RIVERSIDE COUNTY WQMP SANTA ANA REGION

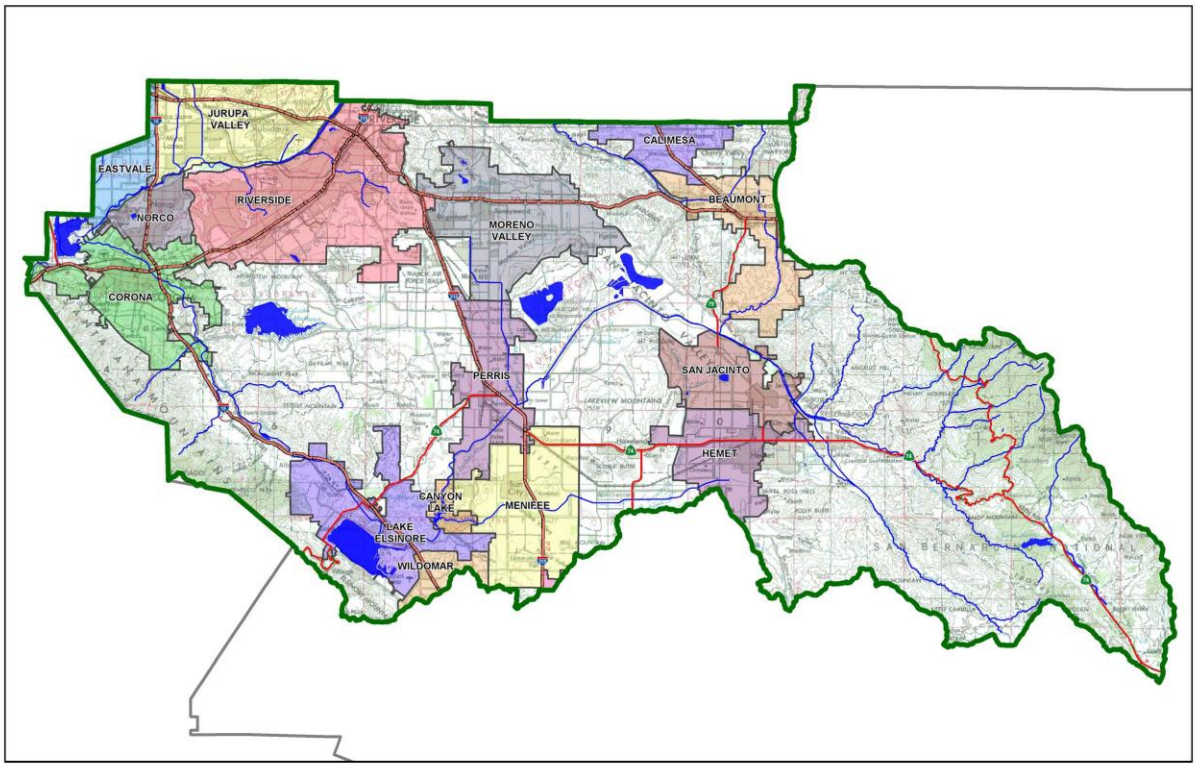
Project Specific Water Quality Management Plan

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

Project Title: Romoland - TTM 39316

Development No: TTM 39316

Design Review/Case No:



☒ **Preliminary**
☐ **Final**

Original Date Prepared: July 2025

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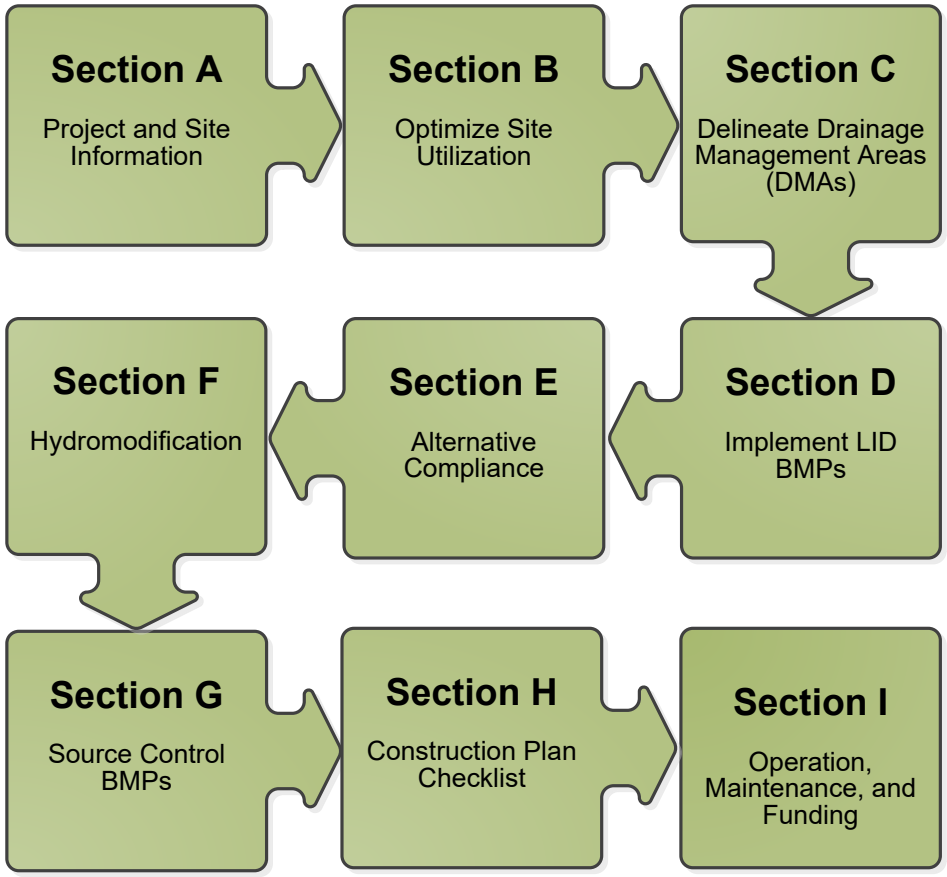
Prepared for Compliance with
Regional Board Order No. **R8-2010-0033**

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A Brief Introduction

This Project-Specific WQMP Template for the **Santa Ana Region** has been prepared to help guide you in documenting compliance for your project. Because this document has been designed to specifically document compliance, you will need to utilize the WQMP Guidance Document as your "how-to" manual to help guide you through this process. Both the Template and Guidance Document go hand-in-hand and will help facilitate a well-prepared Project-Specific WQMP. Below is a flowchart for the layout of this Template that will provide the steps required to document compliance.



OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for EPD Solutions, Inc. by KWC Engineers for the TTM 39316 project.

This WQMP is intended to comply with the requirements of County of Riverside for Ordinance 754.2 which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. In addition, the property owner accepts responsibility for interim operation and maintenance of Stormwater BMPs until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under County of Riverside Water Quality Ordinance (Municipal Code Section 13.121).

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

Owner's Signature	Date
Dane Palanjian	Representative
Owner's Printed Name	Owner's Title/Position

PREPARER'S CERTIFICATION

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

Preparer's Signature	7/17/2026 Date
Guillermo Gonzalez	P.E./ Project Manager
Preparer's Printed Name	Preparer's Title/Position

Preparer's Licensure:



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Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	Residential Housing Subdivision PRD
Planning Area:	Menifee Council District 4
Community Name:	Romoland in the City of Menifee
Development Name:	TTM 39316
PROJECT LOCATION	
Latitude & Longitude (DMS): 33°45'34.7" N, 117°09'54.3" W	
Project Watershed and Sub-Watershed: Lake Elsinore (801.32), San Jacinto (802.11)	
APN(s): All corresponding APNs are associated with tract 31687.	
Project Area = 40.2 acres	
PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	Single Family Residential
Proposed or Potential SIC Code(s)	N/A
Total Area of Project Footprint (SF)	1,750,055
Total Area of proposed Impervious Surfaces within the Project Footprint (SF)/or Replacement	711,032
Does the project consist of offsite road improvements?	☒ Y ☐ N
Does the project propose to construct unpaved roads?	☐ Y ☒ N
Is the project part of a larger common plan of development (phased project)?	☐ Y ☒ N
EXISTING SITE CHARACTERISTICS	
Total area of existing Impervious Surfaces within the Project Footprint (SF)	0
Is the project located within any MSHCP Criteria Cell?	☐ Y ☒ N
If so, identify the Cell number:	N/A
Are there any natural hydrologic features on the project site?	☐ Y ☒ N
Is a Geotechnical Report attached?	☒ Y ☐ N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)	N/A
What is the Water Quality Design Storm Depth for the project?	0.63

Project Description

This project proposes to build 144 single family units on 40.2 acres net of currently vacant land and a water quality basin to the north-west corner of the site. The site is located in the City of Menifee, in the neighborhood of Romoland at the northeast corner of the intersection of Mapes Road and Tradewinds Drive. Surrounding lots consist of existing residential developments surrounding the west, south, and east sides with some vacant or low density lots to the north.

Each lot within the development will include a recessed landscape feature functioning as a shallow side-yard swale. These swales are designed to receive and convey runoff directly from roof drain discharge points. Collected flows are routed through the swale before entering the adjacent roadway gutter and, ultimately, the municipal storm drain system.

The swales provide pretreatment by promoting shallow flow dispersion and sediment deposition. This pretreatment reduces sediment loads entering the storm drain system, thereby decreasing the potential for sediment buildup and clogging within downstream conveyance facilities. During larger storm events, the swales are designed with a controlled overflow to the adjacent street to prevent localized flooding, erosion, or damage to the lot.

These landscape swale features will be maintained by the individual homeowners within the community.

The project site consists of one (1) drainage area, DMA-A, to drain to a proposed bioretention basin located at the northwest corner of the project site. After treatment, outflows from the basin will drain into the proposed storm drain systems, flowing west. The proposed storm drain system will drain into an existing RCTD maintained storm drain pipe located in Tract 37358.

The proposed bioretention basin will consist of layers of engineered soil and gravel, perforated underdrain pipes and overflow outlets following the procedures given in the Riverside County Water Quality Guidance Document. The basin will also mitigate for hydromodification and detention requirements including the self-treating area. WQ Basin 1 to be maintained by Riverside County Community Facilities District (CFD) by keeping all adjacent landscape areas maintained and removing clippings from landscape maintenance activities, removing any trash and debris that may accumulate within the basin, replace any damaged grass and/or plants, maintain the slopes integrity, replacing surface mulch layer as needed to maintain recommended soil cover, inspect for areas of ponding and ensure that all inlets and outlets are clear and functioning at full potential.

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
San Jacinto River Reach 3 (HU# 802.11)	None	MUN, AGR, GWR, REC1, REC2, WARM, WILD	Not a water body classified as rare
Canyon Lake (HU# 802.11, 802.12)	Nutrients, Pathogens	MUN, AGR, GWR, REC1, REC2, WARM, WILD	Not a water body classified as rare
San Jacinto River Reach 1 (HU# 802.10)	None	MUN, AGR, GWR, REC1, REC2, WARM, WILD	Not a water body classified as rare
Lake Elsinore (HU# 802.31)	Nutrients, Organic Enrichment/Low Dissolved Oxygen, PCBs Sediment Toxicity, Unknown Toxicity	REC1, REC2 WARM, WILD	Not a water body classified as rare

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

Table A.2 Other Applicable Permits

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

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

Section B: Optimize Site Utilization (LID Principles)

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

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

Site Optimization

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

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

Yes. The proposed development will mimic the same drainage condition.

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

This site has minimal to no growth of weeds/ non-native vegetation as it was previously graded for another grading tract map, which was never fully implemented. The proposed site will imply new vegetation growth wherever applicable and as much as possible. The site will have planters and landscape areas which will be planted with native vegetation and trees.

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

Yes. As found in the project soils investigation report, the project site is mostly composed of soil with poor infiltration, silty to clay-sands up to 30' in depth. No indications of high groundwater levels were noted per soils report, although based on historic water well data acquired from CDWR, 2004, groundwater levels in nearby wells were measured at depths of 90' to 135' below ground surface. One basin is proposed to serve as Water Quality Basin (bioretention) and detention basin, it will be constructed at the natural low point or flow direction of the site, which is to the northwest of the site. Roof runoff will be directed to landscaped areas which will have incidental infiltration prior to flowing into local storm drains.

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

Yes. Driveways, sidewalks and streets were designed to minimum widths. Also, there is a proposed ornamental landscape area, which help minimize impervious areas.

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

Yes. Roof runoffs with disperse via downspouts that will be directed to landscaping areas to route runoff to pervious areas prior to draining to the storm drain system. All storm drain system pipes will drain to the proposed bioretention basins and there will be some infiltration into native subsoil.

Section C: Delineate Drainage Management Areas (DMAs)

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

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s)[1]	Area (Sq. Ft.)	DMA Type
DMA-A	Roof	367,690	D
DMA-A	Concrete or Asphalt	503,174	D
DMA-A	Landscape	789,288	D
DMA-A	Basin	84,861	D
DMA-B	Concrete or Asphalt	23,086	D
DMA-C	Concrete or Asphalt	13,419	D
DMA-C	Landscape	27,092	D
DMA-D	Concrete or Asphalt	10,454	D

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

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

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

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

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

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

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

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

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

DMA Name or ID	BMP Name or ID
DMA-A	Bioretention Basin 1
DMA-B	Bioretention Basin 1*
DMA-C	Bioretention Basin 1*
DMA-D	Bioretention Basin 1*

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.

*DMAs B and C do not flow to the proposed bioretention basin 1 area because it is not feasible to route storm drain from the east side of the project to the proposed basin. However, the proposed bioretention basin is designed to overtreat the additional volume that would have been required if DMA B, C and D were to flow to the basin.

Section D: Implement LID BMPs

D.1 Infiltration Applicability

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

If yes has been checked, Infiltration BMPs shall not be used for the site. If no, continue working through this section to implement your LID BMPs. It is recommended that you contact your Co-Permittee to verify whether or not your project discharges to an approved downstream 'Highest and Best Use' feature.

Geotechnical Report

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

Guidance Document. If a geotechnical report has been prepared, include it in Appendix 3. In addition, if a Phase I Environmental Site Assessment has been prepared, include it in Appendix 4.

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

Infiltration Feasibility

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

Table D.1 Infiltration Feasibility

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

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

D.2 Harvest and Use Assessment

Please check what applies*:*

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

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

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

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

Irrigation Use Feasibility

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

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

Total Area of Irrigated Landscape: N/A

Type of Landscaping (Conservation Design or Active Turf): N/A

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

Total Area of Impervious Surfaces: N/A

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

Enter your EIATIA factor: N/A

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

Minimum required irrigated area: N/A

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

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

Toilet Use Feasibility

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

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

Projected Number of Daily Toilet Users: N/A

Project Type: Single Family Residential

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

Total Area of Impervious Surfaces: N/A

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

Enter your TUTIA factor: N/A

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

Minimum number of toilet users: N/A

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

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

Other Non-Potable Use Feasibility

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

N/A

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

Average Daily Demand: N/A

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

Total Area of Impervious Surfaces: N/A

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

Enter the factor from Table 2-3: N/A

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

Minimum required use: N/A

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

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

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

D.3 Bioretention and Biotreatment Assessment

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

Select one of the following:

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

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

D.4 Feasibility Assessment Summaries

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

Table D.2 LID Prioritization Summary Matrix

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

The project site will utilize (1) bioretention basin, in this project referenced as WQ Basin 1, to the northwest corner of the site. The project site will drain into WQ basin 1, capturing all of DMA-A. The required water quality volume was determined by using the Santa Ana Watershed BMP Design Volume Spreadsheets and an 85th percentile depth of 0.63 inches.

DMA-B, DMA-C and DMA-D are impermeable areas, along the west, east and south sides of the site, respectively. These DMAs will not be drained into any BMPs as they are not feasible hydrologically. The required DCV for DMA B, C & D is 2,356.3 ft^3. The required DCV for all DMA areas is 48,208 ft^3 and we are providing 50,680 ft^3 in WQ Basin 1. Therefore, even though DMA B, C & D do not drain to the bioretention basin, we are overtreating by an amount of 2,472 ft^3.

