\*\*\*\*\*  
Number of intervals = 1286  
Time interval = 5.0 (Min.)  
Maximum/Peak flow rate = 1.596 (CFS)  
Total volume = 3.675 (Ac.Ft)  
Status of hydrographs being held in storage  
Stream 1 Stream 2 Stream 3 Stream 4 Stream 5  
Peak (CFS) 0.000 0.000 0.000 0.000 0.000  
Vol (Ac.Ft) 0.000 0.000 0.000 0.000 0.000  
\*\*\*\*\*

Section 7.9 – Basin 3 – Routed 2 Year- 24 Hour Hydrograph

# Basin 3 Size and Flow Calculations

## BASIN 3

Horiz. : Vert.

4 : 1 = Basin Side Slope

Basin Elevation	BASIN PARAMETERS					OUTLET									
	Depth	Area S.F.	Volume C.F.	Volume AC-FT	Effective Volume AC-FT	Q1 Orifice Plate (cfs)	Q2 Orifice Plate (cfs)	Q3 Orifice Plate (cfs)	Q4 Orifice Plate (cfs)	Q5 Orifice Plate (cfs)	Q6 Orifice Plate (cfs)	Q7 Orifice Plate (cfs)	Q Weir 1 (cfs)	Q Total (cfs)	
1266.00	0.00	12,107.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
1267.00	1.00	14,361.00	13,234.00	0.304	0.304	0.072	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072	
1268.00	2.00	17,657.00	29,764.00	0.683	0.683	0.110	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.361	
1268.50	2.50	18,942.50	38,913.88	0.893	0.893	0.125	0.000	0.354	0.000	0.000	0.000	0.000	16.971	17.450	
1269.00	3.00	20,228.00	48,706.50	1.118	1.118	0.138	0.000	0.433	0.000	0.000	0.000	0.000	48.000	48.572	

### SUPPORTING DESIGN PARAMETERS

Orifice Coefficient	0.66	Dia of Orifice	1.70	3.50										
Gravimetric Constant	32.2 ft/s <sup>2</sup>	Eff Dia of Orifice	0.1417	0.0000	0.2917	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
Number of Rows		Area of Orifice	0.0158	0.0000	0.0668	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000			
Minimum Orifice Plate Height		Number of Orifices	1	1	1	1	1	1	1	1				
Minimum Orifice Plate Width		Elev	1266.25	1267.5										
		Weir												
		Sharp Crest Weir Coefficient											4	
		Length of Weir											12.00	
		Elev. at Crest of Weir											1268	

Q100 Elevation Weir Calc	
Basin 3 Weir Calc	
Crest Wier Elev.	1268.00
Q100	26.48 cfs
Weir Length	12
Weir Coeff.	4
H Weir	0.67264
<b>Q100 Elevation</b>	<b>1268.67</b>

Program License Serial Number 5006

\*\*\*\*\* HYDROGRAPH INFORMATION \*\*\*\*\*

From study/file name: PRO32242.rte  
 \*\*\*\*\*HYDROGRAPH DATA\*\*\*\*\*  
 Number of intervals = 293  
 Time interval = 5.0 (Min.)  
 Maximum/Peak flow rate = 0.961 (CFS)  
 Total volume = 0.584 (Ac.Ft)  
 Status of hydrographs being held in storage  
 Stream 1 Stream 2 Stream 3 Stream 4 Stream 5  
 Peak (CFS) 0.000 0.000 0.000 0.000 0.000  
 Vol (Ac.Ft) 0.000 0.000 0.000 0.000 0.000  
 \*\*\*\*\*

+++++  
 Process from Point/Station 1.000 to Point/Station 2.000  
 \*\*\*\* RETARDING BASIN ROUTING \*\*\*\*

User entry of depth-outflow-storage data

Total number of inflow hydrograph intervals = 293  
 Hydrograph time unit = 5.000 (Min.)  
 Initial depth in storage basin = 0.00(Ft.)

Initial basin depth = 0.00 (Ft.)  
 Initial basin storage = 0.00 (Ac.Ft)  
 Initial basin outflow = 0.00 (CFS)

Depth vs. Storage and Depth vs. Discharge data:

Basin Depth (Ft.)	Storage (Ac.Ft)	Outflow (CFS)	(S-O*dt/2) (Ac.Ft)	(S+O*dt/2) (Ac.Ft)
0.000	0.000	0.000	0.000	0.000
1.000	0.304	0.072	0.304	0.304
2.000	0.683	0.361	0.682	0.684
2.500	0.893	17.450	0.833	0.953
3.000	1.118	48.572	0.951	1.285

Hydrograph Detention Basin Routing

Graph values: 'I'= unit inflow; 'O'=outflow at time shown

Time (Hours)	Inflow (CFS)	Outflow (CFS)	Storage (Ac.Ft)	.0	0.2	0.48	0.72	0.96	Depth (Ft.)
0.083	0.02	0.00	0.000	O					0.00
0.167	0.05	0.00	0.000	O I					0.00
0.250	0.05	0.00	0.001	O I					0.00
0.333	0.06	0.00	0.001	O I					0.00
0.417	0.08	0.00	0.002	O I					0.01
0.500	0.08	0.00	0.002	O I					0.01
0.583	0.08	0.00	0.003	O I					0.01
0.667	0.08	0.00	0.003	O I					0.01
0.750	0.08	0.00	0.004	O I					0.01
0.833	0.09	0.00	0.004	O I					0.01
0.917	0.11	0.00	0.005	O I					0.02
1.000	0.11	0.00	0.006	O I					0.02
1.083	0.10	0.00	0.007	O I					0.02
1.167	0.09	0.00	0.007	O I					0.02
1.250	0.09	0.00	0.008	O I					0.03
1.333	0.09	0.00	0.008	O I					0.03
1.417	0.09	0.00	0.009	O I					0.03
1.500	0.08	0.00	0.010	O I					0.03
1.583	0.08	0.00	0.010	O I					0.03
1.667	0.08	0.00	0.011	O I					0.04
1.750	0.08	0.00	0.011	O I					0.04
1.833	0.09	0.00	0.012	O I					0.04
1.917	0.11	0.00	0.013	O I					0.04
2.000	0.11	0.00	0.013	O I					0.04
2.083	0.11	0.00	0.014	O I					0.05
2.167	0.11	0.00	0.015	O I					0.05

2.250	0.11	0.00	0.016	0	I					0.05
2.333	0.11	0.00	0.016	0	I					0.05
2.417	0.11	0.00	0.017	0	I					0.06
2.500	0.11	0.00	0.018	0	I					0.06
2.583	0.12	0.00	0.019	0	I					0.06
2.667	0.14	0.00	0.019	0	I					0.06
2.750	0.14	0.00	0.020	0	I					0.07
2.833	0.14	0.01	0.021	0	I					0.07
2.917	0.14	0.01	0.022	0	I					0.07
3.000	0.14	0.01	0.023	0	I					0.08
3.083	0.14	0.01	0.024	0	I					0.08
3.167	0.14	0.01	0.025	0	I					0.08
3.250	0.14	0.01	0.026	0	I					0.09
3.333	0.14	0.01	0.027	0	I					0.09
3.417	0.14	0.01	0.028	0	I					0.09
3.500	0.14	0.01	0.029	0	I					0.09
3.583	0.14	0.01	0.030	0	I					0.10
3.667	0.14	0.01	0.031	0	I					0.10
3.750	0.14	0.01	0.031	0	I					0.10
3.833	0.15	0.01	0.032	0	I					0.11
3.917	0.16	0.01	0.033	0	I					0.11
4.000	0.17	0.01	0.035	0	I					0.11
4.083	0.17	0.01	0.036	0	I					0.12
4.167	0.17	0.01	0.037	0	I					0.12
4.250	0.17	0.01	0.038	0	I					0.12
4.333	0.18	0.01	0.039	0	I					0.13
4.417	0.19	0.01	0.040	0	I					0.13
4.500	0.20	0.01	0.042	0	I					0.14
4.583	0.20	0.01	0.043	0	I					0.14
4.667	0.20	0.01	0.044	0	I					0.14
4.750	0.20	0.01	0.045	0	I					0.15
4.833	0.21	0.01	0.047	0	I					0.15
4.917	0.22	0.01	0.048	0	I					0.16
5.000	0.22	0.01	0.050	0	I					0.16
5.083	0.21	0.01	0.051	0	I					0.17
5.167	0.18	0.01	0.052	0	I					0.17
5.250	0.17	0.01	0.053	0	I					0.18
5.333	0.18	0.01	0.054	0	I					0.18
5.417	0.19	0.01	0.056	0	I					0.18
5.500	0.20	0.01	0.057	0	I					0.19
5.583	0.21	0.01	0.058	0	I					0.19
5.667	0.22	0.01	0.060	0	I					0.20
5.750	0.22	0.01	0.061	0	I					0.20
5.833	0.23	0.01	0.062	0	I					0.21
5.917	0.23	0.02	0.064	0	I					0.21
6.000	0.23	0.02	0.065	0	I					0.21
6.083	0.24	0.02	0.067	0	I					0.22
6.167	0.25	0.02	0.068	0	I					0.22
6.250	0.25	0.02	0.070	0	I					0.23
6.333	0.25	0.02	0.072	0	I					0.24
6.417	0.25	0.02	0.073	0	I					0.24
6.500	0.25	0.02	0.075	0	I					0.25
6.583	0.26	0.02	0.077	0	I					0.25
6.667	0.28	0.02	0.078	0	I					0.26
6.750	0.28	0.02	0.080	0	I					0.26
6.833	0.28	0.02	0.082	0	I					0.27
6.917	0.28	0.02	0.084	0	I					0.28
7.000	0.28	0.02	0.086	0	I					0.28
7.083	0.28	0.02	0.087	0	I					0.29
7.167	0.28	0.02	0.089	0	I					0.29
7.250	0.28	0.02	0.091	0	I					0.30
7.333	0.29	0.02	0.093	0	I					0.31
7.417	0.31	0.02	0.095	0	I					0.31
7.500	0.31	0.02	0.097	0	I					0.32
7.583	0.32	0.02	0.099	0	I					0.32
7.667	0.33	0.02	0.101	0	I					0.33
7.750	0.34	0.02	0.103	0	I					0.34
7.833	0.35	0.02	0.105	0	I					0.35
7.917	0.36	0.03	0.107	0	I					0.35
8.000	0.37	0.03	0.110	0	I					0.36
8.083	0.39	0.03	0.112	0	I					0.37
8.167	0.41	0.03	0.115	0	I					0.38
8.250	0.42	0.03	0.117	0	I					0.39
8.333	0.42	0.03	0.120	0	I					0.39
8.417	0.42	0.03	0.123	0	I					0.40
8.500	0.42	0.03	0.125	0	I					0.41
8.583	0.43	0.03	0.128	0	I					0.42
8.667	0.45	0.03	0.131	0	I					0.43
8.750	0.45	0.03	0.134	0	I					0.44
8.833	0.46	0.03	0.137	0	I					0.45
8.917	0.48	0.03	0.140	0	I					0.46
9.000	0.48	0.03	0.143	0	I					0.47
9.083	0.50	0.03	0.146	0	I					0.48
9.167	0.53	0.04	0.149	0	I					0.49
9.250	0.53	0.04	0.153	0	I					0.50
9.333	0.55	0.04	0.156	0	I					0.51
9.417	0.56	0.04	0.160	0	I					0.53
9.500	0.56	0.04	0.163	0	I					0.54
9.583	0.57	0.04	0.167	0	I					0.55
9.667	0.59	0.04	0.171	0	I					0.56



17.250	0.14	0.19	0.456	I	O	1.40
17.333	0.14	0.19	0.456	I	O	1.40
17.417	0.14	0.19	0.455	I	O	1.40
17.500	0.14	0.19	0.455	I	O	1.40
17.583	0.14	0.19	0.455	I	O	1.40
17.667	0.14	0.19	0.454	I	O	1.40
17.750	0.14	0.19	0.454	I	O	1.40
17.833	0.13	0.19	0.454	I	O	1.40
17.917	0.12	0.19	0.453	I	O	1.39
18.000	0.12	0.19	0.453	I	O	1.39
18.083	0.11	0.19	0.452	I	O	1.39
18.167	0.11	0.18	0.452	I	O	1.39
18.250	0.11	0.18	0.451	I	O	1.39
18.333	0.11	0.18	0.451	I	O	1.39
18.417	0.11	0.18	0.450	I	O	1.39
18.500	0.11	0.18	0.450	I	O	1.39
18.583	0.10	0.18	0.449	I	O	1.38
18.667	0.09	0.18	0.449	I	O	1.38
18.750	0.09	0.18	0.448	I	O	1.38
18.833	0.08	0.18	0.447	I	O	1.38
18.917	0.06	0.18	0.447	I	O	1.38
19.000	0.06	0.18	0.446	I	O	1.37
19.083	0.07	0.18	0.445	I	O	1.37
19.167	0.08	0.18	0.444	I	O	1.37
19.250	0.08	0.18	0.444	I	O	1.37
19.333	0.09	0.18	0.443	I	O	1.37
19.417	0.11	0.18	0.443	I	O	1.37
19.500	0.11	0.18	0.442	I	O	1.36
19.583	0.10	0.18	0.442	I	O	1.36
19.667	0.09	0.18	0.441	I	O	1.36
19.750	0.09	0.18	0.440	I	O	1.36
19.833	0.08	0.18	0.440	I	O	1.36
19.917	0.06	0.17	0.439	I	O	1.36
20.000	0.06	0.17	0.438	I	O	1.35
20.083	0.07	0.17	0.437	I	O	1.35
20.167	0.08	0.17	0.437	I	O	1.35
20.250	0.08	0.17	0.436	I	O	1.35
20.333	0.08	0.17	0.436	I	O	1.35
20.417	0.08	0.17	0.435	I	O	1.35
20.500	0.08	0.17	0.434	I	O	1.34
20.583	0.08	0.17	0.434	I	O	1.34
20.667	0.08	0.17	0.433	I	O	1.34
20.750	0.08	0.17	0.433	I	O	1.34
20.833	0.07	0.17	0.432	I	O	1.34
20.917	0.06	0.17	0.431	I	O	1.34
21.000	0.06	0.17	0.430	I	O	1.33
21.083	0.07	0.17	0.430	I	O	1.33
21.167	0.08	0.17	0.429	I	O	1.33
21.250	0.08	0.17	0.429	I	O	1.33
21.333	0.07	0.17	0.428	I	O	1.33
21.417	0.06	0.17	0.427	I	O	1.33
21.500	0.06	0.17	0.427	I	O	1.32
21.583	0.07	0.16	0.426	I	O	1.32
21.667	0.08	0.16	0.425	I	O	1.32
21.750	0.08	0.16	0.425	I	O	1.32
21.833	0.07	0.16	0.424	I	O	1.32
21.917	0.06	0.16	0.423	I	O	1.31
22.000	0.06	0.16	0.423	I	O	1.31
22.083	0.07	0.16	0.422	I	O	1.31
22.167	0.08	0.16	0.421	I	O	1.31
22.250	0.08	0.16	0.421	I	O	1.31
22.333	0.07	0.16	0.420	I	O	1.31
22.417	0.06	0.16	0.420	I	O	1.31
22.500	0.06	0.16	0.419	I	O	1.30
22.583	0.06	0.16	0.418	I	O	1.30
22.667	0.06	0.16	0.418	I	O	1.30
22.750	0.06	0.16	0.417	I	O	1.30
22.833	0.06	0.16	0.416	I	O	1.30
22.917	0.06	0.16	0.415	I	O	1.29
23.000	0.06	0.16	0.415	I	O	1.29
23.083	0.06	0.16	0.414	I	O	1.29
23.167	0.06	0.16	0.413	I	O	1.29
23.250	0.06	0.15	0.413	I	O	1.29
23.333	0.06	0.15	0.412	I	O	1.29
23.417	0.06	0.15	0.411	I	O	1.28
23.500	0.06	0.15	0.411	I	O	1.28
23.583	0.06	0.15	0.410	I	O	1.28
23.667	0.06	0.15	0.409	I	O	1.28
23.750	0.06	0.15	0.409	I	O	1.28
23.833	0.06	0.15	0.408	I	O	1.27
23.917	0.06	0.15	0.407	I	O	1.27
24.000	0.06	0.15	0.407	I	O	1.27
24.083	0.04	0.15	0.406	I	O	1.27
24.167	0.01	0.15	0.405	I	O	1.27
24.250	0.00	0.15	0.404	I	O	1.26
24.333	0.00	0.15	0.403	I	O	1.26
24.417	0.00	0.15	0.402	I	O	1.26
24.500	0.00	0.15	0.401	I	O	1.26
24.583	0.00	0.15	0.400	I	O	1.25
24.667	0.00	0.14	0.399	I	O	1.25