LID BMP Sizing

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

Refer to Appendix 6 for DCV calculations sheets corresponding to the proposed LID BMPs. All proposed BMPs are designed to handle and treat the minimum design capture volumes as identified on the DCV calculations.

Table D.3 DCV Calculations for LID BMPs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Bioretention/ WQ Basin 1*		
	[A]		[B]	[C]	[A] x [C]			
D/DMA-A	367,690	Roofs	1	0.89	327,979.5			
D/DMA-A	503,174	Concrete or Asphalt	1	0.89	448,831.2			
D/DMA-A	789,288	Landscaping	0.1	0.11	87,183.2			
D/DMA-A	84,861	Basin	0.1	0.11	9,373.6			
D/DMA-B	23,086	Concrete or Asphalt	1	0.89	20,593.4			
D/DMA-C	13,419	Concrete or Asphalt	1	0.89	11,969.7			
D/DMA-C	27,092	Landscaping	0.1	0.11	2,992.5	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
D/DMA-D	10,454	Concrete or Asphalt	1	0.89`	9325			
	A_T = ***1,819,065***				Σ= 918,248.1	0.63	48,208	50,680

[B], [C] is obtained as described in Section 2.3.1 of the WQMP Guidance Document
[E] is obtained from Exhibit A in the WQMP Guidance Document
[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6

Section E: Alternative Compliance (LID Waiver Program)

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

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

- *Or* -

☐ The following Drainage Management Areas are unable to be addressed using LID BMPs. A site-specific analysis demonstrating technical infeasibility of LID BMPs has been approved by the Co-Permittee and included in Appendix 5. Additionally, no downstream regional and/or sub-regional LID BMPs exist or are available for use by the project. The following alternative compliance

measures on the following pages are being implemented to ensure that any pollutant loads expected to be discharged by not incorporating LID BMPs, are fully mitigated.

E.1 Identify Pollutants of Concern

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

Table E.1 Potential Pollutants by Land Use Type

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

P = Potential

N = Not Potential

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

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

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

(4) Specifically petroleum hydrocarbons

(5) Specifically solvents

(6) Bacterial indicators are routinely detected in pavement runoff

E.2 Stormwater Credits

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

Table E.2 Water Quality Credits

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

[1]Cannot Exceed 50%

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

E.3 Sizing Criteria

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

Table E.3 Treatment Control BMP Sizing

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

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

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

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

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

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

E.4 Treatment Control BMP Selection

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

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

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

Table E.4 Treatment Control BMP Selection

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

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

Section F: Hydromodification

F.1 Hydrologic Conditions of Concern (HCOC) Analysis

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

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

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

If Yes, HCOC criteria do not apply.

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

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

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

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

Table F.1 Hydrologic Conditions of Concern Summary

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

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

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

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

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

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.

HCOC Mitigation achieved by satisfying F.2(C)

TTM 39316 drains north westerly to the proposed bioretention basin. To mimic existing conditions the basin will retain part of the increased run-off. The existing and proposed hydrograph results show that we are decreasing flow by 0.1 cfs. See summary results below and hydrograph results in **Appendix 7**.

Pre-Development			
Drainage Area	**Area**	**2-year 24-hour**	
	(ac)	**Discharge (cfs)**	**Volume (ac-ft)**
A	60.0	6.3	3.9

Post-Development			
Drainage Area	**Area**	**2-year 24-hour**	
	(ac)	**Discharge (cfs)**	**Volume (ac-ft)**
A	56.9	6.2	3.8

Section G: Source Control BMPs

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

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

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

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

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

Table 0.1 Permanent and Operational Source Control Measures

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
On-site Storm Drain Catch Basins and grated inlet. Locations are as shown on the Water Quality Site Map Exhibit in Appendix 1	Mark all inlets with the words "Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951-955-1200 to verify.	Maintain and periodically repaint or replace inlet markings. See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com.
Landscape/outdoor pesticide use	State that final landscape plans will accomplish all of the following:	Maintain landscaping using minimum or no pesticides.

	Preserve existing native trees, shrubs, and ground cover to the maximum extent possible. Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution. Consider using pest-resistant plants, especially adjacent to hardscape. To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	See applicable operational BMPs in "What you should know for…..Landscape and Gardening" at http://rcflood.org/stormwater/. Provide IPM information to new owners, lessees and operators.
Pools, spas, ponds, decorative fountains, and other water features	None	See applicable operational BMPs in "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" at http://rcflood/org/stormwater/.
Sidewalks	None	Prevent accumulation of litter and debris. See Appendix 8
Vehicle and Equipment Washing	None	Do not discharge washwater to the storm drain system. See Outdoor Cleaning Activities http://rcflood/org/stormwater/.
Vehicle/Equipment Repair and Maintenance	None	Do not discharge washwater to the storm drain system. See Automotive Maintenance and Care http://rcflood/org/stormwater/.
Need for future indoor and structural pest control	Note building design features that discourage entry of pests	Provide Integrated Pest Management information to owners, lessees, and operators

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 0.1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)
WQ Basin 1,	Water Quality Bioretention Basin	PWQMP Site Plan - Tract 39316 & Conceptual Grading Plan (Appendix 2)

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.

To be included at time of Final WQMP.

Section I: Operation, Maintenance and Funding

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

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

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

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

Maintenance Mechanism: **Upon construction, developer will provide maintenance until proper turn-over to HOA. A Community Facilities District (CFD) will be utilized for all Operation, Maintenance and Funding for The Water Quality Bio-Retention Basins.**

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

☐ Y ☒ N

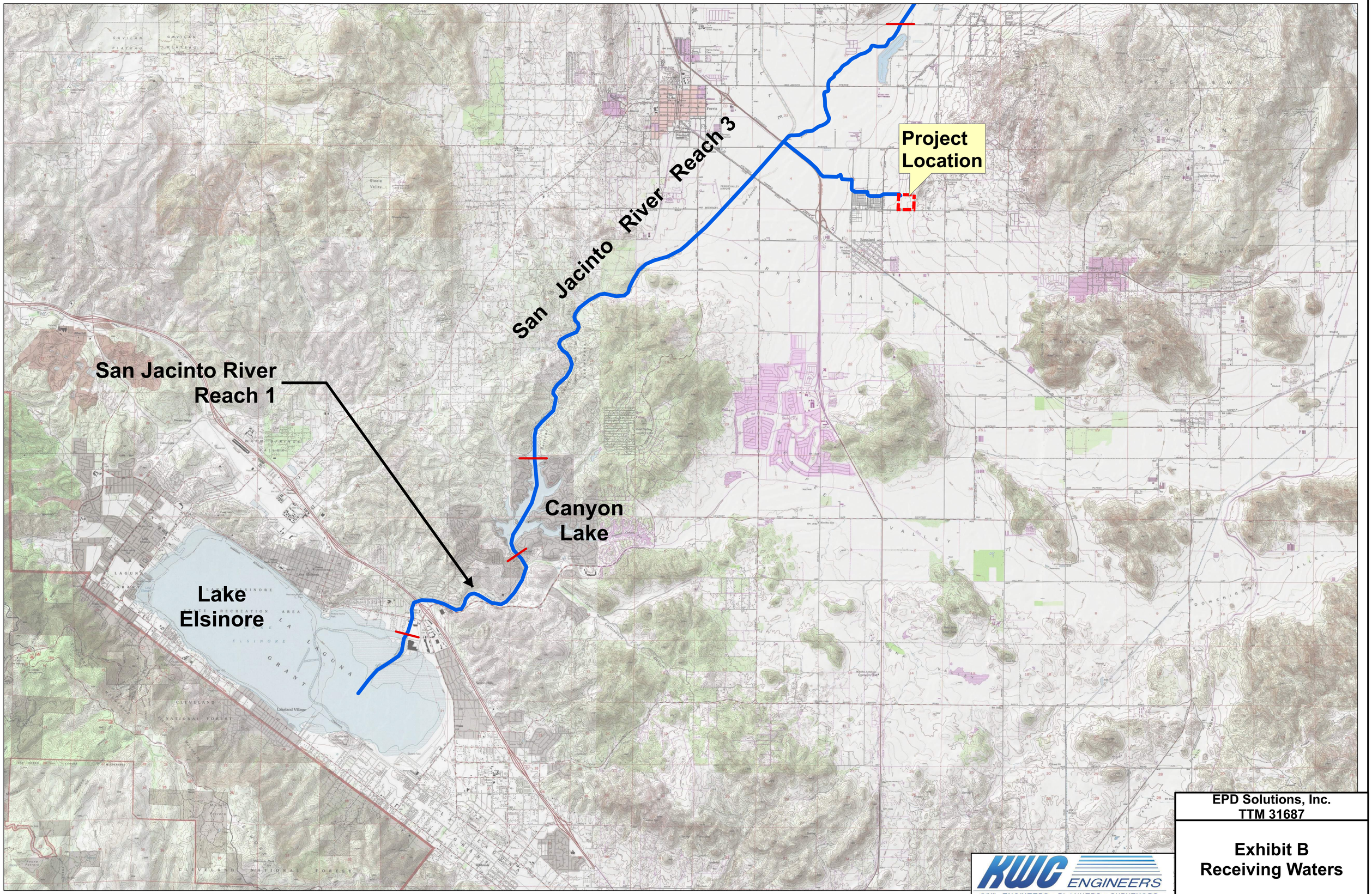
BMPs will be maintained by the Riverside County Community Facilities Districts.

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.

To be included at time of Final WQMP.

Appendix 1: Maps and Site Plans

Location Map, WQMP Site Plan and Receiving Waters Map



EPD Solutions, Inc.
TTM 31687

Exhibit B
Receiving Waters

KWC ENGINEERS
CIVIL ENGINEERS • PLANNERS • SURVEYORS

Appendix 2: Construction Plans

Grading and Drainage Plans

IN THE COUNTY OF RIVERSIDE, STATE OF CALIFORNIA
TENTATIVE TRACT MAP NO. 39316
PWQMP SITE PLAN

OWNER/APPLICANT:

EDP SOLUTIONS
CORONA SOUTH MAIN DEVELOPMENT LP.

3333 MICHELSON DRIVE, SUITE 500
IRVINE, CA 92612
PHONE: (949)794-1188
CONTACT: DANE PALANJIAN
DANE@EPDSOLUTIONS.COM

ENGINEER:

KWC ENGINEERS
1181 CALIFORNIA AVE., SUITE 235
CORONA, CA 92881
CONTACT: NICK NGUYEN
NICK.NGUYEN@KWCENGINEERS.COM

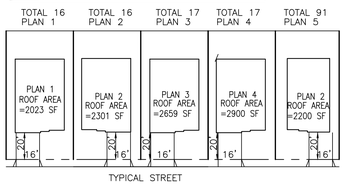
LEGEND

- TOP OF SLOPE / TOE OF SLOPE
- WQMP TRIBUTARY AREA BOUNDARY
- PROPOSED WQMP BASIN
- ASPHALT/CONCRETE (IMPERVIOUS PAVEMENT)
- ORNAMENTAL LANDSCAPING
- DMA A / 10.64 — DRAINAGE MANAGEMENT AREA ID / TRIBUTARY AREA (ACRES)
- PROPOSED STORM DRAIN
- PROPOSED CATCH BASIN
- DRAINAGE FLOW PATH
- SD-10 SITE DESIGN AND LANDSCAPE PLANNING
- SD-12 EFFICIENT IRRIGATION
- SD-13 STORM DRAIN SIGNAGE
- SE-7 STREET SWEEPING AND VACUUMING

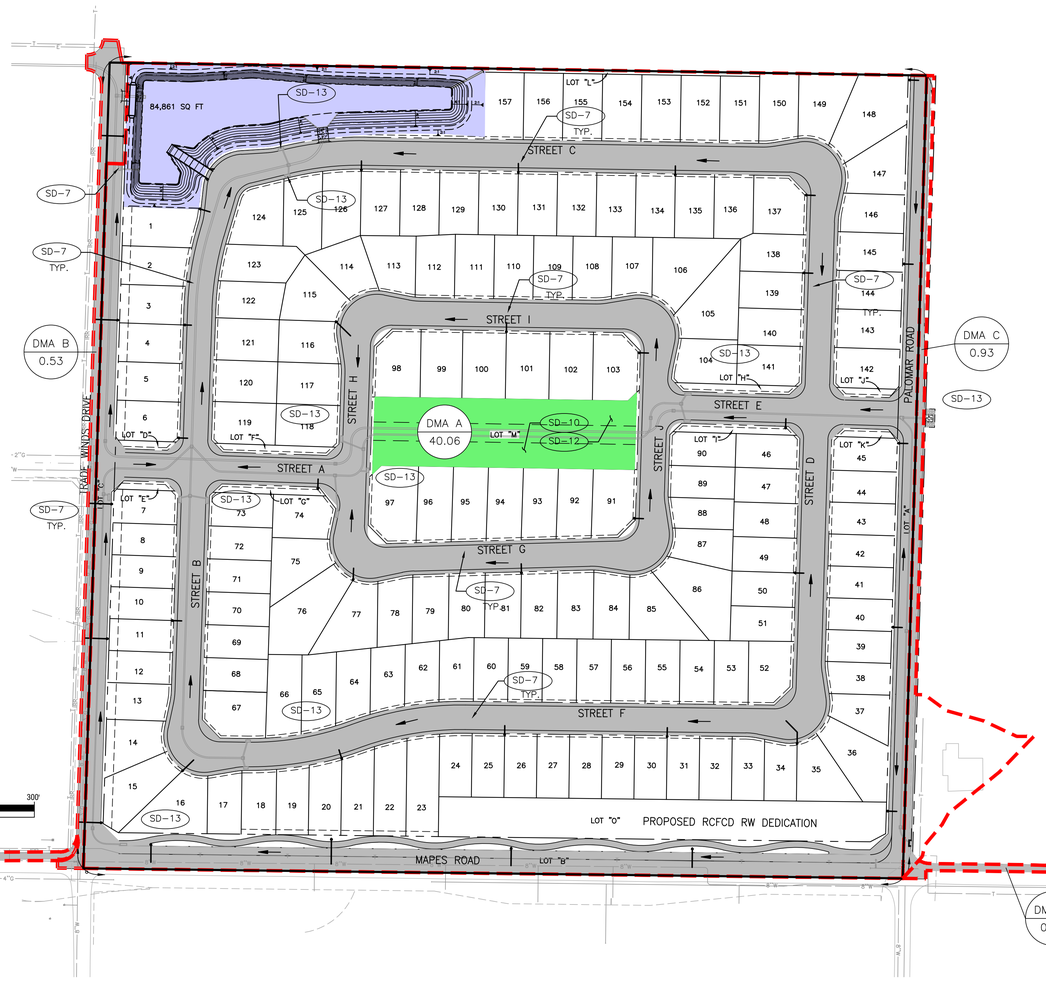
ROOF COVER SUMMARY

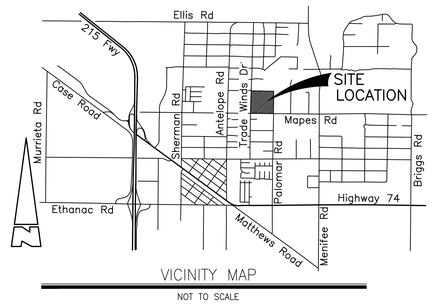
DMA – A		
PLAN #	IMP. AREA	EFFECTIVE IMPERVIOUS AREA
PLAN#1 – 16	2,023 SF	32,368 SF
PLAN#2 – 16	2,301 SF	36,816 SF
PLAN#3 – 17	2,659 SF	45,203 SF
PLAN#4 – 17	2,900 SF	49,300 SF
PLAN#5 – 91	2,200 SF	200,200 SF
		Σ: 363,887 SF

TYPICAL LOT:



TYPICAL STREET





VICINITY MAP
NOT TO SCALE

DMA SUMMARY

DMA – A				
POST PROJECT SURFACE TYPE	DMA (SF)	EFFECTIVE IMPERVIOUS FRACTION	DMA RUN OFF FACTOR	DMA X RUN OFF FACTOR
ROOF	367,690	1	0.89	327,979.5
CONCRETE OR ASPHALT	503,174	1	0.89	448,831.2
ORNAMENTAL LANDSCAPING	789,288	0.1	0.11	87,183.2
BASIN	84,861	0.1	0.11	9,373.6
				Σ: 873,367.5