24.750	0.00	0.14	0.398	I	O	1.25
24.833	0.00	0.14	0.397	I	O	1.25
24.917	0.00	0.14	0.396	I	O	1.24
25.000	0.00	0.14	0.395	I	O	1.24
25.083	0.00	0.14	0.394	I	O	1.24
25.167	0.00	0.14	0.393	I	O	1.24
25.250	0.00	0.14	0.392	I	O	1.23
25.333	0.00	0.14	0.391	I	O	1.23
25.417	0.00	0.14	0.390	I	O	1.23
25.500	0.00	0.14	0.389	I	O	1.23
25.583	0.00	0.14	0.389	I	O	1.22
25.667	0.00	0.14	0.388	I	O	1.22
25.750	0.00	0.14	0.387	I	O	1.22
25.833	0.00	0.13	0.386	I	O	1.22
25.917	0.00	0.13	0.385	I	O	1.21
26.000	0.00	0.13	0.384	I	O	1.21
26.083	0.00	0.13	0.383	I	O	1.21
26.167	0.00	0.13	0.382	I	O	1.21
26.250	0.00	0.13	0.381	I	O	1.20
26.333	0.00	0.13	0.380	I	O	1.20
26.417	0.00	0.13	0.379	I	O	1.20
26.500	0.00	0.13	0.378	I	O	1.20
26.583	0.00	0.13	0.378	I	O	1.19
26.667	0.00	0.13	0.377	I	O	1.19
26.750	0.00	0.13	0.376	I	O	1.19
26.833	0.00	0.13	0.375	I	O	1.19
26.917	0.00	0.13	0.374	I	O	1.19
27.000	0.00	0.12	0.373	I	O	1.18
27.083	0.00	0.12	0.372	I	O	1.18
27.167	0.00	0.12	0.372	I	O	1.18
27.250	0.00	0.12	0.371	I	O	1.18
27.333	0.00	0.12	0.370	I	O	1.17
27.417	0.00	0.12	0.369	I	O	1.17
27.500	0.00	0.12	0.368	I	O	1.17
27.583	0.00	0.12	0.367	I	O	1.17
27.667	0.00	0.12	0.367	I	O	1.16
27.750	0.00	0.12	0.366	I	O	1.16
27.833	0.00	0.12	0.365	I	O	1.16
27.917	0.00	0.12	0.364	I	O	1.16
28.000	0.00	0.12	0.363	I	O	1.16
28.083	0.00	0.12	0.362	I	O	1.15
28.167	0.00	0.12	0.362	I	O	1.15
28.250	0.00	0.12	0.361	I	O	1.15
28.333	0.00	0.11	0.360	I	O	1.15
28.417	0.00	0.11	0.359	I	O	1.15
28.500	0.00	0.11	0.358	I	O	1.14
28.583	0.00	0.11	0.358	I	O	1.14
28.667	0.00	0.11	0.357	I	O	1.14
28.750	0.00	0.11	0.356	I	O	1.14
28.833	0.00	0.11	0.355	I	O	1.14
28.917	0.00	0.11	0.355	I	O	1.13
29.000	0.00	0.11	0.354	I	O	1.13
29.083	0.00	0.11	0.353	I	O	1.13
29.167	0.00	0.11	0.352	I	O	1.13
29.250	0.00	0.11	0.352	I	O	1.13
29.333	0.00	0.11	0.351	I	O	1.12
29.417	0.00	0.11	0.350	I	O	1.12
29.500	0.00	0.11	0.349	I	O	1.12
29.583	0.00	0.11	0.349	I	O	1.12
29.667	0.00	0.11	0.348	I	O	1.12
29.750	0.00	0.10	0.347	I	O	1.11
29.833	0.00	0.10	0.346	I	O	1.11
29.917	0.00	0.10	0.346	I	O	1.11
30.000	0.00	0.10	0.345	I	O	1.11
30.083	0.00	0.10	0.344	I	O	1.11
30.167	0.00	0.10	0.344	I	O	1.10
30.250	0.00	0.10	0.343	I	O	1.10
30.333	0.00	0.10	0.342	I	O	1.10
30.417	0.00	0.10	0.342	I	O	1.10
30.500	0.00	0.10	0.341	I	O	1.10
30.583	0.00	0.10	0.340	I	O	1.10

Remaining water in basin = 0.34 (Ac.Ft)

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*****HYDROGRAPH DATA*****
      Number of intervals = 367
      Time interval = 5.0 (Min.)
      Maximum/Peak flow rate = 0.193 (CFS)
      Total volume = 0.244 (Ac.Ft)
      Status of hydrographs being held in storage
      Stream 1 Stream 2 Stream 3 Stream 4 Stream 5
      Peak (CFS) 0.000 0.000 0.000 0.000 0.000
      Vol (Ac.Ft) 0.000 0.000 0.000 0.000 0.000
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# Appendix 8: Source Control

*Pollutant Sources/Source Control Checklist*

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

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

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
<input type="checkbox"/> A. On-site storm drain inlets	<input type="checkbox"/> Locations of inlets.	<input type="checkbox"/> 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.	<input type="checkbox"/> Maintain and periodically repaint or replace inlet markings. <input type="checkbox"/> Provide stormwater pollution prevention information to new site owners, lessees, or operators. <input type="checkbox"/> See applicable operational BMPs in Fact Sheet SC-44, “Drainage System Maintenance,” in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a> <input type="checkbox"/> 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.”
<input type="checkbox"/> B. Interior floor drains and elevator shaft sump pumps		<input type="checkbox"/> State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.	<input type="checkbox"/> Inspect and maintain drains to prevent blockages and overflow.
<input type="checkbox"/> C. Interior parking garages		<input type="checkbox"/> State that parking garage floor drains will be plumbed to the sanitary sewer.	<input type="checkbox"/> Inspect and maintain drains to prevent blockages and overflow.

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
<input type="checkbox"/> E. Pools, spas, ponds, decorative fountains, and other water features.	<input type="checkbox"/> Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. (Exception: Public pools must be plumbed according to County Department of Environmental Health Guidelines.)	If the Co-Permittee requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.	<input type="checkbox"/> See applicable operational BMPs in “Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain” at <a href="http://rcflood.org/stormwater/">http://rcflood.org/stormwater/</a>
<input type="checkbox"/> F. Food service	<input type="checkbox"/> 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.  <input type="checkbox"/> On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.	<input type="checkbox"/> Describe the location and features of the designated cleaning area.  <input type="checkbox"/> Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.	<input type="checkbox"/> See the brochure, “The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries” at <a href="http://rcflood.org/stormwater/">http://rcflood.org/stormwater/</a>  <b>Provide this brochure to new site owners, lessees, and operators.</b>
<input type="checkbox"/> G. Refuse areas	<input type="checkbox"/> 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.  <input type="checkbox"/> 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.  <input type="checkbox"/> Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.	<input type="checkbox"/> State how site refuse will be handled and provide supporting detail to what is shown on plans.  <input type="checkbox"/> State that signs will be posted on or near dumpsters with the words “Do not dump hazardous materials here” or similar.	<input type="checkbox"/> State how the following will be implemented:  <b>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 <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a></b>

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
<input type="checkbox"/> H. Industrial processes.	<input type="checkbox"/> Show process area.	<input type="checkbox"/> 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.”	<input type="checkbox"/> See Fact Sheet SC-10, “Non-Stormwater Discharges” in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a>  See the brochure “Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities” at <a href="http://rcflood.org/stormwater/">http://rcflood.org/stormwater/</a>

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
<p><input type="checkbox"/> I. Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)</p>	<p><input type="checkbox"/> 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.</p> <p><input type="checkbox"/> 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.</p> <p><input type="checkbox"/> 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.</p>	<p>Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains.</p> <p>Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for:</p> <ul style="list-style-type: none"> <li>▪ Hazardous Waste Generation</li> <li>▪ Hazardous Materials Release Response and Inventory</li> <li>▪ California Accidental Release (CalARP)</li> <li>▪ Aboveground Storage Tank</li> <li>▪ Uniform Fire Code Article 80 Section 103(b) &amp; (c) 1991</li> <li>▪ Underground Storage Tank</li> </ul> <p><a href="http://www.cchealth.org/groups/hazmat/">www.cchealth.org/groups/hazmat/</a></p>	<p><input type="checkbox"/> 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 <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a></p>

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
<p><input type="checkbox"/> <b>J. Vehicle and Equipment Cleaning</b></p>	<p><input type="checkbox"/> <b>Show on drawings as appropriate:</b></p> <p>(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.</p> <p>(2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use).</p> <p>(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.</p> <p>(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.</p>	<p><input type="checkbox"/> <b>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.</b></p>	<p><b>Describe operational measures to implement the following (if applicable):</b></p> <p><input type="checkbox"/> <b>Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system.</b> 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 <a href="http://rcflood.org/stormwater/">http://rcflood.org/stormwater/</a></p> <p><input type="checkbox"/> <b>Car dealerships and similar may rinse cars with water only.</b></p>

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
<ul style="list-style-type: none"> <li><input type="checkbox"/> <b>K. Vehicle/Equipment Repair and Maintenance</b></li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> 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.</li> <li><input type="checkbox"/> 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.</li> <li><input type="checkbox"/> 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.</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area.</li> <li><input type="checkbox"/> 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.</li> <li><input type="checkbox"/> 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.</li> </ul>	<p>In the Stormwater Control Plan, note that all of the following restrictions apply to use the site:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> 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.</li> <li><input type="checkbox"/> 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.</li> <li><input type="checkbox"/> 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.</li> </ul> <p>Refer to "Automotive Maintenance &amp; 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 <a href="http://rcflood.org/stormwater/">http://rcflood.org/stormwater/</a></p> <p>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 <a href="http://rcflood.org/stormwater/">http://rcflood.org/stormwater/</a></p>

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
<input type="checkbox"/> L. Fuel Dispensing Areas	<input type="checkbox"/> Fueling areas <sup>6</sup> 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.  <input type="checkbox"/> Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area <sup>1</sup> .] The canopy [or cover] shall not drain onto the fueling area.		<input type="checkbox"/> The property owner shall dry sweep the fueling area routinely. <input type="checkbox"/> See the Fact Sheet SD-30 , “Fueling Areas” in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a>

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<sup>6</sup> 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.

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
<input type="checkbox"/> M. Loading Docks	<input type="checkbox"/> 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.  <input type="checkbox"/> 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.  <input type="checkbox"/> Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.		<input type="checkbox"/> Move loaded and unloaded items indoors as soon as possible.  <input type="checkbox"/> See Fact Sheet SC-30, “Outdoor Loading and Unloading,” in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a>

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
<input type="checkbox"/> P. Plazas, sidewalks, and parking lots.			<input type="checkbox"/> 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 Maintenance and Recording Mechanisms*

## Operations & Maintenance Responsibility for Treatment Control BMP's

BMP Required Maintenance	Frequency	Maintenance Requirements	Responsibility
Roof Drains/ Gutters	Before wet season, or significant rain event, or when needed	<ul style="list-style-type: none"> <li>• Roof Gutters shall be visually inspected for defects and possible leakage. Damage or defects found shall be corrected as soon as possible.</li> <li>• Owners should avoid use of gutters, roofing, and trim made of copper so as to prevent the metal from leaching into runoff.</li> </ul>	Property Owner
Landscaping	Weekly	<ul style="list-style-type: none"> <li>• Maintain Landscaping using minimum or no pesticides</li> </ul>	HOA
Sidewalks	As needed	<ul style="list-style-type: none"> <li>• Sweep sidewalks 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.</li> </ul>	HOA
Extended Detention Basin	As needed	<ul style="list-style-type: none"> <li>• Maintain vegetation as needed without fertilizers</li> <li>• Care should be taken to avoid contact with the low-flow or other trenches, and the media filter in the bottom stage</li> <li>• Any product used should be applied in accordance with their labeling, especially in relation to application to water, and in areas subjected to flooding</li> <li>• No ponded water should be present for more than 72 hours to avoid nuisance or vector problems. No algae formation should be visible. Correct problems as needed.</li> </ul>	HOA
	<p>Annually, if possible schedule these inspections before the beginning of rain season.</p> <p>Every 5 years (or when observed)</p>	<ul style="list-style-type: none"> <li>• Remove debris and litter from the entire basin.</li> <li>• Inspect hydraulic and structural facilities. Examine the outlet of clogging, the embankment and spillway integrity, as well as damage to any structural element.</li> <li>• Check for erosion, slumping and overgrowth. Repair as needed.</li> <li>• Inspect sand media at the filter drain to verify it is allowing acceptable infiltration.</li> <li>• Scarify top 3 inches by raking the filter drain's sand surface annually.</li> <li>• Check the media filter underdrains (via the cleanout) for damage or clogging. Repair as needed.</li> <li>• Removed accumulated sediment and debris from the forebay, and ensure that the notch weir is clear and will allow proper drainage.</li> <li>• Check gravel filled low flow and collector trenches for sediment buildup and repair as needed.</li> <li>• Remove the top 3 inches of sand from the filter drain and backfill with 3 inches of new sand to return the sand layer to its original depth.</li> </ul>	

## Water Quality Management Plan (WQMP)

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	drain times are less than 72 hours.)	<ul style="list-style-type: none"><li>• When scarification or removal of the top 3 inches of sand is no longer effective, remove and replace sand filter layer.</li></ul>	
	Whenever substantial sediment accumulation has occurred.	<ul style="list-style-type: none"><li>• Remove accumulated sediment from the bottom of the basin. Removal should extend to the original basin depth.</li></ul>	

BMP's should start and be inspected prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.

### **Funding**

*Funding for Ongoing Maintenance will be provided by the Property Owner and HOA.*

*Mitch Adkison – Managing Member*

*6879 Airport Drive*

*Riverside, CA 92504*

*Tel: (951) 688-0241*

### **Acceptance of Responsibility**

*Property Owner accepts responsibility of said BMP's for maintenance and operation, as listed herein, from the time BMPs are constructed and accepted until the responsibility is legally transferred.*



# Appendix 10: Educational Materials

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

**Affidavit for NPDES Education**

**After the Storm (RCFC&WCD Handout)**

**Outdoor Cleaning Activities (RCFC & WCD Handout)**

**Guidelines for Maintaining Pools (RCFC & WCD Handout)**

**10 Ways to Save Water Outdoors (RCFC& WCD Handout)**

## **CASQA GUIDELINES**

**SD-10 - Site Design & Landscape Planning**

**SD-11 – Roof Runoff Controls**

**SD-12 – Efficient Irrigation**

**SD-13 – Storm Drain Signage**

**TC-22 Extended Detention Basin**

**TC-32 - Bioretention**

WARREN D. WILLIAMS  
General Manager-Chief Engineer



1995 MARKET STREET  
RIVERSIDE, CA 92501  
951.955.1200  
951.788.9965 FAX

RIVERSIDE COUNTY FLOOD CONTROL  
AND WATER CONSERVATION DISTRICT

**Affidavit to provide Riverside County National Pollutant Discharge Elimination System (NPDES) Public Education Materials to Prospective Property Owners within Commercial/Residential Developments**

The property owner or developer of the proposed project must, on company letterhead, complete and return a notarized original copy of this affidavit directly, by mail or with your plan check submittal to the address shown below. The affidavit states that the distribution of educational materials to the tenants is assured prior to the issuance of occupancy permits. **Do not place the original affidavit into the Water Quality Management Report (WQMP).** Upon receipt, the Riverside County Flood Control and Water Conservation District (Plan Check Section) will date stamp, file and remove the appropriate "Flood RI BMP\_Education" Condition of Approval for the development project identified prior to occupancy or final building inspection.

**Placing a copy of the affidavit in the WQMP without submitting the original will not guarantee clearance of the condition.**

Development Review/Plan Check Section  
Riverside County Flood Control  
and Water Conservation District  
1995 Market Street  
Riverside, CA 92501

Tract # \_\_\_\_\_ Tract Name: \_\_\_\_\_  
Developer: \_\_\_\_\_  
Engineer: \_\_\_\_\_

Residential Units (gross number): \_\_\_\_\_

Commercial Units (gross number): \_\_\_\_\_

Watershed Location (Place a check box by the appropriate watershed and circle appropriate community):

\_\_\_ **Santa Ana:** Alberhill, Arnold Heights, Belltown, Beaumont, Calimesa, Canyon Lake, Cherry Valley, Eastvale, El Cariso, El Cerrito, Glen Avon, Glen Ivy Hot Springs, Glen Valley, Green Acres, Good Hope, Highgrove, Home Gardens, Homeland, Idyllwild, Juniper Flats, Jurupa Valley, Lake Elsinore, Lakeland Village, Lakeview, Mead Valley, Menifee, Mira Loma, Moreno Valley, Mountain Center, Nuevo, Norco, Pedley, Perris, Pine Cove, Quail Valley, Romoland, Rubidoux, San Jacinto, Sedco Hills, Sun City, Sunnyslope, Winchester, Wood Crest,  
Other: \_\_\_\_\_.

\_\_\_ **Whitewater:** Banning, Bermuda Dunes, Cabazon, Cathedral City, Coachella, Desert Haven, Desert Hot Springs, Indian Wells, Indio, Indio Hills, La Quinta, North Palm Springs, Palm Desert, Palm Springs, Rancho Mirage, San Gorgonio, Sky Valley, Thousand Palms, Thermal, Whitewater, Other \_\_\_\_\_.

\_\_\_ **Santa Margarita:** Aguanga, Anza, Murrieta, Temecula, French Valley, Wildomar,  
Other \_\_\_\_\_.

I certify that my staff has obtained the appropriate number of required National Pollutant Discharge Elimination System (NPDES) homeowner and/or business owner education materials for the above referenced development from the:

\_\_\_ Public Information Specialist, Riverside County Flood Control District, by contacting 1.800.506.2555 or by e-mailing a request to [FLOOD.fcnpdes@rcflood.org](mailto:FLOOD.fcnpdes@rcflood.org).

These materials will be distributed to each homeowner/business owner or successor in interest within the development prior to move in, occupancy or transfer of property, as appropriate.

Signature: \_\_\_\_\_

Title: \_\_\_\_\_ Date: \_\_\_\_\_

# Appendix 10: Educational Materials

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

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**SD-13 – Storm Drain Signage**

**TC-22 Extended Detention Basin**

**TC-32 - Bioretention**



# A Citizen's Guide to Understanding Stormwater



United States Environmental Protection Agency  
**EPA**

EPA 833-B-03-002

January 2003

Internet Address (URL) • HTTP://www.epa.gov  
Oil Based Inks on 100% Postconsumer  
Recycled Paper • Printed with Vegetable  
Process Chlorine Free Recycled Paper



## After the Storm

For more information contact:  
[www.epa.gov/nps/stormwater](http://www.epa.gov/nps/stormwater)  
or visit  
[www.epa.gov/nps](http://www.epa.gov/nps)



### What is stormwater runoff?

Stormwater runoff occurs when precipitation from rain or snowmelt flows over the ground. Impervious surfaces like driveways, sidewalks, and streets prevent stormwater from naturally soaking into the ground.



### Why is stormwater runoff a problem?

Stormwater can pick up debris, chemicals, dirt, and other pollutants and flow into a storm sewer system or directly to a lake, stream, river, wetland, or coastal water. Anything that enters a storm sewer system is discharged untreated into the waterbodies we use for swimming, fishing, and providing drinking water.



### The effects of pollution

Polluted stormwater runoff can have many adverse effects on plants, fish, animals, and people.

- ◆ Sediment can cloud the water and make it difficult or impossible for aquatic plants to grow. Sediment also can destroy aquatic habitats.
- ◆ Excess nutrients can cause algae blooms. When algae die, they sink to the bottom and decompose in a process that removes oxygen from the water. Fish and other aquatic organisms can't exist in water with low dissolved oxygen levels.
- ◆ Bacteria and other pathogens can wash into swimming areas and create health hazards, often making beach closures necessary.
- ◆ Debris—plastic bags, six-pack rings, bottles, and cigarette butts—washed into waterbodies can choke, suffocate, or disable aquatic life like ducks, fish, turtles, and birds.
- ◆ Household hazardous wastes like insecticides, pesticides, paint, solvents, used motor oil, and other auto fluids can poison aquatic life. Land animals and people can become sick or die from eating diseased fish and shellfish or ingesting polluted water.
- ◆ Polluted stormwater often affects drinking water sources. This, in turn, can affect human health and increase drinking water treatment costs.



# Stormwater Pollution Solutions

## Residential

Recycle or properly dispose of household products that contain chemicals, such as insecticides, pesticides, paint, solvents, and used motor oil and other auto fluids. Don't pour them onto the ground or into storm drains.

### Lawn care

Excess fertilizers and pesticides applied to lawns and gardens wash off and pollute streams. In addition, yard clippings and leaves can wash into storm drains and contribute nutrients and organic matter to streams.