DMA SUMMARY

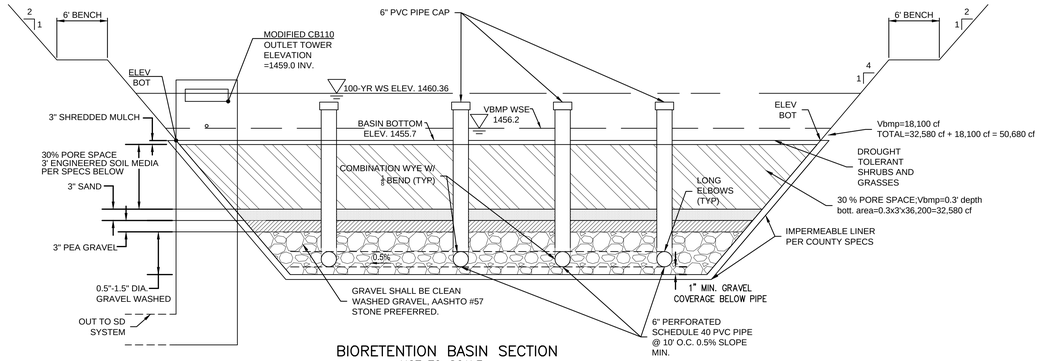
DMA – B				
POST PROJECT SURFACE TYPE	DMA (SF)	EFFECTIVE IMPERVIOUS FRACTION	DMA RUN OFF FACTOR	DMA X RUN OFF FACTOR
CONCRETE OR ASPHALT	23,086	1	0.89	20,593.4

DMA SUMMARY

DMA – C				
POST PROJECT SURFACE TYPE	DMA (SF)	EFFECTIVE IMPERVIOUS FRACTION	DMA RUN OFF FACTOR	DMA X RUN OFF FACTOR
CONCRETE OR ASPHALT	13,419	1	0.89	11,969.7
ORNAMENTAL LANDSCAPING	27,092	0.1	0.11	2,992.5
				Σ: 14,962.2

DMA SUMMARY

DMA – D				
POST PROJECT SURFACE TYPE	DMA (SF)	EFFECTIVE IMPERVIOUS FRACTION	DMA RUN OFF FACTOR	DMA X RUN OFF FACTOR
CONCRETE OR ASPHALT	10,454	1	0.89	9,325.3



BIORETENTION BASIN SECTION
NOT TO SCALE

NOTES: ALL ROCK OR SAND TO BE PLACED IN POST-CONSTRUCTION BMPS SHALL BE CLEAN-WASHED ROCK TO THE SATISFACTION OF THE GRADING INSPECTOR.

*ENGINEERED SOIL MEDIA/BSM NOTES

1. THE ENGINEER SHALL FURNISH TO THE COUNTY A COPY OF THE SOURCE TESTING AND A SIGNED CERTIFICATION THAT THE FULLY BLENDED BIORETENTION/BIOFILTRATION SOIL MEDIA (BSM) MATERIAL MEETS ALL OF THE WQMP REQUIREMENTS BEFORE MATERIAL IS IMPORTED OR IF THE MATERIAL IS MIXED ONSITE PRIOR TO INSTALLATION.

2. AS BSM MATERIAL IS BEING INSTALLED, QUALITY ASSURANCE (QA) TESTS SHALL BE CONDUCTED OR FOR EVERY 1,200 TONS OR 800 CUBIC YARDS MIXED ON-SITE FROM A COMPLETELY MIXED STOCKPILE OR WINDROW, WITH A MINIMUM OF THREE TESTS. FOR IMPORTED MATERIAL FROM A SUPPLIER WITH A QUALITY CONTROL PROGRAM THE QA TESTS SHALL BE CONDUCTED 2,400 TONS OR 1,600 CUBIC YARDS FROM THE SUPPLIER.

3. THE ENGINEER CONDUCTING THE QUALITY CONTROL TESTING SHALL FURNISH TO THE COUNTY COPY OF THE QA TESTING AND A CERTIFICATION THAT THE BSM FOR THE PROJECT MEETS ALL OF THE FOLLOWING REQUIREMENTS. CERTIFIED MITIGATION PLANS CAN BE USED FOR EXCEEDANCES, AS LONG AS ALL REQUIREMENTS ARE DESIGNED TO BE MET.
   A. BSM SHALL NOT BE COMPACTED. BSM SHALL CONSIST OF THE 60-80% CLEAN SAND, UP TO 20% TOPSOIL , AND 20% OF A NUTRIENT-STABILIZED ORGANIC AMENDMENT. THE INITIAL INFILTRATION RATE SHALL BE GREATER THAN 8 INCHES PER HOUR PER LABORATORY TEST.
   B. pH: 6.0-8.5 SALINITY: 0.5 TO 3.0 MMHO/CM AS ELECTRICAL CONDUCTIVITY; SODIUM ABSORPTION RATIO: <6.0; CHLORIDE: <800 PPM IN SATURATED EXTRACT; CATION EXCHANGE CAPACITY (CEC): >10 MEQ/100G; ORGANIC MATTER 2 TO 5-PERCENT ON A DRY WEIGHT BASIS; CARBON: NITROGEN RATIO: 12 TO 40, PREFERABLY 15 TO 40; GRAVEL LARGER THAN 2MM: 0 TO 25-PERCENT OF THE TOTAL SAMPLE: CLAY SMALLER THAN 0.005 MM: 0 TO 5 PERCENT OF THE NON GRAVEL FRACTION.
   C. BSM SHALL BE TESTED TO LIMIT THE LEACHING OF POTENTIAL INHERENT POLLUTANTS. BSM USED IN BIOFILTRATION BMPs SHALL CONFORM TO THE FOLLOWING LIMITS PER POLLUTANT CONCENTRATIONS IN SATURATED EXTRACT: PHOSPHORUS: < 1 MG/L: NITRATE < 3MG/L, COPPER < 0.025 MG/L. THESE POLLUTANT LIMITS ARE FOR THE AMOUNT THAT IS LEACHED FROM THE SAMPLE, NOT FROM THE SOIL SAMPLE ITSELF. TESTING MAY BE PERFORMED AFTER LABORATORY RINSING OF MEDIA WITH UP TO 15 PORE VOLUMES OF WATER. EQUIVALENT TEST RESULTS WILL BE ACCEPTED IF CERTIFIED BY A LABORATORY OR APPROPRIATE TESTING FACILITY.
   D. LOW NUTRIENT COMPOST USED IN BSM SHALL BE SOURCED FROM A FACILITY PERMITTED THROUGH CALRECYCLE, PREFERABLY THROUGH USCC STA PROGRAM. COMPOST SHALL CONFORM TO THE FOLLOWING REQUIREMENTS: PHYSICAL CONTAMINANTS <1% BY DRY WEIGHT; CARBON: NITROGEN RATIO: 12:1 TO 0:1; MATURITY/STABILITY SHALL CONFORM TO EITHER: SALVITA MATURITY INDEX: >5.5, CO2 EVOLUTION: <2.5 MG CO2-C PER G COMPOST ORGANIC MATTER PER DAY, OR <5MG CO2-C PER G COMPOST C PER DAY; SELECT PATHOGENS AND TRACE METALS SHALL PASS US EPA CLASS A STANDARD. TESTING SHALL BE NO MORE THAN 6 MONTHS OLD AND REPRESENTATIVE OF CURRENT STOCKPILES.
   E. COCONUT COIR PITH USED IN BSM SHALL BE THOROUGHLY RINSED WITH FRESHWATER AND SCREENED TO REMOVE COARSE FIBERS AS PART OF PRODUCTION AND AGED > 6 MONTHS. PEAT USED IN BSM SHALL BE SPHAGNUM PEAT.

BY	DATE	REVISIONS

KWC ENGINEERS
CIVIL ENGINEERING, PLANNING AND CONSTRUCTION MANAGEMENT
1880 COMPTON AVENUE, SUITE 100 ● CORONA, CA. 92881-3370 ● 951-734-2130

KWC File: N:\25\2507\PRELIM\REPORTS\PRELIM WQMP\2507 PRELIM WQMP.dwg

IN THE UNINCORPORATED TERRITORY OF THE COUNTY OF RIVERSIDE, STATE OF CALIFORNIA

PRELIMINARY GRADING PLAN

N/E CORNER OF MAPES ROAD AND TRADE WINDS DRIVE

GENERAL NOTES

1. TOTAL PROJECT AREA = 36.6323 AC
2. THIS SUBDIVISION MAP INCLUDES THE ENTIRE CONTIGUOUS OWNERSHIP OF THE LAND DIVIDER
3. THE SITE HAS "NO GROSS LOTS 2 ACRE OR LARGER IN SIZE".
4. THE PROJECT IS WITHIN THE MOUNTAIN VISTA COMMUNITY FACILITIES DISTRICT, NOT WITHIN A RECREATION AND PARK DISTRICT OR COUNTY SERVICE AREA AUTHORIZED TO COLLECT FEES FOR PARK AND RECREATION SERVICES.
5. PROPOSED IMPROVEMENT SCHEDULE 'A' SUBDIVISION.
6. THOMAS BROTHERS GUIDE: RIVERSIDE COUNTY, PAGE 808, GRID E6
7. EXISTING ZONING: R-R
   PROPOSED ZONING: R-4
8. EXISTING LAND USE: LOW DENSITY RESIDENTIAL (LDR)
   PROPOSED LAND USE: MEDIUM DENSITY RESIDENTIAL (MDR)
9. ADJACENT LAND USE:
   NORTH – LOW DENSITY RESIDENTIAL (LDR)
   SOUTH – CITY OF MENIFEE (RR)
   EAST – LOW DENSITY RESIDENTIAL (LDR)
   WEST – LOW DENSITY RESIDENTIAL (LDR)
10. THIS PROJECT IS NOT WITHIN AN EXISTING SPECIFIC PLAN
11. THE SITE IS WITHIN PERRIS UNION DISTRICT
12. THIS TRACT IS WITHIN S.E. 1/4 OF THE S.W. 1/4 OF SECTION 2, T5S, R3W, S.B.M.–STREET LIGHTING–CSA.
13. TOPO SOURCE: AEROTECH MAPPING DATED 05/02/25.
14. THIS PROPERTY IS SUBJECT TO LOW LIQUEFACTION POTENTIAL AMP, NO GEOLOGIC HAZARDS, AND NOT WITHIN A SPECIAL STUDY ZONE.
15. THIS TRACT IS WITHIN FLOOD ZONE "X" FEMA COMMUNITY MAP NO. 06065C1445H.
16. THERE ARE NO KNOWN EXISTING WELLS ON THE PROPERTY.
17. THERE ARE NO EXISTING BUILDINGS LOCATED ON THIS SITE.
18. THIS TRACT CONTAINS 157 NUMBERED LOTS AND 15 LETTERED LOTS.
19. THIS PARCEL CONTAINS FOUR (4) PHASES
    TRACT 39316–1 = 32 RESIDENTIAL LOTS/39 TOTAL LOTS AND STREETS A,B,C,E,H,I,&J
    TRACT 39316–2 = 34 RESIDENTIAL LOTS/37 TOTAL LOTS AND STREETS C&D
    TRACT 39316–3 = 43 RESIDENTIAL LOTS/47 TOTAL LOTS AND STREETS B,D,G,H&J
    TRACT 39316–4 = 48 RESIDENTIAL LOTS/49 TOTAL LOTS AND STREETS B,D&F
20. COMMUNITY SERVICE AREA 146.
21. COMMUNITY SERVICE AREA 152.

EXISTING EASEMENTS

EASEMENTS SHOWN HEREON ARE LISTED IN CHICAGO TITLE COMPANY, PRELIMINARY REPORT NO. 00205355–K27 DATED APRIL 29, 2025, NUMBERED ACCORDING TO REPORT.

PLOTTABLE EASEMENTS ARE SHOWN FROM AN OWNER–SUPPLIED TITLE REPORT INDICATED BY A "○". NON–PLOTTABLE EASEMENTS ARE INDICATED BY " □ " ALL WITHIN THE "EXCEPTION" ITEMS OF THE TITLE REPORT.

THE FOLLOWING ITEMS AFFECT PARCEL A:

[2] EASEMENT FOR THE PURPOSE OF PERPETUAL AIR OR FLIGHT EASEMENT, ALSO REFERRED TO AS 'AVIGATION RIGHTS.' RECORDED MARCH 28, 2007 AS INST. NO 2007–0210043, OF OFFICIAL RECORDS.
AFFECTS ALL THE AIR SPACE ABOVE SAID LAND. (BLANKET IN NATURE)

(8) EASEMENTS FOR STREET AND PUBLIC UTILITY PURPOSES AS SHOWN ON TRACT NO. 31687, RECORDED SEPTEMBER 28, 2022 IN BOOK 486, PAGES 7–10 INCLUSIVE OF MAPS. A PORTION OF THE LAND OVER LETTERED LOTS A THROUGH D. OFFERED FOR DEDICATION AND ACCEPTED AS SUBJECT TO IMPROVEMENTS IN ACCORDANCE TO COUNTY STANDARDS, IMPROVEMENTS WERE NOT CONSTRUCTED. (PLOTTED HEREON)(TO BE VACATED)

(9a) EASEMENTS FOR THE PRIVATE USE FOR THE SOLE BENEFIT OF WATERMARKE HOMES, LLC, A CALIFORNIA LIMITED LIABILITY COMPANY, THEIR SUCCESSORS, ASSIGNEES, AND LOT OWNERS WITHIN SAID TRACT. WATERMARKE HOMES, LLC RETAIN THE EASEMENTS INDICATED AS 'PRIVATE DRAINAGE EASEMENT' AS SHOWN ON TRACT NO. 31687, RECORDED SEPTEMBER 28, 2022 IN BOOK 486, PAGES 7–10 INCLUSIVE OF MAPS. (PLOTTED HEREON)(TO BE VACATED)

(9b) EASEMENTS FOR THE PRIVATE USE FOR THE SOLE BENEFIT OF WATERMARKE HOMES, LLC, A CALIFORNIA LIMITED LIABILITY COMPANY, THEIR SUCCESSORS, ASSIGNEES, AND LOT OWNERS WITHIN SAID TRACT. WATERMARKE HOMES, LLC RETAIN THE EASEMENTS INDICATED AS 'LANDSCAPE AND MAINTENANCE EASEMENT' OVER LOTS 5, 18, 28, AND 29 AS SHOWN ON TRACT NO. 31687, RECORDED SEPTEMBER 28, 2022 IN BOOK 486, PAGES 7–10 INCLUSIVE OF MAPS. (PLOTTED HEREON)(TO BE VACATED)

(11) EASEMENT FOR THE PURPOSE OF PUBLIC UTILITIES AND RIGHTS INCIDENTAL THERETO, AS GRANTED TO SOUTHERN CALIFORNIA EDISON COMPANY, RECORDED DECEMBER 2, 2022 AS INST NO. 2022–0489553 OFFICIAL RECORDS
AFFECTS: A PORTION OF THE LAND OVER LOT 1 (PLOTTED HEREON)(TO REMAIN)

THE FOLLOWING MATTERS AFFECT PARCEL B:

(12) EASEMENT FOR THE PURPOSE OF POLE LINES, CONDUITS AND UNDERGROUND FACILITIES AND RIGHTS INCIDENTAL THERETO, AS SET FORTH IN A DOCUMENT RECORDED DECEMBER 27, 1946 IN BOOK 802, PAGE 595 OF OFFICIAL RECORDS, AND RE–RECORDED JANUARY 18, 1950 IN BOOK 1139, PAGE 491, OF OFFICIAL RECORDS. AFFECTS PORTION OF THE LAND OVER LETTERED LOT B. (PLOTTED HEREON)(TO REMAIN)

(13) EASEMENT FOR THE PURPOSE OF POLE LINES, CONDUITS AND UNDERGROUND FACILITIES AND RIGHTS INCIDENTAL THERETO, AS SET FORTH IN A DOCUMENT RECORDED JANUARY 18, 1950 IN BOOK 1139, PAGE 501 OF OFFICIAL RECORDS, AFFECTS PORTION OF THE LAND OVER LETTERED LOT B. (PLOTTED HEREON)(TO REMAIN)

[14] EASEMENT FOR THE PURPOSE OF PERPETUAL AIR OR FLIGHT EASEMENT, ALSO REFERRED TO AS 'AVIGATION RIGHTS.' RECORDED MARCH 28, 2007 AS INST. NO 2007–0210043 OF OFFICIAL RECORDS. AFFECTS ALL THE AIR SPACE ABOVE SAID LAND. (BLANKET IN NATURE)

(21) EASEMENTS FOR STREET AND PUBLIC UTILITY PURPOSES AS SHOWN ON TRACT NO. 31687–1, RECORDED SEPTEMBER 28, 2022 IN BOOK 486, PAGES 1–3 INCLUSIVE OF MAPS. A PORTION OF THE LAND OVER LETTERED LOTS A THROUGH D. OFFERED FOR DEDICATION AND ACCEPTED AS SUBJECT TO IMPROVEMENTS IN ACCORDANCE TO COUNTY STANDARDS, IMPROVEMENTS WERE NOT CONSTRUCTED. ALSO AFFECTS WATER QUALITY BASIN IN LOT 18. (PLOTTED HEREON)
(TO BE VACATED)

(22) THE OWNERSHIP OF SAID LAND DOES NOT INCLUDE RIGHTS OF ACCESS TO OR FROM THE STREET, HIGHWAY, OR FREEWAY ABUTTING SAID LAND, SUCH RIGHTS HAVING BEEN RELINQUISHED BY SAID MAP/PLAT.
AFFECTS: LOTS 1 THROUGH 6, AND 19 ABUTTING MAPES ROAD (LETTERED LOT B) (PLOTTED HEREON)

(23a) EASEMENTS FOR THE PRIVATE USE FOR THE SOLE BENEFIT OF WATERMARKE HOMES, LLC, A CALIFORNIA LIMITED LIABILITY COMPANY, THEIR SUCCESSORS, ASSIGNEES, AND LOT OWNERS WITHIN SAID TRACT. WATERMARKE HOMES, LLC RETAINS THE EASEMENTS INDICATED AS 'BLANKET DRAINAGE EASEMENT' OVER OPEN SPACE WATER QUALITY BASIN LOT 18, THE RETENTION IS FOR THE MAINTENENCE OF FLOOD CONTROL FACILITES, THE EASEMENT INDICATED AS 'BLANKET DRAINAGE EASEMENT' OVER OPEN SPACE AND LANDSCAPING LOT 19, THE RETENTION IS FOR THE MAINTENENCE OF FLOOD CONTROL FACILITES. (TO BE VACATED)

(23b) EASEMENTS FOR THE PRIVATE USE FOR THE SOLE BENEFIT OF WATERMARKE HOMES, LLC, A CALIFORNIA LIMITED LIABILITY COMPANY, THEIR SUCCESSORS, ASSIGNEES, AND LOT OWNERS WITHIN SAID TRACT. WATERMARKE HOMES, LLC RETAIN THE EASEMENTS INDICATED AS 'LANDSCAPE AND MAINTENANCE EASEMENT' OVER LOTS 1THROUGH 7, 12 AND 17 AS SHOWN ON TRACT NO. 31687–1, RECORDED SEPTEMBER 28, 2022 IN BOOK 486, PAGES 1–3 INCLUSIVE OF MAPS. (PLOTTED HEREON)(TO BE VACATED)

THE FOLLOWING ITEMS AFFECT PARCEL C:

(25) EASEMENT FOR THE PURPOSE OF POLE LINES, CONDUITS AND UNDERGROUND FACILITIES AND RIGHTS INCIDENTAL THERETO, AS SET FORTH IN A DOCUMENT RECORDED DECEMBER 27, 1946 IN BOOK 802, PAGE 595 OF OFFICIAL RECORDS, AND RE–RECORDED JANUARY 18, 1950 IN BOOK 1139, PAGE 491, OF OFFICIAL RECORDS. AFFECTS PORTION OF THE LAND OVER LOT 1 AND LETTERED LOT B. (PLOTTED HEREON)(TO REMAIN)

(26) EASEMENT FOR THE PURPOSE OF POLE LINES, CONDUITS AND UNDERGROUND FACILITIES AND RIGHTS INCIDENTAL THERETO, AS SET FORTH IN A DOCUMENT RECORDED SEPTEMBER 27, 1966 IN INST. NO 1966–95825 OFFICIAL RECORDS. (PLOTTED HEREON)(TO REMAIN)

27 EASEMENT FOR THE PURPOSE OF PERPETUAL AIR OR FLIGHT EASEMENT, ALSO REFERRED TO AS 'AVIGATION RIGHTS.' RECORDED MARCH 28, 2007 AS INST. NO 2007–0210043, OF OFFICIAL RECORDS.
AFFECTS ALL THE AIR SPACE ABOVE SAID LAND. (BLANKET IN NATURE)

(31) EASEMENTS FOR STREET AND PUBLIC UTILITY PURPOSES AS SHOWN ON TRACT NO. 31687–2, RECORDED SEPTEMBER 28, 2022 IN BOOK 486, PAGES 4–6 INCLUSIVE OF MAPS. A PORTION OF THE LAND OVER LETTERED LOTS A THROUGH E. OFFERED FOR DEDICATION AND ACCEPTED AS SUBJECT TO IMPROVEMENTS IN ACCORDANCE TO COUNTY STANDARDS, IMPROVEMENTS WERE NOT CONSTRUCTED. (PLOTTED HEREON) (TO BE VACATED)

(32) THE OWNERSHIP OF SAID LAND DOES NOT INCLUDE RIGHTS OF ACCESS TO OR FROM THE STREET, HIGHWAY, OR FREEWAY ABUTTING SAID LAND, SUCH RIGHTS HAVING BEEN RELINQUISHED BY SAID MAP/PLAT. AFFECTS LOT 18 ABUTTING MAPES ROAD (LETTERED LOT A) (PLOTTED HEREON)

(33a) EASEMENTS FOR THE PRIVATE USE FOR THE SOLE BENEFIT OF WATERMARKE HOMES, LLC, A CALIFORNIA LIMITED LIABILITY COMPANY, THEIR SUCCESSORS, ASSIGNEES, AND LOT OWNERS WITHIN SAID TRACT. WATERMARKE HOMES, LLC RETAINS THE EASEMENTS INDICATED AS 'BLANKET DRAINAGE EASEMENT' OVER OPEN SPACE WATER QUALITY BASIN LOT 18, THE RETENTION IS FOR THE MAINTENENCE OF FLOOD CONTROL FACILITES, THE EASEMENT INDICATED AS 'BLANKET DRAINAGE EASEMENT' OVER OPEN SPACE AND LANDSCAPING LOT 19, THE RETENTION IS FOR THE MAINTENENCE OF FLOOD CONTROL FACILITES AS SHOWN ON TRACT NO. 31687–2, RECORDED SEPTEMBER 28, 2022 IN BOOK 486, PAGES 4–6 INCLUSIVE OF MAPS. (PLOTTED HEREON)(TO BE VACATED)

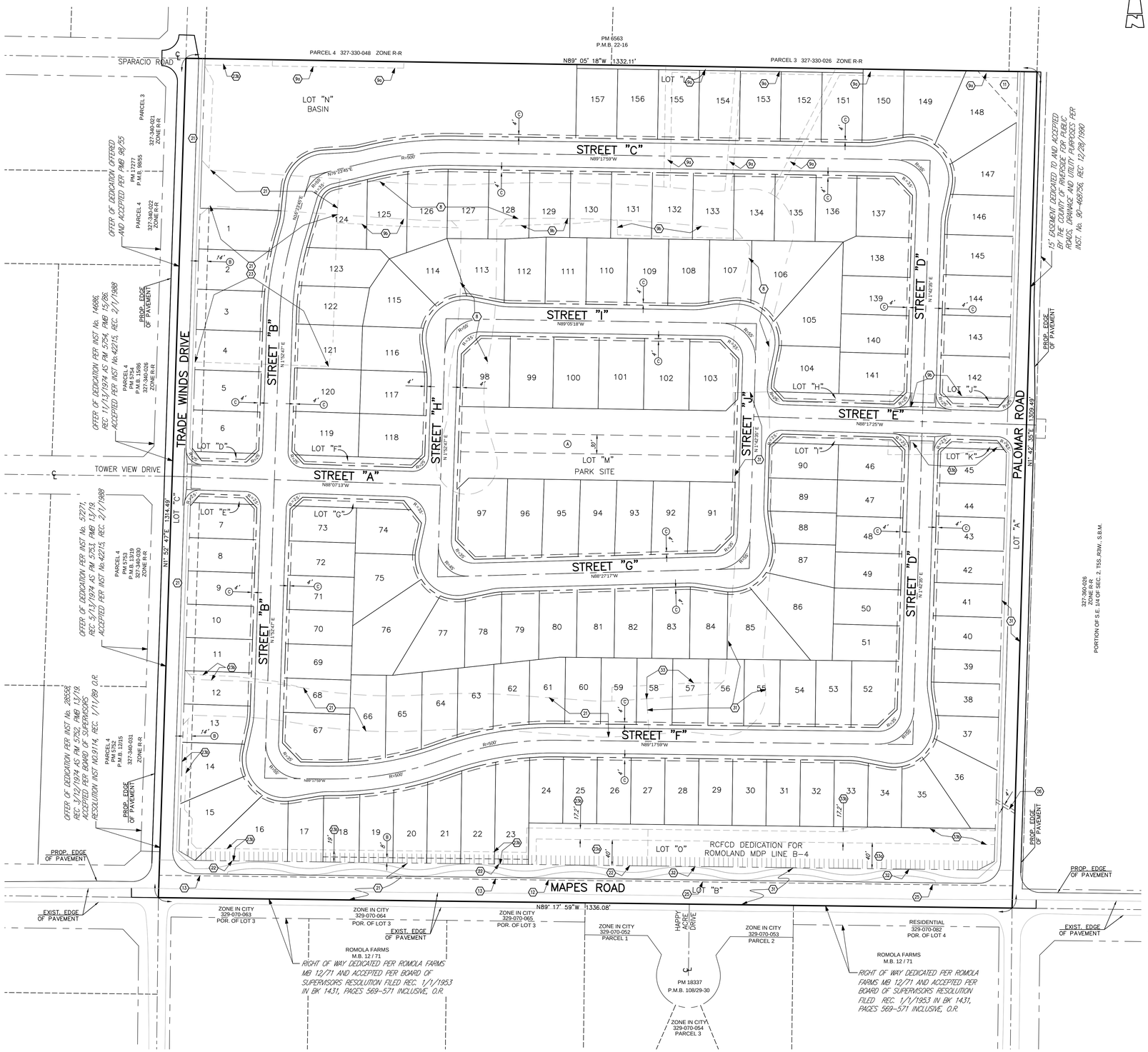
(33b) EASEMENTS FOR THE PRIVATE USE FOR THE SOLE BENEFIT OF WATERMARKE HOMES, LLC, A CALIFORNIA LIMITED LIABILITY COMPANY, THEIR SUCCESSORS, ASSIGNEES, AND LOT OWNERS WITHIN SAID TRACT. WATERMARKE HOMES, LLC RETAIN THE EASEMENTS INDICATED AS 'LANDSCAPE AND MAINTENANCE EASEMENT' OVER LOTS 1,6,11,12,13 AND 14 AS SHOWN ON TRACT NO. 31687–2, RECORDED SEPTEMBER 28, 2022 IN BOOK 486, PAGES 4–6 INCLUSIVE OF MAPS. (PLOTTED HEREON)(TO BE VACATED)

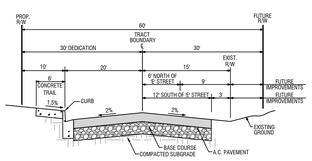
PROPOSED EASEMENTS

(A) INDICATES PROPOSED EASEMENT FOR STORM DRAIN PURPOSES.

(B) INDICATES PROPOSED EASEMENT FOR LANDSCAPE PURPOSES.

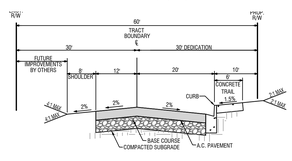
(C) INDICATES PROPOSED PUBLIC UTILITY EASEMENT FOR UTILITY PURPOSES.





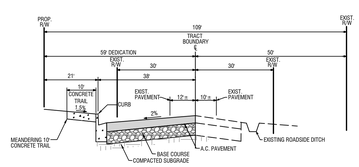
PALOMAR ROAD (LOOKING NORTH) TYPICAL STREET SECTION (PER RIV. CO. STD. NO. 104-A)

NOT TO SCALE



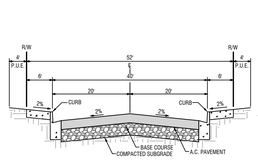
TRADE WINDS DRIVE (LOOKING NORTH) TYPICAL STREET SECTION

NOT TO SCALE



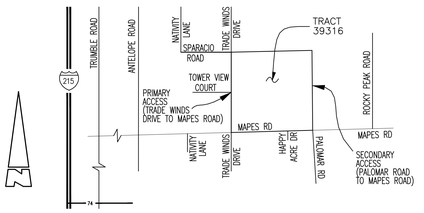
MAPES ROAD (LOOKING EAST) TYPICAL STREET SECTION

NOT TO SCALE



TYPICAL INTERIOR STREET SECTION PER RIV. CO. STD. NO. 105-A MODIFIED

NOT TO SCALE



VICINITY MAP

N.T.S.

INDEX

	SHEET NO.
TITLE SHEET	1
CONCEPTUAL GRADING PLAN	2
PRELIMINARY UTILITY PLAN	3
PRELIMINARY UTILITY PLAN	4

OWNER/DEVELOPER

EDP SOLUTIONS, INC.
3333 MICHELSON DRIVE, SUITE 500
IRVINE, CA 92612
PHONE: (949)794–1188
CONTACT: DANE PALANJIAN

CIVIL ENGINEER

KWC ENGINEERS
1181 CALIFORNIA AVE., SUITE 235
CORONA, CA 92881
PHONE: (951) 734–2130
CONTACT: NICK NGUYEN

ARCHITECT

KEVIN L CROOK ARCHITECTS, INC.
1360 REYNOLDS AVENUE
IRVINE, CA 92614
PHONE: (949) 660–1568
CONTACT: JEFF ADDISON

PROPERTY ADDRESS

NORTH SIDE OF MAPES ROAD BETWEEN TRADE WINDS DRIVE AND PALOMAR ROAD IN THE UNINCORPORATED COUNTY OF RIVERSIDE, CA

ASSESSOR'S PARCEL NUMBER

327–490–001 THRU 327–490–016; 327–491–001 THRU 327–491–018; 327–480–001 THRU 327–480–022 & 327–481–001 THRU 327–481–012

LEGAL DESCRIPTION

REAL PROPERTY IN THE COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, DESCRIBED AS FOLLOWS:

BEING A SUBDIVISION OF LOTS 1 THROUGH 31 AND LETTERED LOTS A THROUGH D OF TRACT NO. 31687, FILED IN BOOK 486, PAGES 7 THROUGH 10 OF MAPS, TOGETHER WITH LOTS 1 THROUGH 19 AND LETTERED LOTS A THROUGH D OF TRACT NO. 31687–1, FILED IN BOOK 486, PAGES 1 THROUGH 3 OF MAPS, TOGETHER WITH LOTS 1 THROUGH 18 AND LETTERED LOTS A THROUGH C OF TRACT NO. 31687–2, FILED IN BOOK 486, PAGES 4 THROUGH 6 OF MAPS, ALL INCLUSIVE IN THE OFFICE OF THE COUNTY RECORDER OF THE COUNTY RIVERSIDE, CALIFORNIA.