- ◆ Don't overwater your lawn. Consider using a soaker hose instead of a sprinkler.
- ◆ Use pesticides and fertilizers sparingly. When use is necessary, use these chemicals in the recommended amounts. Use organic mulch or safer pest control methods whenever possible.
- ◆ Compost or mulch yard waste. Don't leave it in the street or sweep it into storm drains or streams.
- ◆ Cover piles of dirt or mulch being used in landscaping projects.

### Septic systems

Leaking and poorly maintained septic systems release nutrients and pathogens (bacteria and viruses) that can be picked up by stormwater and discharged into nearby waterbodies. Pathogens can cause public health problems and environmental concerns.



- ◆ Inspect your system every 3 years and pump your tank as necessary (every 3 to 5 years).
- ◆ Don't dispose of household hazardous waste in sinks or toilets.

### Auto care

Washing your car and degreasing auto parts at home can send detergents and other contaminants through the storm sewer system. Dumping automotive fluids into storm drains has the same result as dumping the materials directly into a waterbody.



- ◆ Use a commercial car wash that treats or recycles its wastewater, or wash your car on your yard so the water infiltrates into the ground.
- ◆ Repair leaks and dispose of used auto fluids and batteries at designated drop-off or recycling locations.

### Pet waste

Pet waste can be a major source of bacteria and excess nutrients in local waters.



- ◆ When walking your pet, remember to pick up the waste and dispose of it properly. Flushing pet waste is the best disposal method. Leaving pet waste on the ground increases public health risks by allowing harmful bacteria and nutrients to wash into the storm drain and eventually into local waterbodies.

## Residential landscaping

**Permeable Pavement**—Traditional concrete and asphalt don't allow water to soak into the ground. Instead these surfaces rely on storm drains to divert unwanted water. Permeable pavement systems allow rain and snowmelt to soak through, decreasing stormwater runoff.

**Rain Barrels**—You can collect rainwater from rooftops in mosquito-proof containers. The water can be used later on lawn or garden areas.



**Rain Gardens and Grassy Swales**—Specially designed areas planted with native plants can provide natural places for



rainwater to collect and soak into the ground. Rain from rooftop areas or paved areas can be diverted into these areas rather than into storm drains.

**Vegetated Filter Strips**—Filter strips are areas of native grass or plants created along roadways or streams. They trap the pollutants stormwater picks up as it flows across driveways and streets.

## Commercial

Dirt, oil, and debris that collect in parking lots and paved areas can be washed into the storm sewer system and eventually enter local waterbodies.

- ◆ Sweep up litter and debris from sidewalks, driveways and parking lots, especially around storm drains.
- ◆ Cover grease storage and dumpsters and keep them clean to avoid leaks.
- ◆ Report any chemical spill to the local hazardous waste cleanup team. They'll know the best way to keep spills from harming the environment.

Erosion controls that aren't maintained can cause excessive amounts of sediment and debris to be carried into the stormwater system. Construction vehicles can leak fuel, oil, and other harmful fluids that can be picked up by stormwater and deposited into local waterbodies.

- ◆ Divert stormwater away from disturbed or exposed areas of the construction site.
- ◆ Install silt fences, vehicle mud removal areas, vegetative cover, and other sediment and erosion controls and properly maintain them, especially after rainstorms.
- ◆ Prevent soil erosion by minimizing disturbed areas during construction projects, and seed and mulch bare areas as soon as possible.

## Construction



## Agriculture

Lack of vegetation on streambanks can lead to erosion. Overgrazed pastures can also contribute excessive amounts of sediment to local waterbodies. Excess fertilizers and pesticides can poison aquatic animals and lead to destructive algae blooms. Livestock in streams can contaminate waterways with bacteria, making them unsafe for human contact.

- ◆ Keep livestock away from streambanks and provide them a water source away from waterbodies.
- ◆ Store and apply manure away from waterbodies and in accordance with a nutrient management plan.
- ◆ Vegetate riparian areas along waterways.
- ◆ Rotate animal grazing to prevent soil erosion in fields.
- ◆ Apply fertilizers and pesticides according to label instructions to save money and minimize pollution.

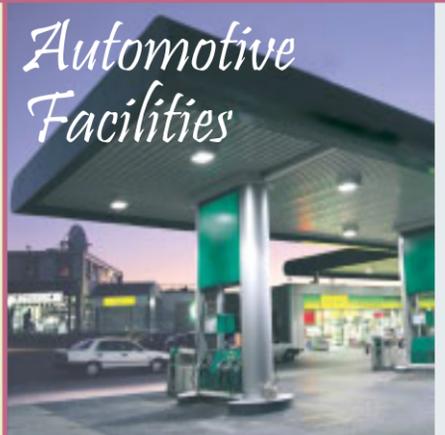


## Forestry

Improperly managed logging operations can result in erosion and sedimentation.

- ◆ Conduct preharvest planning to prevent erosion and lower costs.
- ◆ Use logging methods and equipment that minimize soil disturbance.
- ◆ Plan and design skid trails, yard areas, and truck access roads to minimize stream crossings and avoid disturbing the forest floor.
- ◆ Construct stream crossings so that they minimize erosion and physical changes to streams.
- ◆ Expedite revegetation of cleared areas.

## Automotive Facilities



Uncovered fueling stations allow spills to be washed into storm drains. Cars waiting to be repaired can leak fuel, oil, and other harmful fluids that can be picked up by stormwater.

- ◆ Clean up spills immediately and properly dispose of cleanup materials.
- ◆ Provide cover over fueling stations and design or retrofit facilities for spill containment.
- ◆ Properly maintain fleet vehicles to prevent oil, gas, and other discharges from being washed into local waterbodies.
- ◆ Install and maintain oil/water separators.



Education is essential to changing people's behavior. Signs and markers near storm drains warn residents that pollutants entering the drains will be carried untreated into a local waterbody.

## Helpful telephone numbers and links:

### Riverside County Stormwater Protection Partners

Flood Control District	(951) 955-1200
County of Riverside	(951) 955-1000
City of Banning	(951) 922-3105
City of Beaumont	(951) 769-8520
City of Calimesa	(909) 795-9801
City of Canyon Lake	(951) 244-2955
Cathedral City	(760) 770-0327
City of Coachella	(760) 398-4978
City of Corona	(951) 736-2447
City of Desert Hot Springs	(760) 329-6411
City of Eastvale	(951) 361-0900
City of Hemet	(951) 765-2300
City of Indian Wells	(760) 346-2489
City of Indio	(760) 391-4000
City of Lake Elsinore	(951) 674-3124
City of La Quinta	(760) 777-7000
City of Menifee	(951) 672-6777
City of Moreno Valley	(951) 413-3000
City of Murrieta	(951) 304-2489
City of Norco	(951) 270-5607
City of Palm Desert	(760) 346-0611
City of Palm Springs	(760) 323-8299
City of Perris	(951) 943-6100
City of Rancho Mirage	(760) 324-4511
City of Riverside	(951) 361-0900
City of San Jacinto	(951) 654-7337
City of Temecula	(951) 694-6444
City of Wildomar	(951) 677-7751

### REPORT ILLEGAL STORM DRAIN DISPOSAL

1-800-506-2555 or e-mail us at  
[fcnpdes@rcflood.org](mailto:fcnpdes@rcflood.org)

- Riverside County Flood Control and Water Conservation District  
[www.rcflood.org](http://www.rcflood.org)

#### Online resources include:

- California Storm Water Quality Association  
[www.casqa.org](http://www.casqa.org)
- State Water Resources Control Board  
[www.waterboards.ca.gov](http://www.waterboards.ca.gov)
- Power Washers of North America  
[www.thepwna.org](http://www.thepwna.org)

# Stormwater Pollution

What you should know for...

## Outdoor Cleaning Activities and Professional Mobile Service Providers



### Storm drain pollution prevention information for:

- Car Washing / Mobile Detailers
- Window and Carpet Cleaners
- Power Washers
- Waterproofers / Street Sweepers
- Equipment cleaners or degreasers and all mobile service providers

Do you know where street flows actually go?

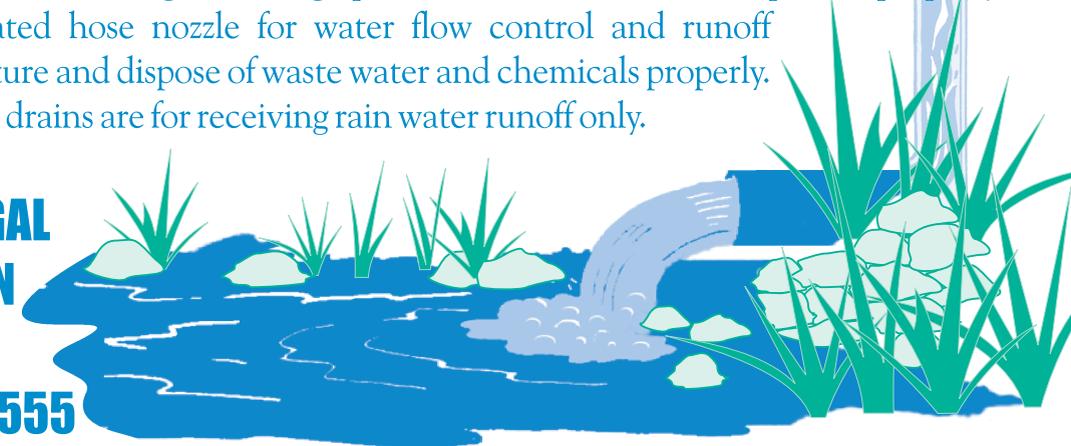
## Storm drains are NOT connected to sanitary sewer systems and treatment plants!