BENCHMARK

RIVERSIDE COUNTY BENCHMARK NO. 600–31–68. DESCRIBED AS 700' NORTH OF INTERSECTION OF MURRIETA ROAD AND ETHANAC ROAD, 40' WEST OF MURRIETA ROAD AND LEVEL WITH ROAD, 3 FT NORTHEAST OF THE SOUTHEAST CORNER OF 8 FT CHAIN LINK FENCE OF EMWD MURRIETA PUMPING STATION, 2 FT NORTH OF A MARKER POST, A SET BRASS CAP IN TOP OF A CONCRETE POST.

ELEV.= 1414.416 FEET (NGVD 29 DATUM)

BASIS OF BEARINGS

THE BASIS OF BEARINGS FOR THIS MAP IS THE CALIFORNIA STATE PLANE COORDINATE SYSTEM CCS83, ZONE 6, BASED LOCALLY ON CONTROL STATIONS "BILL", "NOCO" AND "9584" NAD 83 (NSRS2011) EPOCH 2010.00 GRID DISTANCES MAY BE OBTAINED BY MULTIPLYING THE GROUND DISTANCE BY A COMBINATION FACTOR OF 0.99991487. CALCULATIONS ARE MADE AT SET MONUMENT "POINT # 1 WITH COORDINATES OF N 2221797.0097, E 6284021.8260', AT ELEVATION 1507.01' (WGS) GEOID 18. ELEVATIONS ARE ADJUSTED TO BENCHMARK STAMPED "600–31–68, COUNTY OF RIVERSIDE (PUBLISHED ELEVATION= 1414.416 FEET NGVD 29 DATUM).

EARTHWORK QUANTITIES

TOTAL CUT:	–140,536	CY
TOTAL FILL:	136,505	CY
PIPE SPOILS:	–9,616	CY
NET EXPORT:	13,647	CY

UTILITY PURVEYORS

WATER:	EASTERN MUNICIPAL WATER DISTRICT (EMWD)	(951) 928–3777
SEWER:	EASTERN MUNICIPAL WATER DISTRICT (EMWD)	(951) 928–3777
GAS:	SOUTHERN CALIFORNIA GAS COMPANY	(951) 335–7674
ELECTRIC:	SOUTHERN CALIFORNIA ELECTRIC COMPANY	(951) 930–8580
PHONE:	FRONTIER	(805) 388–7351
CABLE:	SPECTRUM	(844) 780–6054
WASTE:	CR&R ENVIRONMENTAL SERVICES	(951) 943–1991

LEGEND

- *PROPOSED PROJECT BOUNDARY*
- *PROPOSED LOT LINES*
- *PROPOSED RIGHT OF WAY*
- *EXISTING RIGHT OF WAY*
- *EXISTING EASEMENTS*

REGISTERED PROFESSIONAL ENGINEER NICK V. NGUYEN No. 59138 Civil STATE OF CALIFORNIA

PREPARED FOR:
EPD SOLUTIONS, INC.
EPD SOLUTIONS, INC
3333 MICHELSON DRIVE, SUITE 500
IRVINE, CA 92612

PREPARED BY:
KWC ENGINEERS
CIVIL ENGINEERS • PLANNERS • SURVEYORS
1181 CALIFORNIA AVENUE, SUITE 235 CORONA, CA. 92881–3370 951–734–2130

SHEET 1 OF 4 SHEET

J.N. 22.2252.3 P:\22\2252\3\PRELIM\DRN\Preliminary Grading Plan\2252 PRELIM GRADING PLAN 01.dwg 07/16/26 2:35pm

SPARACIO ROAD

TRADE WINDS DRIVE

TOWER VIEW DRIVE

STREET 'A'

STREET 'B'

STREET 'C'

STREET 'D'

STREET 'E'

STREET 'F'

STREET 'G'

STREET 'H'

STREET 'I'

STREET 'J'

MAPES ROAD

PALOMAR ROAD

HAPPY ACRE DRIVE

NATIVITY LANE

LOT "N"

LOT "O"

LOT "M"

LOT "K"

TRACT BOUNDARY

N89°05'18"W 1332.11'

N89°17'59"W 1336.08'

327-330-046
28170 SPARACIO ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

327-330-047
28190 SPARACIO ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

327-330-048
VERY LOW DENSITY-RESIDENTIAL
R-R

327-330-026
28481 MAHOGANY LANE
VERY LOW DENSITY-RESIDENTIAL
R-R

327-350-008
24700 PALOMAR ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

327-340-021
28185 SPARACIO ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

327-340-022
VERY LOW DENSITY-RESIDENTIAL
R-R

327-340-026
28248 TOWER VIEW COURT
VERY LOW DENSITY-RESIDENTIAL
R-R

327-340-030
28243 TOWER VIEW COURT
VERY LOW DENSITY-RESIDENTIAL
R-R

327-340-031
28240 MAPES ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

327-360-026
28538 MAPES ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

329-360-023
25015 TRADE WINDS DRIVE
VERY LOW DENSITY-RESIDENTIAL
R-R

329-070-063
25050 TRADE WINDS DRIVE
VERY LOW DENSITY-RESIDENTIAL
R-R

329-070-064
28309 MAPES ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

329-070-065
28369 MAPES ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

329-070-052
25025 HAPPY ACRES DRIVE
VERY LOW DENSITY-RESIDENTIAL
R-R

329-070-053
25020 HAPPY ACRE DRIVE
VERY LOW DENSITY-RESIDENTIAL
R-R

329-070-082
28485 MAPES ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

329-310-011
28521 MAPES ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

1462.5 TOP OF BASIN
1460.4 BASIN WSE
1456.2 WQMP WSE
1455.7 BASIN BOTTOM
AREA BOT.=36,200 SQ FT

Q_{100}=6.16 CFS
Q_{100}=10.6 CFS

Q_{100}=0.52 CFS
Q_{100}=0.86 CFS

Q_{100}=5.81 CFS
Q_{100}=9.85 CFS

Q_{100}=3.84 CFS
Q_{100}=6.54 CFS

Q_{100}=3.60 CFS
Q_{100}=6.09 CFS

Q_{100}=4.11CFS
Q_{100}=6.71CFS

Q_{100}=7.0 CFS
Q_{100}=11.60 CFS

Q_{100}=4.00 CFS
Q_{100}=6.57 CFS

Q_{100}=5.00 CFS
Q_{100}=8.43 CFS

Q_{100}=16.3 CFS
Q_{100}=29.2 CFS

Q_{100}=1.7 CFS
Q_{100}=3.0 CFS

Q_{100}=0.66 CFS
Q_{100}=1.09 CFS

Q_{100}=2.28 CFS
Q_{100}=3.94 CFS

Q_{100}=1.61 CFS
Q_{100}=2.77 CFS

Q_{100}=3.61 CFS
Q_{100}=6.08 CFS

EX. 15' x 30' DRAINAGE EASEMENT DEDICATED TO AND ACCEPTED BY THE COUNTY OF RIVERSIDE FOR DRAINAGE PURPOSE PER INSTRUMENT No. 2007-0290108, RECORDED 05/01/2007

MATCH EXIST. (1460.1)

MATCH EXIST. (1498.8)

MATCHLINE SEE RIGHT

MATCHLINE SEE LEFT

SCALE IN FEET
50 0 50 100 150

SECTION A–A
NOT TO SCALE

SECTION B–B
NOT TO SCALE

SECTION C–C
NOT TO SCALE

SECTION D–D
NOT TO SCALE

SECTION E–E
NOT TO SCALE

SECTION F–F
NOT TO SCALE

SECTION G–G
NOT TO SCALE

SECTION H–H
NOT TO SCALE

SECTION J–J
NOT TO SCALE

PRELIMINARY GRADING PLAN
MAPES ROAD RESIDENTIAL
COUNTY OF RIVERSIDE, CA

PREPARED FOR:
EPD SOLUTIONS, INC.
3333 MICHELSON DRIVE, SUITE 500
IRVINE, CA 92612

PREPARED BY:
KWC ENGINEERS
CIVIL ENGINEERS • PLANNERS • SURVEYORS
1181 CALIFORNIA AVENUE, SUITE 235 CORONA, CA. 92881-3370 951-734-2130

SHEET 2 OF 4 SHEET

JN: 22.22552 R:\22\22552\PRELIM\EXH\Preliminary Grading Plan\22552 PRELIM GRADING PLAN 02.dwg 07/17/24 10:53am

MATCHLINE - SEE SHEET 4

APN 327-330-047

327-330-048
VERY LOW DENSITY-RESIDENTIAL
R-R

327-330-026
28481 MAHOGANY LANE
VERY LOW DENSITY-RESIDENTIAL
R-R

327-350-008
24700 PALOMAR ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

327-340-021
28185 SPARACIO ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

327-340-022
VERY LOW DENSITY-RESIDENTIAL
R-R

327-340-026
28248 TOWER VIEW COURT
VERY LOW DENSITY-RESIDENTIAL
R-R

327-340-030
28243 TOWER VIEW COURT
VERY LOW DENSITY-RESIDENTIAL
R-R

327-340-031
28240 MAPES ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

327-360-026
28538 MAPES ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

APN 329-360-023

329-070-063
25050 TRADE WINDS DRIVE
VERY LOW DENSITY-RESIDENTIAL
R-R

329-070-064
28309 MAPES ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

329-070-065
28369 MAPES ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

329-070-052
25025 HAPPY ACRES DRIVE
VERY LOW DENSITY-RESIDENTIAL
R-R

329-070-053
25020 HAPPY ACRE DRIVE
VERY LOW DENSITY-RESIDENTIAL
R-R

329-070-082
28485 MAPES ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

329-310-011
28521 MAPES ROAD
VERY LOW DENSITY-RESIDENTIAL
R-R

SPARACIO ROAD
TRADE WINDS DRIVE
TOWER VIEW DRIVE
PALOMAR ROAD
MAPES ROAD
HAPPY ACRE DRIVE
STREET 'A'
STREET 'B'
STREET 'C'
STREET 'D'
STREET 'E'
STREET 'F'
STREET 'G'
STREET 'H'
STREET 'I'
STREET 'J'
LOT "L"
LOT "M"
LOT "N"
LOT "O"
TRACT BOUNDARY
N89°05'18"W 1332.11'
N1°52'47"E 1314.49'
N1°42'35"E 1309.46'
N89°17'59"W 1336.08'
PROP. 36" SD CFD MAINTAINED
EXIST. PP TO BE REMOVED & UNDERGROUNDED BY OTHERS
EXIST. PP PROTECT IN PLACE
EXIST. SCE ESMT. INSTRUMENT # 2022-0489553
EXIST. 3" GAS PER SOCAL FAC MAP RCO 4543
EXIST. 8" ACP WATER PER D-3654
EXIST. 12" IRR WATER PER D-3654
EXIST. 8" ACP WATER PER D-5489
EXIST. TELEPHONE PER EMWD D-21788
EXIST. 8" CWL & C PER D-278
EXIST. COMM LINE PER FRONTIER SUBSTRUCTURE MAP NO. 701105268040
EXIST. GAS PER SOCAL GAS FAC MAP RCO4643
EXIST. R/W
EXIST. WM
EXIST. WATER
EXIST. FH
EXIST. FRONTIER PED
EXIST. TELE PED
EXIST. SPECTRUM PB
PROP. SEWER
PROP. SD
PROP. WTR
PROP. CB
PROP. R/W
PROP. SIDEWALK
PROP. CURB & GUTTER
PROP 8" WATER
PROP. 8" PVC WATER
PROP. CATCH BASIN WITH 6" CONC PAD AND 6" AC DIKE
PROP. CONCRETE DROP INLET PER RCFCD STD DWG NO. CB110 AND 6" PCC PAD W/24"H x 24"W GABIONS SURROUNDING THE INLET
EX. 15' x 30' DRAINAGE EASEMENT DEDICATED TO AND ACCEPTED BY THE COUNTY OF RIVERSIDE FOR DRAINAGE PURPOSE PER INSTRUMENT No. 2007-0290108, RECORDED 05/01/2007
65' RCFCD DEDICATION
ROMONA AND MDP LINE E-4
PROP. 6' MEANDERING SIDEWALK
PROP. 30' SD ESMT. CFD MAINTAINED
14' LS ESMT. CFD MAINTAINED
8' LS ESMT. CFD MAINTAINED
4' PUE
6' HOA COMMON LOT
R=500'
R=450'
R=25'
R=55'
N16°23'45"E
N1°52'47"E
N1°42'35"E
N89°17'59"W
N88°07'13"W
N88°27'17"W
N89°05'18"W
N88°17'25"W
1 PAD=1464.7
2 PAD=1465.2
3 PAD=1465.7
4 PAD=1466.2
5 PAD=1466.7
6 PAD=1467.2
7 PAD=1468.3
8 PAD=1468.7
9 PAD=1469.2
10 PAD=1469.6
11 PAD=1470.0
12 PAD=1470.4
13 PAD=1470.9
14 PAD=1471.3
15 PAD=1471.9
16 PAD= 1472.4
17 PAD= 1473.9
18 PAD= 1475.0
19 PAD= 1475.9
20 PAD= 1476.9
21 PAD= 1477.9
22 PAD= 1478.9
23 PAD= 1479.9
24 PAD= 1480.9
25 PAD= 1481.8
26 PAD= 1482.8
27 PAD= 1483.7
28 PAD= 1484.7
29 PAD= 1485.6
30 PAD= 1486.6
31 PAD= 1487.5
32 PAD= 1488.5
33 PAD= 1489.4
34 PAD= 1489.9
35 PAD= 1490.0
36 PAD= 1490.0
37 PAD=1490.0
38 PAD=1489.9
39 PAD=1489.6
40 PAD=1489.1
41 PAD=1488.7
42 PAD=1488.3
43 PAD=1487.9
44 PAD=1487.5
45 PAD=1487.1
46 PAD=1487.1
47 PAD=1487.5
48 PAD=1488.0
49 PAD=1488.4
50 PAD=1488.9
51 PAD=1489.3
52 PAD= 1489.6
53 PAD= 1488.9
54 PAD= 1487.9
55 PAD= 1486.9
56 PAD= 1485.9
57 PAD= 1484.9
58 PAD= 1483.9
59 PAD= 1482.9
60 PAD= 1481.9
61 PAD= 1480.9
62 PAD= 1479.9
63 PAD= 1479.0
64 PAD= 1478.0
65 PAD= 1476.9
66 PAD= 1475.9
67 PAD=1470.9
68 PAD=1470.5
69 PAD=1470.0
70 PAD=1469.6
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72 PAD=1468.8
73 PAD=1468.3
74 PAD=1472.5
75 PAD= 1472.8
76 PAD= 1473.2
77 PAD= 1474.1
78 PAD= 1475.3
79 PAD= 1476.6
80 PAD= 1478.0
81 PAD= 1479.3
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84 PAD= 1483.0
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111 PAD= 1477.0
112 PAD= 1476.2
113 PAD= 1475.4
114 PAD=1474.7
115 PAD=1474.5
116 PAD=1474.1
117 PAD=1473.1
118 PAD=1472.1
119 PAD=1467.2
120 PAD=1466.7
121 PAD=1466.2
122 PAD=1465.6
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126 PAD= 1465.7
127 PAD= 1466.7
128 PAD= 1468.2
129 PAD= 1469.7
130 PAD= 1472.7
131 PAD= 1474.2
132 PAD= 1475.7
133 PAD= 1477.2
134 PAD= 1478.7
135 PAD= 1480.2
136 PAD= 1483.0
137 PAD=1486.6
138 PAD=1488.6
139 PAD=1488.2
140 PAD=1487.7
141 PAD=1487.2
142 PAD=1487.2
143 PAD=1487.7
144 PAD=1488.2
145 PAD=1488.7
146 PAD=1489.2
147 PAD=1489.0
148 PAD=1488.9
149 PAD= 1488.3
150 PAD= 1487.1
151 PAD= 1483.4
152 PAD= 1480.4
153 PAD= 1478.9
154 PAD= 1477.4
155 PAD= 1475.9
156 PAD= 1474.0
157 PAD= 1471.9

PAD ELEV.
TC/INV.
1.0% MIN
HP/FL
LOT NO.
PAD= PAD ELEV
FF= FINISH FLOOR ELEV
GF= GARAGE FRONT ELEV
(STEP DOWN TO GARAGE -0.5')
DRIVEWAY 18% MAX.
16'
R/W
CURB FACE
DIRECTION OF FLOW

TYPICAL LOT DRAINAGE DETAIL
NOT TO SCALE

UTILITY LEGEND

- W — PROPOSED WATER (1801 ZONE)
- S — PROPOSED SEWER
- PROPOSED STORM DRAIN
- W — EXISTING WATER
- S — EXISTING SEWER
- EXISTING STORM DRAIN
- PROPOSED FIRE HYDRANT
- EXISTING FIRE HYDRANT

N

50 0 50 100 150
SCALE IN FEET

PRELIMINARY UTILITY PLAN
MAPES ROAD RESIDENTIAL
COUNTY OF RIVERSIDE, CA

PREPARED FOR:
EPD SOLUTIONS, INC.
3333 MICHELSON DRIVE, SUITE 500
IRVINE, CA 92612

PREPARED BY:
KWC ENGINEERS
CIVIL ENGINEERS • SURVEYORS • PLANNERS
1181 CALIFORNIA AVENUE, SUITE 205 CORONA, CA 92881-3370 951-734-2130

SHEET 3 OF 4 SHEET

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APN 327-170-004

APN 327-330-013

APN 327-330-044

APN 327-330-045

APN 327-330-046

APN 327-340-002

APN 327-340-003

APN 327-340-019

APN 327-340-020

APN 327-340-021

APN 327-340-023

APN 327-340-024

APN 327-340-025

APN 327-340-027

APN 327-340-028

APN 327-340-029

APN 327-304-001

APN 327-340-013

APN 327-340-014

APN 327-340-015

APN 329-050-001

APN 329-050-002

APN 329-360-001

APN 329-360-002

APN 329-360-022

APN 329-360-023

TRACT 37358

TRACT 37358

BLUE GRASS LANE

HABITAT PLACE

ANTELOPE ROAD

PITCHER STREET

BEAM CLAY LANE

STRIKE OUT DRIVE

NATIVITY LANE

SPARACIO ROAD

TOWER VIEW DRIVE

MAPES ROAD

EXIST. R/W

EXIST. R/W

60'

JOIN EXIST. 36" SD
1438.44 INV.

EXIST. 36" SD PER RCFCD &
WCD PROJECT NO. 4-0-00426,
DRAWING NO. 4-1221, LAT A-7

EXIST. 42" SD
PER TR 37358

20' SD EASEMENT

EXIST. CB

EXIST. CB

EXIST. DROP INLET

EXIST. 18" SD

PROP. 36" SD
CFD MAINTAINED

EXIST. PROPERTY LINE

30'

EXIST. UTILITY ESM'T PER
INSTRUMENT # 67-269536

EXIST. UTILITY ESM'T PER
INSTRUMENT # 67-269536

PROP. 36" SD
CFD MAINTAINED

30' EX R/W

EXIST.
DRIVEWAY

EXIST. R/W

60' EX R/W

℄ OF STREET

PROP. 36" SD
CFD MAINTAINED

ROAD SURFACE ON SPARACIO
ROAD SHALL BE PRIVATELY
MAINTAINED BY OTHERS

EXIST. R/W

EXIST.
DRIVEWAY

VERY LOW DENSITY-RESIDENTIAL
R-R

EXIST. 3" GAS PER SOCAL
FAC MAP RCO 4543

EXIST. 3" GAS PER SOCAL
FAC MAP RCO 4543

EXIST. 8" ACP
WATER PER D-3654

EXIST. 8" ACP
WATER PER D-3654

EXIST. R/W

EXIST. R/W

60'

ANTELOPE ROAD

EXIST. UTIL
PED

EXIST.
ROW

EXIST. PP
PROTECT IN
PLACE

EXIST. 8" WATER

EXIST. 8" WATER

JOIN EX. 15" SEWER
1420.71 INV.

N89°34'04"W

EXIST. 8" SEWER

EXIST. M.H. #12
PER EMWD D-67583
COUNTY FILE NO. 972 S

PROP. 15" SEWER

EXIST.
ROW

℄ OF STREET

PROP. 15" SEWER

EXIST. GAS PER SOCAL
GAS FAC MAP RCO4643

EXIST. PP
PROTECT IN
PLACE

EXIST.
ROW

EXIST. PP
PROTECT IN
PLACE

EXIST.
SPECTRUM
PB

EXIST. PP
PROTECT IN
PLACE

EXIST. GTE
PED

EXIST.
DRIVEWAY

EXIST. PP
PROTECT IN
PLACE

EXIST. WM

EXIST. PH

EXIST. WM

EXIST. PP
PROTECT IN
PLACE

EXIST.
DRIVEWAY

EXIST. WM

EXIST.
SPECTRUM
PB

EXIST. PP
PROTECT IN
PLACE

EXIST.
DRIVEWAY

EXIST. GAS PER SOCAL
GAS FAC MAP RCO4643

NATIVITY LANE

60'

MATCHLINE - SEE SHEET 3

N

SCALE IN FEET
50 0 50 100 150

PRELIMINARY UTILITY PLAN
MAPES ROAD RESIDENTIAL
COUNTY OF RIVERSIDE, CA

PREPARED FOR:
EPD SOLUTIONS, INC.
3333 MICHELSON DRIVE, SUITE 500
IRVINE, CA 92612

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1181 CALIFORNIA AVENUE, SUITE 220, CORONA, CA. 92881-3370. 951-734-2130

SHEET
4 OF 4
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Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data

PRELIMINARY GEOTECHNICAL INVESTIGATION AND GENERAL RIPPABILITY ASSESSMENT TRACT 31687, ROMOLAND AREA RIVERSIDE COUNTY, CALIFORNIA

FOR

SOUTHERN CALIFORNIA LAND MANAGEMENT
31566 RAILROAD CANYON ROAD, #643
CANYON LAKE, CALIFORNIA 92587

W.O. 4787-A-SC JUNE 30, 2005

GeoSoils, Inc.

Geotechnical • Coastal • Geologic • Environmental

26590 Madison Avenue • Murrieta, California 92562 • (909) 677-9651 • FAX (909) 677-9301

June 30, 2005

W.O. 4787-A-SC

Southern California Land Management
31566 Railroad Canyon Road, #643
Canyon Lake, California 92587

Attention: Mr. Brian Merritt

Subject: Preliminary Geotechnical Investigation and General Rippability Assessment, Tract 31687, Romoland Area, Riverside County, California

Dear Mr. Merritt:

In accordance with your request and authorization, this report presents the results of GeoSoils, Inc.'s (GSI) preliminary geotechnical investigation and general rippability assessment of Tract 31687, in the Romoland area of Riverside County, California. The purpose of this study was to provide a preliminary geotechnical report, in light of onsite soils and geologic conditions and their effects on the proposed site development from a geologic/geotechnical viewpoint. In general, our study was to evaluate potential remedial removal depths, rock hardness (i.e., general rippability assessment), etc. In addition, preliminary geotechnical foundation design parameters, slope stability evaluations, settlement evaluations, and developed recommendations for earthwork construction for the proposed residential development are provided herein.

EXECUTIVE SUMMARY

Based on our review of data (Appendix A), field exploration, laboratory testing, and geologic and engineering analyses, the proposed site appears suitable for its intended use, from a geotechnical viewpoint, provided the recommendations presented in the text of this report are properly implemented. The most significant elements of our preliminary investigation are provided below:

- In general, the site may be characterized as being underlain at depth by Cretaceous-aged granitic bedrock, which is discontinuously overlain by ±1½ feet to in excess of +39½ feet of older alluvial fan deposits, which are likely Pleistocene in age. Alluvium, of likely Holocene-age, ranging up to ±5 feet in thickness, underlies the northwest portion of the site, contained within a gully/swale. These units are mantled by ±1½ to ±6 feet of potentially compressible topsoil/colluvium.

Removal and recompaction of the topsoil/colluvium, alluvium, and weathered near surface fan deposits (additional ±1 to ±2 feet) will be required should settlement sensitive improvements be proposed within their influence. For preliminary planning purposes, these depths are estimated to range from ±2½ to ±4 feet across the site, with localized deeper removals on the order of ±8 feet deep, or deeper, if not removed by planned excavation. A minimum of 2 feet of compacted fill is recommended below foundation elements.

- Based upon our experience in this area, and the seismic refraction data obtained, assuming a D9L, or equivalent, the granitic bedrock, where encountered, should be generally rippable (i.e., seismic velocities of less than about 6,000 feet per second [fps]) to depths ranging from about ±15 to greater than ±35 feet. However, there are localized areas (e.g., boulder outcrops, buried corestones, etc.) which may potentially require very difficult ripping to possible blasting. This should be considered during preliminary planning and cost estimation purposes.

- Using the 3,800 fps cut-off for non-rippable trenching, assuming a CAT 235 hoe, the granitic bedrock, if encountered, throughout much of the site should be generally trenchable (i.e., seismic velocities of less than about 3,800 fps) to depths ranging from about ±14 to greater than ±35 feet. However, very difficult trenching to possible line-blasting, may not be precluded during utility installation assuming a commercial rubber-tire backhoe, and should also be considered during preliminary planning and cost estimation purposes.

- Oversize materials (boulders, etc., greater than 12 inches in diameter) should be anticipated during grading and trenching. Many stockpiled boulders and/or boulder outcrops were mapped on the northeastern portion of the site. Excavation and placement difficulties, as well as possible offsite disposal of these materials should be considered. As per the Uniform Building Code/California Building Code ([UBC/CBC], International Conference of Building Officials [ICBO], 1997 and 2001) requirements, no oversize materials greater than 12 inches in diameter should be placed within 10 feet of finish grade. This may necessitate the need for scraper/dozer pits, if the oversized materials are not removed from the site, or reduced in size, prior to or, during grading.

- Cut and fill slopes are designed at gradients of 2:1 horizontal to vertical (h:v), or flatter, and are proposed to a maximum height of about ±9 and ±15½ feet, respectively. Based on the current proposed configurations of cut and fill slopes, field mapping, current sampling and laboratory testing, and our preliminary evaluation, the proposed cut and fill slopes are considered grossly and surficially stable. Keyways for fills-over-cut, and daylight cuts, should be properly constructed, as depicted in the General Earthwork and Grading Guidelines section of this report.

- Preliminary laboratory testing and our experience on other nearby properties, indicates the expansion potentials of the onsite soils are generally very low to low; however, soils exhibiting medium expansion potentials cannot be precluded from occurring onsite. Preliminary foundation recommendations for conventional and post-tension design are provided herein, for very low to medium expansive conditions.

- Typical samples of the site materials have been analyzed for soluble sulfate/corrosion potential. Based on preliminary laboratory testing results, which indicated 0.0052 percent by weight, the use of sulfate resistant (Type V) concrete is generally not anticipated for the site. In addition, based on the preliminary test results, the onsite soils are considered moderately alkaline and are moderately corrosive to ferrous metals in a saturated state. Accordingly, additional recommendations should be obtained from a consulting corrosion engineer, including recommendations for foundations, metals, and piping, etc., where such materials may come into contact with site soils.

- No groundwater was encountered onsite to a depth in excess of ±39½ feet below the ground surface. However, due to the relatively dense nature of the underlying bedrock/alluvial fan deposits, the possibility of local seepage may not be precluded, during or after site development, and should be anticipated. The need for subdrainage systems for the control of localized seepage and/or groundwater may not be precluded during grading or after development. This potential should be disclosed to all homeowners and any homeowners association.

- The potential for liquefaction, subsidence, or significant mass wasting within the site is considered low, provided our recommendations are properly implemented.

- Our review indicates no known active faults are crossing the site area, and the site is not within an Alquist-Priolo Earthquake Fault Zone, nor is it within a known liquefaction zone established by the County of Riverside or State of California.

- Adverse geologic features that would preclude project feasibility were not encountered.

- The recommendations presented in this report should be incorporated into the design and construction considerations of the project.

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

Respectfully submitted,

GeoSoils, Inc.

John P. Franklin
Engineering Geologist, CEG 1340

David W. Skelly
Civil Engineer, RCE 47857

Todd A. Greer
Engineering Geologist, CEG 2377

TAG/JPF/DWS/jh

Distribution: (6) Addressee

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Appendix D - Laboratory Test Results . . . . . Rear of Text
Appendix E - Seismic Refraction Data . . . . . Rear of Text
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SCOPE OF SERVICES

The scope of our services has included the following:

1. Review of available geologic maps and data, including aerial photography, for the site area (Appendix A).

2. Review of the current tentative tract map for the site (CSL Engineering, Inc., [CSL], 2005).

3. Geologic site reconnaissance and mapping, as well as meeting with Underground Service Alert (USA).

4. Performance of a photo-lineament analysis for the site and vicinity.

5. Surface and subsurface exploration consisting of the advancement of three 8-inch hollow stem borings and excavation of 19 backhoe test pits, utilizing a rubber-tire backhoe, across the site for geotechnical logging and sampling (see Appendix B). The approximate locations of exploratory test pits and borings are shown on Plate 1 (Geotechnical Map).

6. General areal seismicity (see Appendix C).

7. Relevant laboratory testing of representative soil samples collected during our subsurface exploration program (see Appendix D).

8. Execution of four double-directional seismic refraction survey lines to generally evaluate the potential depth, occurrence, and hardness (rippability) of the underlying granitic bedrock across the site (see Appendix E). The approximate locations of the seismic refraction survey lines are shown on Plate 1 (Geotechnical Map).

9. Appropriate engineering and geologic analysis of data collected.

10. Preparation of this geotechnical report, and attachments, including boring and test pit logs, seismic refraction data (including rock hardness evaluations), laboratory test results, regional seismic data, preliminary foundation design, general earthwork factors, and recommendations for site grading.

SITE LOCATION/CONDITIONS

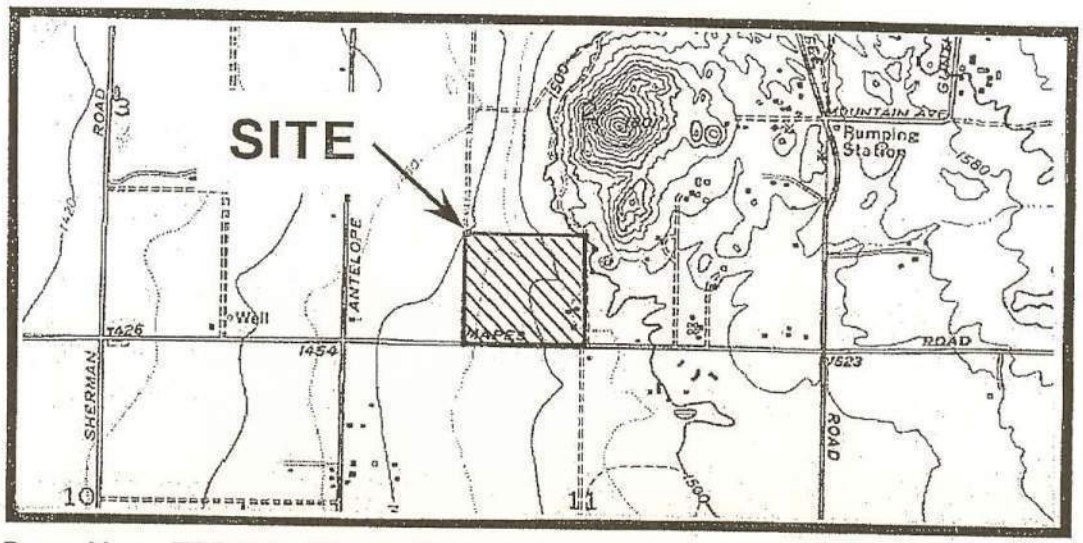
Tentative Tract 31687 is an rectangular-shaped parcel that consists of ±40 acres of generally undeveloped land, located on the northeast corner of the intersection of Mapes Road and Trade Winds Drive in the Romoland area of Riverside County, California (see Figure 1, Site Location Map). The property is bounded on the south by Mapes Road, on the west by Trade Winds Drive, on the east by the extension of Palomar Road, and on the north by an undeveloped property. The site slopes gently to the northwest, and onsite elevations generally range from a low of about ±1,458 feet mean sea level (MSL) in the northwest corner of the site to a high of about ±1,492 feet MSL in the southeast corner of the site. Drainage across the site is primarily to the northwest by sheetflow and one small incised gully/swale located on the northeast portion of the property.