The primary purpose of storm drains is to carry *rain* water away from developed areas to prevent flooding. Pollutants discharged to storm drains are transported directly into rivers, lakes and streams. Soaps, degreasers, automotive fluids, litter and a host of materials are washed off buildings, sidewalks, plazas and parking areas. Vehicles and equipment must be properly managed to prevent the pollution of local waterways.

Unintentional spills by mobile service operators can flow into storm drains and pollute our waterways. **Avoid mishaps.** Always have a **Spill Response Kit** on hand to clean up unintentional spills. Only emergency **Mechanical** repairs should be done in City streets, using drip pans for spills. **Plumbing** should be done on private property. Always store chemicals in a leak-proof container and keep covered when not in use. **Window/Power Washing** waste water shouldn't be released into the streets, but should be disposed of in a sanitary sewer, landscaped area or in the soil. Soiled **Carpet Cleaning** wash water should be filtered before being discharged into the sanitary sewer. Dispose of all filter debris properly. **Car Washing/Detailing** operators should wash cars on private property and use a regulated hose nozzle for water flow control and runoff prevention. Capture and dispose of waste water and chemicals properly. Remember, storm drains are for receiving rain water runoff only.

**REPORT ILLEGAL  
STORM DRAIN  
DISPOSAL  
1-800-506-2555**



# Help Protect Our Waterways!

Use these guidelines for Outdoor Cleaning Activities and Wash Water Disposal

**D**id you know that disposing of pollutants into the street, gutter, storm drain or body of water is **PROHIBITED** by law and can result in stiff penalties?

## Best Management Practices

Waste wash water from Mechanics, Plumbers, Window/Power Washers, Carpet Cleaners, Car Washing and Mobile Detailing activities may contain significant quantities of motor oil, grease, chemicals, dirt, detergents, brake pad dust, litter and other materials.

Best Management Practices, or BMPs as they are known, are guides to prevent pollutants from entering the storm drains. *Each of us* can do our part to keep stormwater clean by using the suggested BMPs below:

## Simple solutions for both light and heavy duty jobs:

**Do...**consider dry cleaning methods first such as a mop, broom, rag or wire brush. Always keep a spill response kit on site.

**Do...**prepare the work area before power cleaning by using sand bags, rubber mats, vacuum booms, containment pads or temporary berms to keep wash water away from the gutters and storm drains.

**Do...**use vacuums or other machines to remove and collect loose debris or litter before applying water.

**Do...**obtain the property owner's permission to dispose of *small amounts* of power washing waste water on to landscaped, gravel or unpaved surfaces.

**Do...**check your local sanitary sewer agency's policies on wash water disposal regulations before disposing of wash water into the sewer. (See list on reverse side)

**Do...**be aware that if discharging to landscape areas, soapy wash water may damage landscaping. Residual wash water may remain on paved surfaces to evaporate. Sweep up solid residuals and dispose of properly. Vacuum booms are another option for capturing and collecting wash water.

**Do...**check to see if local ordinances prevent certain activities.

**Do not let...**wash or waste water from sidewalk, plaza or building cleaning go into a street or storm drain.



Report illegal storm drain disposal  
Call Toll Free  
**1-800-506-2555**

## Using Cleaning Agents

Try using biodegradable/phosphate-free products. They are easier on the environment, but don't confuse them with being toxic free. Soapy water entering the storm drain system can impact the delicate aquatic environment.



When cleaning surfaces with a *high-pressure washer* or *steam cleaner*, additional precautions should be taken to prevent the discharge of pollutants into the storm drain system. These two methods of surface cleaning can loosen additional material that can contaminate local waterways.

## Think Water Conservation

Minimize water use by using high pressure, low volume nozzles. Be sure to check all hoses for leaks. Water is a precious resource, don't let it flow freely and be sure to shut it off in between uses.

## Screening Wash Water

Conduct thorough dry cleanup before washing exterior surfaces, such as buildings and decks **with loose paint**, sidewalks or plaza areas. Keep debris from entering the storm drain after cleaning by first passing the wash water through a "20 mesh" or finer screen to catch the solid materials, then dispose of the mesh in a refuse container. Do not let the remaining wash water enter a street, gutter or storm drain.

## Drain Inlet Protection & Collection of Wash Water

- Prior to any washing, block all storm drains with an impervious barrier such as sandbags or berms, or seal the storm drain with plugs or other appropriate materials.
- Create a containment area with berms and traps or take advantage of a low spot to keep wash water contained.
- Wash vehicles and equipment on grassy or gravel areas so that the wash water can seep into the ground.
- Pump or vacuum up all wash water in the contained area.

## Concrete/Coring/Saw Cutting and Drilling Projects

Protect any down-gradient inlets by using dry activity techniques whenever possible. If water is used, minimize the amount of water used during the coring/drilling or saw cutting process. Place a barrier of sandbags and/or absorbent berms to protect the storm drain inlet or watercourse. Use a shovel or wet vacuum to remove the residue from the pavement. Do not wash residue or particulate matter into a storm drain inlet or watercourse.

# Saltwater Pools

- Salt water pools, although different from regular pools, are in fact, sanitized using chlorine. A salt-chlorine generator separates the chlorine and sodium molecules in salt and reintroduces them into the pool water. The same harmful effects of chlorine still apply.
- A salt water pool is still maintained with chemicals such as Muriatic acid, soda ash and sodium carbonate to help keep a proper pH, total Alkalinity, Calcium Hardness and Stabilizer levels.



- It may be illegal to discharge salt water to land. The salt may kill plants and the build-up of salt in soil puts animals, plants, and groundwater at risk. Consult your city representatives to determine local requirements regarding salt water drainage.

**NEVER** put unused chemicals into the trash, onto the ground or down a storm drain.

**IMPORTANT:** The discharge of pollutants into the street, gutter, storm drain system or waterways - without a permit or waiver - is strictly prohibited by local ordinances, state and federal law. Violations may result in monetary fines and enforcement actions.

# Helpful telephone numbers and links

## RIVERSIDE COUNTY WATER AGENCIES:

City of Banning.....	(951) 922-3130
City of Beaumont/Cherry Valley.....	(951) 845-9581
City of Blythe.....	(760) 922-6161
City of Coachella.....	(760) 398-3502
City of Corona.....	(951) 736-2263
City of Hemet.....	(951) 765-3710
City of Norco.....	(951) 270 5607
City of Riverside Public Works.....	(951) 351-6140
City of San Jacinto.....	(951) 654-4041
Coachella Valley Water District.....	(760) 398-2651
Desert Water Agency (Palm Springs).....	(760) 323-4971
Eastern Municipal Water District.....	(951) 928-3777
Elsinore Valley Municipal Water District.....	(951) 674 3146
Elsinore Water District.....	(951) 674-2168
Farm Mutual Water Company.....	(951) 244-4198
Idyllwild Water District.....	(951) 659-2143
Indio Water Authority.....	(760) 391-4129
Jurupa Community Services District.....	(951) 685-7434
Lee Lake Water.....	(951) 658-3241
Mission Springs Water.....	(760) 329-6448
Rancho California Water District.....	(951) 296-6900
Ripley, CSA #62.....	(760) 922-4951
Riverside Co. Service Area #51.....	(760) 227-3203
Rubidoux Community Services District.....	(951) 684-7580
Valley Sanitary District.....	(760) 347-2356
Western Municipal Water District.....	(951) 789-5000
Yucaipa Valley Water District.....	(909) 797-5117

## CALL 1-800-506-2555 to:

- Report clogged storm drains or illegal storm drain disposal from residential, industrial, construction and commercial sites into public streets, storm drains and/or water bodies.
- Find out about our various storm drain pollution prevention materials.
- Locate the dates and times of Household Hazardous Waste (HHW) Collection Events.
- Request adult, neighborhood, or classroom presentations.
- Locate other County environmental services.
- Receive grasscycling information and composting workshop information.

Or visit our

Riverside County Flood Control and Water Conservation District  
website at: [www.rcflood.org](http://www.rcflood.org)

## Other links to additional storm drain pollution information:

- County of Riverside Environmental Health: [www.rivcoeh.org](http://www.rivcoeh.org)
- State Water Resources Control Board: [www.waterboards.ca.gov](http://www.waterboards.ca.gov)
- California Stormwater Quality Association: [www.casqa.org](http://www.casqa.org)
- United States Environmental Protection Agency (EPA):  
[www.epa.gov/compliance/assistance](http://www.epa.gov/compliance/assistance) (compliance assistance information)



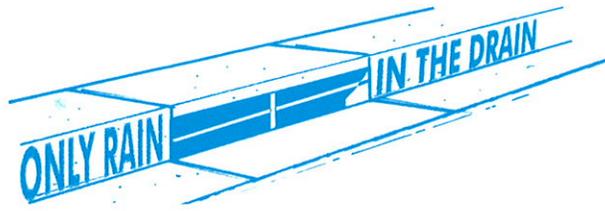
Riverside County's, "Only Rain Down the Storm Drain" Pollution Prevention Program gratefully acknowledges the Bay Area Stormwater Management Agencies Association and the Cleaning Equipment Trade Association for information provided in this brochure.

# Guidelines for Maintaining your...



# Swimming Pool, Jacuzzi and Garden Fountain

## Where does the water go?



Pool, Jacuzzi and Fountain wastewater and rain water runoff (also called stormwater) that reach streets can enter the storm drain and be conveyed directly into local streams, rivers and lakes.



A storm drain's purpose is to prevent flooding by carrying rain water away from developed areas. Storm drains are not connected to sanitary sewers systems and treatment plants!