PROPOSED DEVELOPMENT/PLAN REVIEW

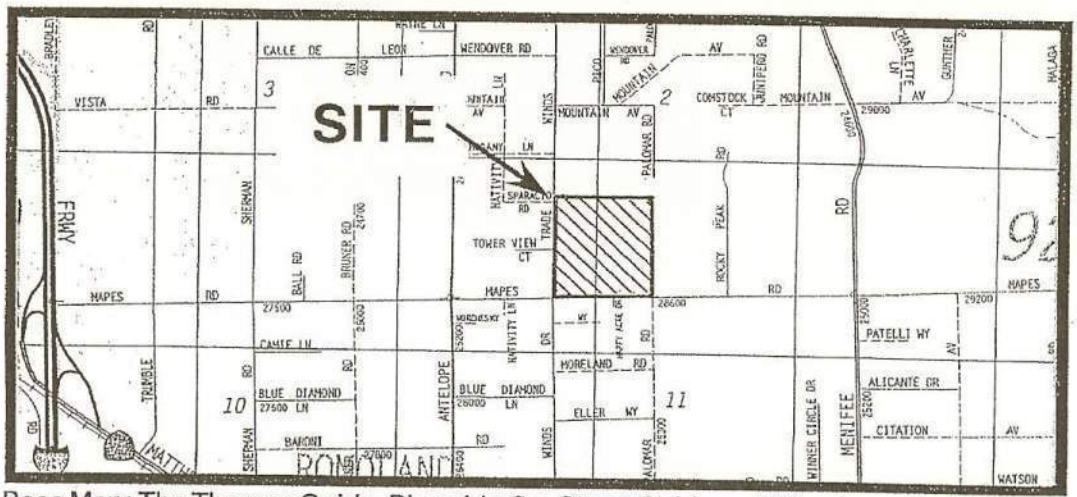
The 100-scale plans prepared by CSL (2005), indicate that typical cut and fill grading techniques would be utilized to ready the site for single-family residential development of 65 lots, with associated infrastructure, landscaping, and underground utilities. According to the plans, rough grading will create cut and fill slopes designed at inclinations of 2:1 (h:v), or flatter, attaining maximum heights of about ±9 and ±15½ feet, respectively. The maximum thickness of proposed cuts and fills are on the order of ±11 and ±9 feet, respectively. It is also our understanding that the residential buildings would be one- and/or two-story structures, utilizing typical wood-frame construction with slabs-on-grade and continuous footings and/or utilizing post-tensioned foundations. Building loads are assumed to be typical for this type of relatively light construction. Sewage disposal is to be accommodated by tying into the regional municipal system. The need for import soils is currently unknown.

FIELD STUDIES

Field investigations conducted during our preliminary evaluation of the property for this study entailed geologic reconnaissance mapping, advancement of three 8-inch hollow-stem exploratory borings, excavation of 19 exploratory test pits, and performance of five double-directional seismic refraction survey lines. The exploratory borings and test pits were logged by a geologist from our firm who collected representative bulk and undisturbed ring samples for appropriate laboratory testing. The seismic refraction surveys were performed by geologists from our firm. Logs of the borings and test pits are presented in Appendix B. The seismic refraction survey data is presented in Appendix E. The approximate locations of the borings, test pits, and seismic refraction surveys are shown on Plate 1 (Geotechnical Map).



Base Map: TOPO!® ©2003 National Geographic, USGS Perris Quadrangle, California–Riverside Co., 7.5-Minute, dated 1978, current 1979.



Base Map: The Thomas Guide, Riverside Co. Street Guide and Directory, 2005 Edition, by Thomas Bros. Maps, page 808

LOCATION AND SCALES APPROXIMATE

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GeoSoils, Inc.	W.O. 4787-A-SC
SITE LOCATION MAP	
Figure 1	

GEOLOGY

Regional Geologic Setting

The property is situated in the eastern portionn of the Perris Block, a portion of a prominent natural geomorphic province in southwestern California known as the Peninsular Ranges. The Perris Block is a stable structural block bounded on the west by the Elsinore fault zone and on the east by the San Jacinto fault zone. The Peninsular Ranges is characterized by steep, elongated ranges and valleys that trend northwesterly. This province is typified by plutonic and metamorphic rocks (bedrock) which comprise the majority of the mountain masses, with relatively thin volcanic and sedimentary deposits discontinuously overlying the bedrock, and with Plio/Pleistocene-age (Quaternary-age) alluvial fan deposits filling in the valleys and younger alluvium filling in the incised drainages. The alluvial deposits are derived from the water borne deposition of the products of weathering and erosion of the bedrock materials.

Local Geology

As mapped by Dibblee (2003), the majority of the site is underlain by Quaternary-age alluvial deposits, which are in-turn underlain by plutonic bedrock (commonly called "granitics") at depth, and locally exposed at the surface on the northeastern portion of the site. However, based on our subsurface investigation, the underlying sedimentary deposits are more aptly termed alluvial fan deposits. The alluvial fan deposits, as encountered onsite, are likely Pleistocene in age based on Stage II carbonate veins, veinlets, and generally indurated nature of the fan deposits encountered onsite during our subsurface exploratory program. The basement rocks were described by Dibblee (2003) as foliated granitic rocks of quartz tonalite and quartz diorite composition.

SITE EARTH MATERIALS

The geologic units encountered within the project site consist of colluvium/topsoil, alluvium, Quaternary-age alluvial fan deposits, and Cretaceous-age granitic bedrock. Mappable geologic units are shown on Plate 1, these units are described as follows, from youngest to oldest:

Colluvium/Topsoil (Unmapped)

In general, the site is mantled by a relatively thin layer of colluvium/topsoil. These materials were generally observed to be light brown to reddish brown, silty sands. The materials were dry to damp, loose to locally medium dense with depth, and locally porous. These surficial soils occasionally contained minor to locally abundant rootlets. In general, these materials typically have a low, and sometimes medium, expansion potential. The colluvium/topsoil was encountered ranging from ±1½ to ±6 feet in thickness. Due to the

potentially compressible nature of these surficial soils, they are considered unsuitable for support of structures and/or improvements in their existing state. Therefore, these soils will be need to be removed and recompacted, if not removed during planned excavation, should settlement sensitive improvements be proposed within their influence.

Quaternary-age Alluvium (Map Symbol - Qal)

Quaternary-age alluvium was mapped in a northwest-trending gully/swale, in the northern portion of the site. The materials were generally observed to be brown, silty sands that were damp to moist and loose; the alluvial layer is about ±5 feet in thickness. Due to the potentially compressible nature of these surficial soils, they are considered unsuitable for support of structures and/or improvements in their existing state. Therefore, these soils will be need to be removed and recompacted, if not removed during planned excavation, should settlement sensitive improvements be proposed within their influence.

Quaternary-age Alluvial Fan Deposits (Map Symbol - Qf)

Quaternary-age alluvial fan deposits were encountered underlying topsoil/colluvium onsite. These sediments were basically distinguished to be dark brown to reddish brown, silty sands. Localized layers contained minor amounts of clay. These deposits were generally noted to be dry to moist and medium dense to dense with depth. Localized areas were encountered that contained Stage II carbonate veinlets near the stratigraphic top of the formation, and thus are likely at least Pleistocene in age, near the surface. As encountered onsite, the alluvial fan deposits typically have a low expansion potential; however, medium expansive soils may not be entirely precluded. Due to the potential for settlement, near surface weathered alluvial fan deposits should be removed and/or processed prior to compacted fill placement (additional ±1 to ±2 feet), should settlement-sensitive improvements be proposed within their influence.

Cretaceous-age Granitics-Undifferentiated (Map Symbol - Kgr)

Cretaceous-age plutonic rocks (commonly called "granitics") underlie the site at varying depths. These rocks have been mapped (Dibblee, 2003) as quartz diorite and tonalite. The granitic materials encountered in our test pits were primarily moderately to heavily weathered near the surface. The weathered granitics encountered in our exploratory test pits were generally observed to be quartz diorite that had weathered to grayish to reddish brown silty sands. These materials were dry to moist and medium dense to very dense, at depth. Generally, these materials typically have a very low to low expansion potential; however, residual colluvium developed on granitic rocks may be medium expansive. These rocks were generally more heavily weathered and fractured in the near surface and will, therefore, require surficial removal (upper ±1 foot) if not removed by planned excavation.

GEOLOGIC STRUCTURE

Field mapping from this study, indicates that the strike of the regional foliation patterns within the granitic bedrock onsite are generally from N20W to N45W, and are steeply inclined to the northeast. Joint spacing within the granitic bedrock onsite ranges from 4 to 18 inches to greater than 10 feet or more. It is likely that these regional joint and foliation trends are pervasive (primary discontinuity systems), and may reasonably be projected to depth owing to their formation from regional: a) tectonic stresses causing fracturing essentially contemporaneously with tectonic activity; b) residual stresses due to events that happened long before the fracturing; or, c) caused by regional uplift, and faulting related to other nearby batholithic emplacements along weakened planes within the granitic bedrock unit.

Based on the above, it appears that structural conditions within the bedrock are relatively complex. Jointing, foliation, and fracturing represent potentially weak planes in otherwise massive rock that, when unfavorably oriented, may adversely affect cut slope stability. Based on the available data, adverse geologic structures are not anticipated to significantly affect the proposed development. Geologic structure within the granitic bedrock, where encountered, should be further evaluated during actual site earthwork, to assess bedrock structure relative to actual slope designs. Based on the conditions disclosed during the plan review or grading stages, supplemental recommendations regarding slope stabilization may be warranted.

FAULTING AND REGIONAL SEISMICITY

The site is situated in an area of active as well as potentially-active faults. The nearby San Jacinto fault zone is considered active and is included within an Alquist-Priolo Earthquake Fault Zone. Our review indicates that there are no known active faults crossing the site, and the site is not within a Fault-Rupture Hazard Zone (Hart and Bryant, 1997). During our review of aerial photographs (USDA, 1980), we did not observe photolineaments or other features specifically indicative of faulting crossing the site.

The following table lists the major faults and fault zones in southern California that could have a significant effect on the site should they experience activity.

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE MILES (KM)
Burnt Mountain	47.1 (75.8)
Chino - Central Avenue (Elsinore)	24.4 (39.2)
Clamshell - Sawpit	53.1 (85.5)
Cleghorn	36.0 (58.0)

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE MILES (KM)
Compton Thrust	47.0 (75.6)
Coronado Bank	55.4 (89.2)
Cucamonga	35.0 (56.4)
Earthquake Valley	52.1 (83.9)
Elsinore - Glen Ivy	13.4 (21.6)
Elsinore - Julian	27.9 (44.9)
Elsinore - Temecula	13.2 (21.3)
Elysian Park Thrust	41.8 (67.2)
Emerson South - Copper Mountain	60.9 (98.0)
Eureka Peak	49.8 (80.1)
Helendale - South Lockhardt	45.5 (73.3)
Johnson Valley (Northern)	56.5 (90.9)
Landers	51.3 (82.5)
Lenwood - Lockhart - Old Woman Springs	51.1 (82.3)
Newport - Inglewood (L.A. Basin)	45.0 (72.4)
Newport - Inglewood (Offshore)	39.0 (62.7)
North Frontal Fault Zone (East)	38.8 (62.4)
North Frontal Fault Zone (West)	33.9 (54.6)
Palos Verdes	55.1 (88.6)
Pinto Mountain	32.7 (52.7)
Rose Canyon	46.0 (74.1)
San Andreas - 1857 Rupture	43.6 (70.1)
San Andreas - Coachella	41.5 (66.8)
San Andreas - Mojave	43.6 (70.1)
San Andreas - San Bernardino	23.4 (37.6)
San Andreas - Southern	23.4 (37.6)
San Jacinto - Anza	14.4 (23.1)
San Jacinto - Coyote Creek	43.1 (69.4)
San Jacinto - San Bernardino	18.4 (29.6)
San Jacinto - San Jacinto Valley	9.6 (15.4)
San Jose	39.5 (63.5)
Sierra Madre	42.2 (67.9)
Whittier	28.0 (45.1)

The possibility of ground shaking at the site may be considered similar to the southern California region as a whole. The relationship of the site location to these major mapped faults is indicated on the California Fault Map (see Figure 2). Our field observations and review of readily available geologic data indicate that known active faults do not cross the site.

The acceleration-attenuation relations of Bozorgnia, Campbell, and Niazi (1999), and Campbell and Bozorgnia (1997), have been incorporated into EQFAULT (Blake, 2000a). For this study, peak horizontal ground accelerations anticipated at the site were determined based on the random mean and random mean plus 1 - sigma attenuation curves developed by Bozorgnia, Campbell, and Niazi (1999), and Campbell and Bozorgnia (1997). These acceleration-attenuation relations have been incorporated in EQFAULT, a computer program by Thomas F. Blake (2000a), which performs deterministic seismic hazard analyses using digitized California faults as earthquake sources. The program estimates the closest distance between each fault and a user-specified file. If a fault is found to be within a user-selected radius, the program estimates peak horizontal ground acceleration that may occur at the site from the upper bound ("maximum credible") earthquake on that fault. Site acceleration (g) is computed by user-selected acceleration-attenuation relations that are contained in EQFAULT. Based on the above, peak horizontal ground accelerations from an upper bound event may be on the order of 0.24g to 0.48g.

Historical site seismicity was evaluated with the acceleration-attenuation relations of Bozorgnia, Campbell, and Niazi (1999), and the computer program EQSEARCH (Blake, 2000b, updated to December 2004). This program performs a search of historical earthquake records for magnitude 4.0 to 9.0 seismic events within a 100-mile radius, between the years 1800 to December, 2004. Based on the selected acceleration-attenuation relationship, a peak horizontal ground acceleration is estimated, which may have effected the site during the specific event listed. Based on the available data and the attenuation relationship used, the estimated maximum repeatable peak site acceleration during the period 1800 through December, 2005 was 0.38g. In addition, site specific probability of exceeding various peak horizontal ground accelerations and a seismic recurrence curve are also estimated/generated from the historical data. Printouts from EQSEARCH are provided in Appendix C.

A probabilistic seismic hazards analysis was performed using FRISKSP (Blake, 2000c) which models earthquake sources as three-dimensional planes and evaluates the site specific probabilities of exceedance for given peak acceleration levels or pseudo-relative velocity levels. Based on a review of these data, and considering the relative seismic activity of the southern California region, a peak horizontal ground acceleration of 0.55g was calculated. This value was chosen as it corresponds to a 10 percent probability of exceedance in 50 years (or a 475-year return period). Printouts from FRISKSP are also included in Appendix C.