Wastewater, from residential swimming pools, Jacuzzis, fishponds and fountains, often contains chemicals used for sanitizing or cleansing purposes. Toxic chemicals (such as chlorine or copper-based algaecides) may pollute the environment when discharged into a storm drain system.

The Cities and County of Riverside have adopted ordinances that prohibit the discharge of wastewater to the street and storm drain system.



## Discharge Regulations

Regulatory requirements for discharging wastewater from your pool may differ from city to city. Chlorinated water should not be discharged into the street, storm drain or surface waters. Check with your water agency to see if disposal to the sanitary sewer line is allowed for pool discharges (see reverse for Riverside County sewer agencies).

If allowed, a hose can be run from the pool Jacuzzi, or fountain to the private sewer cleanout, washing machine drain or a sink or bathtub.



**If you cannot discharge to the sewer**, you may drain your fountain, pool, or jacuzzi to your landscaping by following these guidelines:

**First**, reduce or eliminate solids (e.g. debris, leaves or dirt) in the pool water and allow the chemicals in the pool water to dissipate before draining the pool (this could take up to 7 days, verify using a home pool test kit).

**Second**, slowly drain to a landscaped area away from buildings or structures. Control the flow to prevent soil erosion; it may take more than one day to empty. Do not allow sediment to enter the street, gutter or storm drain.

## Maintenance & Chemicals

### Cleaning Filters

Filter rinse water and backwash must be discharged to the sanitary sewer, on-site septic tank and drain field system (if properly designed and adequately sized), or a seepage pit. Alternatively, rinse water or backwash may be diverted to landscaped or dirt areas. Filter media and other non-hazardous solids should be picked up and disposed of in the trash.



### Algaecides

Avoid using copper-based algaecides unless absolutely necessary. Control algae with chlorine, organic polymers or other alternatives to copper-based pool chemicals. Copper is a heavy metal that can be toxic to aquatic life when you drain your pool.

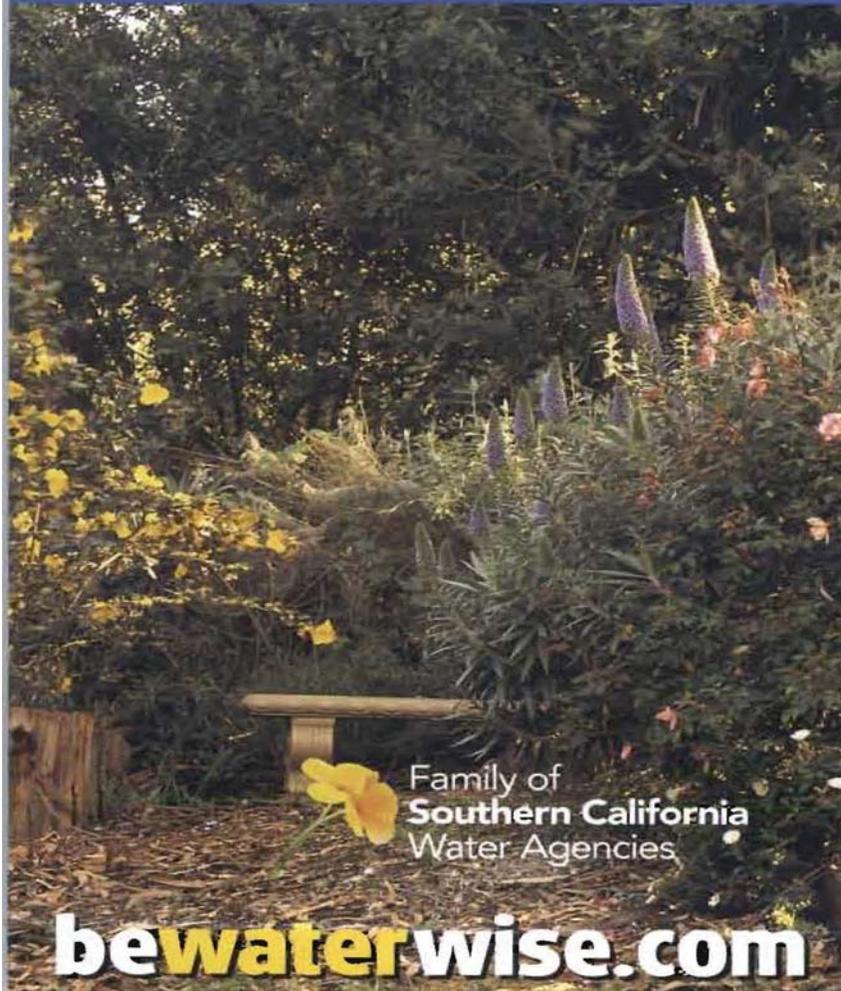
### Chemical Storage and Handling

- Use only the amount indicated on product labels
- Store chlorine and other chemicals in a covered area to prevent runoff. Keep out of reach of children and pets.
- Chlorine kits, available at retail swimming pool equipment and supply stores, should be used to monitor the chlorine and pH levels before draining your pool.
- Chlorine and other pool chemicals should never be allowed to flow into the gutter or storm drain system.

Take unwanted chemicals to a Household Hazardous Waste (HHW) Collection Event. There's no cost for taking HHW items to collection events – it's FREE! Call 1-800-506-2555 for a schedule of HHW events in your community.



# 10 Ways to **Save** Water Outdoors



Family of  
**Southern California**  
Water Agencies

**bewaterwise.com**

**TIP #1** The average homeowner uses twice the amount of water needed to keep plants healthy. Use the watering calculator and index at [bewaterwise.com](http://bewaterwise.com) to know exactly how much water your plants need.

**TIP #2** Check your sprinkler system for leaks, overspray and broken sprinkler heads. Update with drip or other more water-efficient sprinklers where appropriate.

**TIP #3** This fall, plant a portion of your garden with beautiful native and California Friendly plants. Browse the plant database at [bewaterwise.com](http://bewaterwise.com) to find just the right look for your outdoor spaces.

**TIP #4** Reduce the amount of water-thirsty grass. Keep only what you need and replace the rest with less-thirsty plants or permeable paving.

**TIP #5** For the grass you keep, set your lawnmower blade higher.

**TIP #6** Adjust your sprinkler timer downward in September. Plants need less water when days are shorter.

**TIP #7** Use a broom instead of the hose for cleaning sidewalks and patios.

**TIP #8** Mulch! A layer of bark, gravel, compost, sawdust or low-growing groundcover evens out soil temperature and allows better water retention.

**TIP #9** Check the list of invasive plants that hurt our environment at [caleppc.org](http://caleppc.org) and remove any from your garden.

**TIP #10** Share these tips with your gardener, neighbors and friends. Water conservation should be a part of every Southern Californian's lifestyle, but that doesn't mean we can't have lush and beautiful outdoor spaces.

**[bewaterwise.com](http://bewaterwise.com)**

### 3.1 INFILTRATION BASIN

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

#### **Description**

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



**Figure 1 – Infiltration Basin**

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

#### **Siting Considerations**

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

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

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

## INFILTRATION BASIN BMP FACT SHEET

### Setbacks

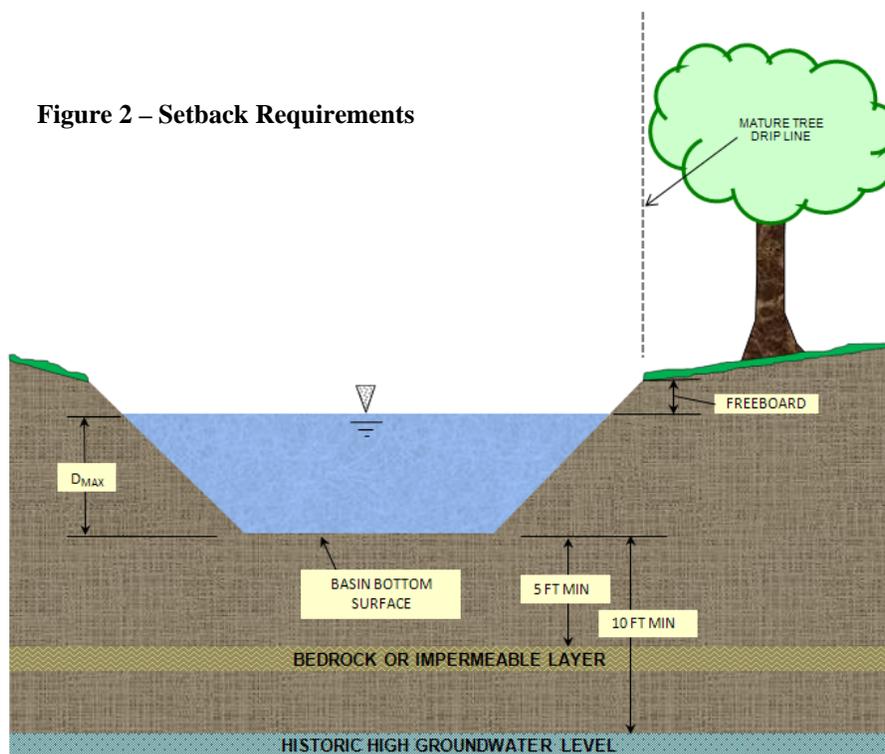
Always consult your geotechnical engineer for site specific recommendations regarding setbacks for infiltration trenches. Recommended setbacks are needed to protect buildings, existing trees, walls, onsite or nearby wells, streams, and tanks. Setbacks should be considered early in the design process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

Infiltration basins typically must be set back:

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

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

**Figure 2 – Setback Requirements**



## INFILTRATION BASIN BMP FACT SHEET

### Forebay

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

### Overflow

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

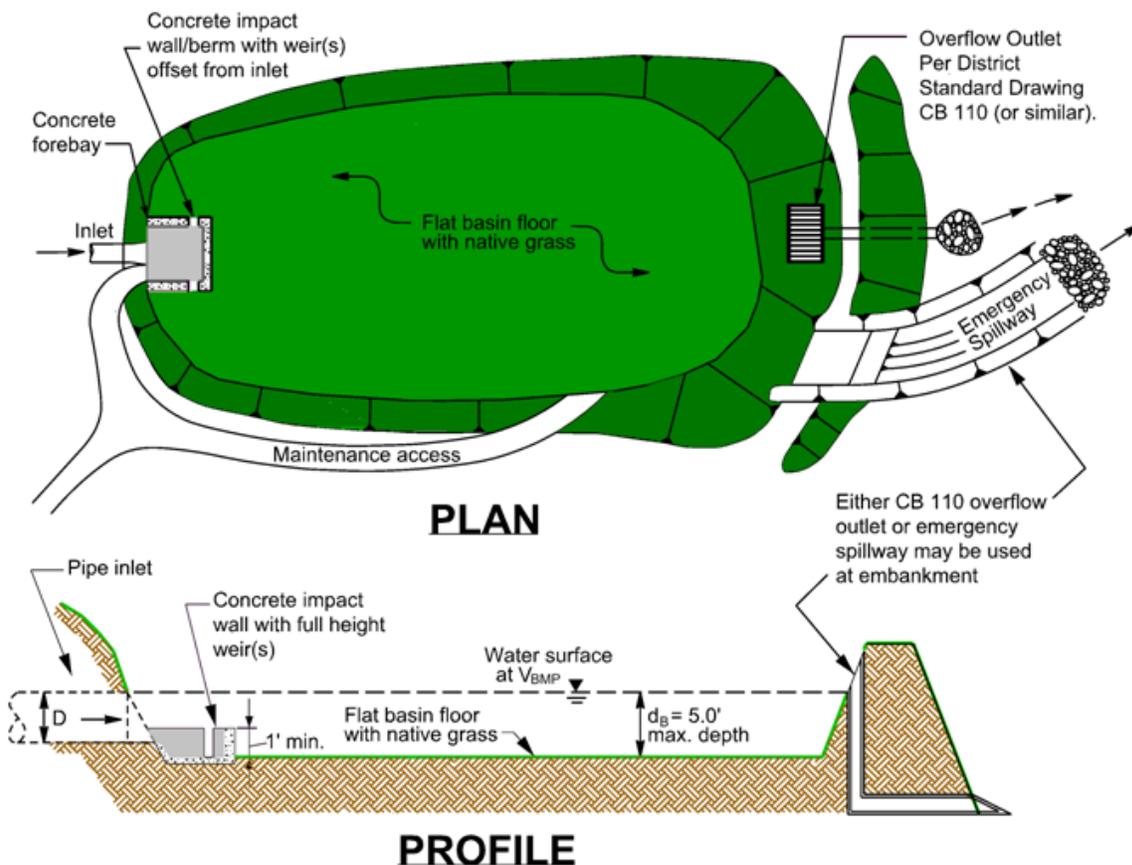


Figure 3 – Infiltration Basin

## INFILTRATION BASIN BMP FACT SHEET

### Landscaping Requirements

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

### Maintenance

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

**Table 1 - Inspection and Maintenance**

Schedule	Inspection and Maintenance Activity
<p><b>Ongoing</b> including just before annual storm seasons and following rainfall events.</p>	<ul style="list-style-type: none"> <li>• Maintain vegetation as needed. Use of fertilizers, pesticides and herbicides should be strenuously avoided to ensure they don't contribute to water pollution. If appropriate native plant selections and other IPM methods are used, such products shouldn't be needed. If such projects are used,                             <ul style="list-style-type: none"> <li>○ Products shall be applied in accordance with their labeling, especially in relation to application to water, and in areas subjected to flooding.</li> <li>○ Fertilizers should not be applied within 15 days before, after, or during the rain season.</li> </ul> </li> <li>• Remove debris and litter from the entire basin to minimize clogging and improve aesthetics.</li> <li>• Check for obvious problems and repair as needed. Address odor, insects, and overgrowth issues associated with stagnant or standing water in the basin bottom. There should be no long-term ponding water.</li> <li>• Check for erosion and sediment laden areas in the basin. Repair as needed. Clean forebay if needed.</li> <li>• Revegetate side slopes where needed.</li> </ul>
<p><b>Annually.</b> If possible, schedule these inspections within 72 hours after a significant rainfall.</p>	<ul style="list-style-type: none"> <li>• Inspection of hydraulic and structural facilities. Examine the inlet for blockage, the embankment and spillway integrity, as well as damage to any structural element.</li> <li>• Check for erosion, slumping and overgrowth. Repair as needed.</li> <li>• Check basin depth for sediment build up and reduced total capacity. Scrape bottom as needed and remove sediment. Restore to original cross-section and infiltration rate. Replant basin vegetation.</li> <li>• Verify the basin bottom is allowing acceptable infiltration. Use a disc or other method to aerate basin bottom only if there is actual significant loss of infiltrative capacity, rather than on a routine basis<sup>1</sup>.</li> <li>• No water should be present 72 hours after an event. No long term standing water should be present at all. No algae formation should be visible. Correct problem as needed.</li> </ul>
<p><b>1. CA Stormwater BMP Handbook for New Development and Significant Redevelopment</b></p>	

## INFILTRATION BASIN BMP FACT SHEET

**Table 2 - Design and Sizing Criteria for Infiltration Basins**

Design Parameter	Infiltration Basin
Design Volume	$V_{BMP}$
Forebay Volume	0.5% $V_{BMP}$
Drawdown time (maximum)	72 hours
Maximum tributary area	50 acres <sup>2</sup>
Minimum infiltration rate	Must be sufficient to drain the basin within the required Drawdown time over the life of the BMP. The WQMP may include specific requirements for minimum tested infiltration rates.
Maximum Depth	5 feet
Spillway erosion control	Energy dissipators to reduce velocities <sup>1</sup>
Basin Slope	0%
Freeboard (minimum)	1 foot <sup>1</sup>
Historic High Groundwater Setback (max)	10 feet
Bedrock/impermeable layer setback (max)	5 feet
Tree setbacks	Mature tree drip line must not overhang the basin
Set back from wells, tanks or springs	100 feet
Set back from foundations	As recommended in Geotechnical Report
<ol style="list-style-type: none"> <li>1. Ventura County's Technical Guidance Manual for Stormwater Quality Control Measures</li> <li>2. CA Stormwater BMP Handbook for New Development and Significant Redevelopment</li> </ol>	

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

### **INFILTRATION BASIN SIZING PROCEDURE**

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

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

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

## INFILTRATION BASIN BMP FACT SHEET

- d) Enter the depth of freeboard.
- e) Enter the depth to the historic high groundwater level measured from the top of the basin.
- f) Enter the depth to the top of bedrock or other impermeable layer measured from the finished grade.
- g) The spreadsheet will determine  $D_2$ , the total basin depth (including freeboard, if used) of the basin, based on restrictions to the depth by groundwater and an impermeable layer.

$$D_2 = \text{Depth to groundwater} - (10 + \text{freeboard}) \text{ (ft);}$$

**or**

$$D_2 = \text{Depth to impermeable layer} - (5 + \text{freeboard}) \text{ (ft)}$$

Whichever is least.

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

### 3. Basin Geometry

- a) Enter the basin side slopes,  $z$  (no steeper than 4:1).
- b) Enter the proposed basin depth,  $d_B$  excluding freeboard.
- c) The spreadsheet will determine the minimum required surface area of the basin:

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

Where  $A_s$  = minimum area required ( $\text{ft}^2$ )

$V_{BMP}$  = volume of the infiltration basin ( $\text{ft}^3$ )

$d_B$  = proposed depth not to exceed maximum allowable depth,  $D_{MAX}$  (ft)

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

### 4. Forebay

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

- a) The spreadsheet will determine the minimum required forebay volume based on 0.5%  $V_{BMP}$ .
- b) Enter the proposed depth of the forebay berm/splashwall (1foot minimum).
- c) The spreadsheet will determine the minimum required forebay surface area.
- d) Enter the width of rectangular weir to be used (minimum 1.5 inches). Weir width should be established based on a 5 minute drawdown time.

# Site Design & Landscape Planning SD-10



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## Design Objectives

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

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

## Approach

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

## Suitable Applications

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

## Design Considerations

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



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## *Designing New Installations*

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

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

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

## *Conserve Natural Areas during Landscape Planning*

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

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

## *Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit*

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

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

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

## *Protection of Slopes and Channels during Landscape Design*

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

## ***Redeveloping Existing Installations***

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

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

## **Other Resources**

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

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

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

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

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



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  $\frac{1}{4}$  to  $\frac{1}{2}$  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](http://www.stormh2o.com)

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD.  
[www.lid-stormwater.net](http://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.



- 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.

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## Design Objectives

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## Description

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

## Approach

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

## Suitable Applications

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

## Design Considerations

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

## *Designing New Installations*

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

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



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

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

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

### ***Redeveloping Existing Installations***

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

### **Additional Information**

#### ***Maintenance Considerations***

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

#### ***Placement***

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

### **Supplemental Information**

#### ***Examples***

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

### **Other Resources**

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

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

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