CALIFORNIA FAULT MAP

4787-A

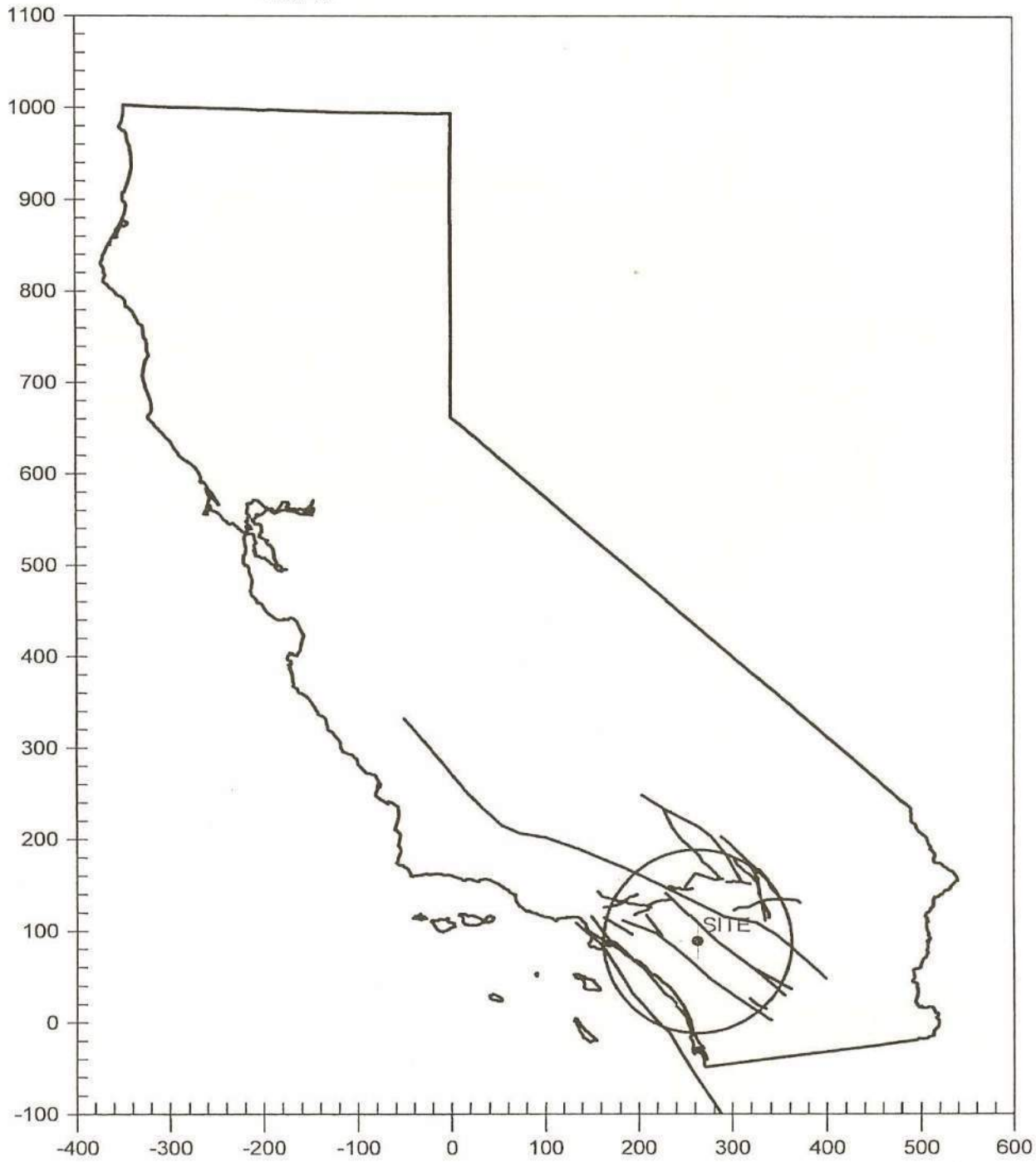


Figure 2

Seismic Shaking Parameters

Based on the site conditions, Chapter 16 of the UBC/CBC (ICBO, 1997), and ICBO (1998), the following seismic parameters are provided.

UBC/CBC TABLE/FIGURE DESIGNATION	FAULT PARAMETERS
Seismic zone (per Figure 16-2*)	4
Seismic zone factor Z (per Table 16-I*)	0.40
Soil Profile Types (per Table 16-J*)	S_D
Seismic Coefficient C_a (per Table 16-Q*)	0.44 N_a
Seismic Coefficient C_v (per Table 16-R*)	0.64 N_v
Near Source factor N_a (per Table 16-S*)	1.0
Near Source factor N_v (per Table 16-T*)	1.0
Distance to Seismic Source (San Jacinto Valley fault)	9.6 mi. (15.4 km)
Seismic Source Type (per Table 16-U*)	B**
Upper Bound Earthquake (San Jacinto Valley fault)	M_W 6.9**
* Figure and table references from Chapter 16 of the UBC/CBC (ICBO, 1997 and 2001). ** ICBO (1998).	

GROUNDWATER

Seeps, springs, mottled soils, or other indications of a high groundwater level were not noted on the subject property during the time of our field investigation to depths in excess of ±39½ feet. Based on historic water well data acquired from the California Department of Water Resources (CDWR, 2004), "Water Data Library," groundwater levels in other nearby wells were previously measured at depths ranging from ±92 feet to in excess of +135 feet below the ground surface. However, perched groundwater onsite may occur in the bedrock and alluvial fan materials, or along jointing and/or fractures due to migration from adjacent drainage areas and development during and/or after periods of above normal or heavy precipitation or irrigation. Thus, perched groundwater conditions may occur in the future, and should be anticipated. Should manifestations of perched conditions (i.e., seepage) develop in the future, GSI could assess the conditions and provide mitigative recommendations, as necessary. This potential should be disclosed to all homeowners and any homeowners association. Additional discussions of groundwater are presented within the conclusions section of this report.

OTHER GEOLOGIC HAZARDS

Liquefaction

Seismically-induced liquefaction is a phenomenon in which cyclic stresses, produced by earthquake-induced ground motion, create excess pore pressures in soils. The soils may thereby acquire a high degree of mobility, and lead to lateral movement, sliding, sand boils, consolidation and settlement of loose sediments, and other damaging deformations. This phenomenon occurs only below the water table; but after liquefaction has developed, it can propagate upward into overlying, non-saturated soil as excess pore water dissipates. Typically, liquefaction has a relatively low potential at depths greater than 45 feet and is virtually unknown below a depth of 60 feet.

Liquefaction susceptibility is related to numerous factors and the following conditions should be concurrently present for liquefaction to occur: 1) sediments must be relatively young in age and not have developed a large amount of cementation; 2) sediments generally consist of medium to fine grained relatively cohesionless sands; 3) the sediments must have low relative density; 4) free groundwater must be present in the sediment; and 5) the site must experience a seismic event of a sufficient duration and magnitude, to induce straining of soil particles.

The condition of liquefaction has two principal effects. One is the consolidation of loose sediments with resultant settlement of the ground surface. The other effect is lateral sliding. Significant permanent lateral movement generally occurs only when there is significant differential loading, such as fill or natural ground slopes within susceptible materials. No such loading conditions exist on the site. In the site area, we found there is a potential for seismic activity and a groundwater table deeper than ±39½ feet below the ground surface. In addition, relatively shallow granitic bedrock was encountered across portions of the site that was dense to very dense.

It should be noted that throughout our site observations and borings and test pits, there was no evidence of upward-directed hydraulic force that was suddenly applied, and was of short duration, nor were there any features commonly caused by seismically induced liquefaction, such as dikes, sills, vented sediment, lateral spreads, or soft-sediment deformation. These features would be expected if the site area had been subject to liquefaction in the past (Obermeier, 1996). Inasmuch as the future performance of the site with respect to liquefaction should be similar to the past, excluding the effects of urbanization (irrigation), GSI concludes that the site generally has not been subject to liquefaction in the geologic past, regardless of the depth of the regional water table.

Inasmuch as at least two or three of these five required concurrent conditions discussed above do not have the potential to affect the site, evidence of paleoliquefaction features was not observed, and the relatively dense alluvial fan deposits or bedrock that underlies the site, our evaluation indicates that the potential for liquefaction and associated adverse

effects within the site is low, even with a future rise in groundwater levels. The site conditions will also be improved by removal and recompaction of low density near-surface soils. Therefore, it is our opinion that the liquefaction potential does not constitute a significant risk to site development.

Subsidence

The effects of areal subsidence generally occur at the transition or boundaries between low-lying areas and adjacent hillside terrain, where materials of substantially different engineering properties (i.e., alluvium vs. bedrock) are present. The potential for this condition exists between the bedrock and alluvial fan deposits. However, based on the available data, the site is not situated at, or near the boundaries of an actively subsiding basin. Therefore, the potential for this phenomena to affect the site is also considered low.

In addition, our review of available data, as well as stereoscopic aerial photographs (USDA, 1980), showed no features generally associated with areal subsidence (i.e., radially-directed drainages flowing into a depression(s), linearity of depressions associated with mountain fronts, etc.). Ground fissures are generally associated with excessive groundwater withdrawal and associated subsidence, or active faulting. Our review did not reveal any information that active faulting or excessive groundwater withdrawal, or ground fissures, or hydroconsolidation in the specific site vicinity, is occurring at this time. Therefore, the potential for areal subsidence or ground fissures is deemed low. However, groundwater levels may change in the future as a result of groundwater withdrawal/pumping, climatic change, or irrigation.

Mass Wasting

Mass wasting refers to the various processes by which earth materials are moved down slope in response to the force of gravity. Examples of these processes include slope creep, surficial failures, rockfall, deep-seated landslides, etc. Creep is the slowest form of mass wasting and generally involves the outer 5 to 10 feet of the slope surface. During heavy rains, such as those in 1969, 1978, and 1980, 1983, 1993, 1998, and 2004/2005 creep-affected materials may become saturated, resulting in a more rapid form of down slope movement (i.e., landslides, surficial failures, and/or rockfall). However, the subject site consists of relatively low gradient terrain and indications of significant mass wasting phenomena on the site were not observed during our review of stereoscopic photographs of the area (USDA, 1980) or during our site reconnaissance mapping. However, due to the non-cohesive materials that may exist on portions of the site, caving and sloughing should be anticipated in all subsurface excavations and trenching. Appropriate safety considerations for potential caving and sloughing, such as shoring or layback cuts, should be incorporated into the construction design details. Therefore, based on the above, the potential for mass wasting phenomena within the site is considered low, provided our recommendations are properly implemented. Likewise, the potential for seismically induced landsliding is considered low. The potential for flooding should be evaluated by the design civil engineer.

LABORATORY TESTING

Classification

Soils were classified visually according to the Unified Soils Classification System and by supplemental index testing. The soil classifications are shown on the Boring Logs and Test Pit Logs (Appendix B).

Moisture-Density

The field moisture content and dry unit weight were determined for each undisturbed sample of the soils encountered in the borings. The dry unit weight was determined in pounds per cubic foot (pcf), and the field moisture content was determined as a percentage of the dry weight. The results of these tests are shown on the Boring Logs (Appendix B).

Laboratory Standard

The maximum dry density and optimum moisture content was determined for the major soil types encountered in the borings and test pits. The laboratory standard used was ASTM D-1557. The moisture-density relationships obtained for these soils are shown below:

SOIL TYPE	LOCATION AND DEPTH (ft.)	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
Gray, SILTY SAND	TP-4 @ 3' - 4'	135.0	8.5
Reddish Brown, SILTY SAND	TP-10 @ 3' - 4'	136.0	8.0

Expansion Index Testing

Expansion Index (E.I.) testing was performed on a representative soil sample, according to Standard No. 18-2 of the UBC/CBC (ICBO, 1997 and 2001). The test results are presented below as well as the expansion classification according to UBC/CBC (ICBO, 1997 and 2001).

LOCATION	SOIL TYPE	EXPANSION INDEX	EXPANSION POTENTIAL
TP-4 @ 3' - 4'	Gray, SILTY SAND	0	Very Low
TP-13 @ 2½' - 3½'	Reddish Brown, SILTY SAND	23	Low

Plasticity Index Testing/Atterberg Limits

For preliminary foundation planning purposes, plasticity index testing was performed where E.I. testing indicated an E.I. greater than 20. Testing was performed to evaluate the liquid limit, plastic limit and plasticity index in general accordance with ASTM D-4318-64. The test results were also utilized to evaluate the soil classification in accordance with the Unified Soil Classification System. The test result and classification are presented in the following table:

LOCATION	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
TP-13 @ 2½' - 3½'	34	18	16

Sulfate/Corrosion Testing

Typical samples of the site materials were analyzed for soluble sulfates, pH, and resistivity. The soluble sulfate and corrosion potential results are shown as follows:

LOCATION AND DEPTH (FT.)	SOLUBLE SULFATES PERCENTAGE BY WEIGHT	pH	RESISTIVITY (Ohms-cm)
TP-2 @ 5 - 6'	0.0052	8.4	2,100

For preliminary planning purposes, based upon the soluble sulfate test results and the latest edition of the UBC/CBC (ICBO, 1997 and 2001), the soluble sulfate content is categorized as negligible. Therefore, on a preliminary basis, sulfate-resistant concrete (Type V), with a modified cement to water ratio and modified concrete compressive strength should not be necessary. Based on the results of the resistivity and pH testing, the onsite soils are judged to be generally moderately alkaline (pH of 7.9 to 8.4) and are considered to be moderately corrosive (resistivity of 2,000 to 10,000) toward ferrous metals in a saturated state.

Although the site soils are categorized as being moderately corrosive toward ferrous metals, no exposure conditions stated in Table 19-A-2 of the UBC/CBC (ICBO, 1997 and 2001) were found within the subject site. It is our understanding that ferrous metals embedded in properly poured and formed Type I, II, or V concrete should be adequately protected from these conditions. Additionally, as stated above, the preliminary soluble sulfate content on the subject site is considered negligible. Based on the test results obtained, a consulting corrosion engineer should be retained to provide specific recommendations for foundations, metal, piping, etc., that may come into contact with site soils.

Consolidation Testing

Consolidation testing was performed on a relatively undisturbed soil samples in general accordance with ASTM Test Method D-2435. The consolidation test results are presented in Appendix D.

Shear Testing

Shear testing was performed in a direct shear machine of the strain-control type. The rate of deformation is approximately 0.05 inches per minute. The samples were sheared under varying confining loads in order to determine the Coulomb shear strength parameters, angle of internal friction and cohesion. The testing was performed on an undisturbed and remolded sample of the alluvial fan deposits. The shear testing results are presented in Appendix D.

R-value Testing

Two representative samples were collected for resistance (R-value) testing to aid with preliminary pavement design. The samples were tested and evaluated in general accordance with California Materials Method No. 301. The test results indicated R-values of 15 and 41. The test results are presented in Appendix D. Preliminary pavement design recommendations are presented in following sections of this report.

EMBANKMENT FACTORS

Embankment factors (shrinkage) for the site have been estimated based upon our field and laboratory testing, visual site observations, and experience. It is apparent that shrinkage would vary with depth and with areal extent over the site, based on previous site use. Variables include vegetation, weed control, and discing. However, all these factors are difficult to define in a three-dimensional fashion. Therefore, the information presented below represents average shrinkage/bulking values, using certain earthwork assumptions as follows:

Range of maximum density = 135.0 to 136.0 pcf
Relative Compaction = 92%

Material	% Range
Colluvium/Topsoil Deposits	-15 to -22 (shrinkage)
Alluvium Deposits	-18 to -25 (shrinkage)
Quaternary Alluvial Fan Deposits	-10 to -15 (shrinkage)
Bedrock (Weathered - 25% Rock Fragments, 75% Earth Materials)	0 to -8 (shrinkage)
Bedrock (Mix - 50% Rock Fragments, 50 % Earth Materials)	0 to -5 (shrinkage)
Bedrock (Unweathered -75% Rock Fragments, 25% Earth Materials)	0 to +12 (bulking)

An additional shrinkage factor item would include the removal of individual large plants or trees. The root structures/root balls of these plants and trees vary in size, but when pulled, they may result in a loss of ½ to 1½ cubic yards. This factor needs to be multiplied by the number of significant plants or trees present to determine the net loss. Subsidence due to dynamic compaction from equipment routes, etc., is estimated to be 0.10 feet in non-bedrock areas. Furthermore, the grading contractor also influences shrinkage based on the degree of compaction attained in the field (i.e., 90 vs. 94 percent compaction, etc.)

The above factors indicate that earthwork balance of the site would be difficult to define and flexibility in design is essential to achieve a balanced end product.

ROCK HARDNESS EVALUATION

A seismic refraction survey, consisting of four seismic refraction lines, was conducted using a Geometrics SmartSeis 12-channel exploration seismograph, with a hammer and plate energy source. The approximate seismic line locations are shown on the enclosed Plate 1 (Geotechnical Map), and the velocity and depth interval results are graphically shown in Appendix E. An example of the raw seismic data is included as Plate E-1, and illustrates a forward and split spread shot from the same line.

The first arrival information, shot point locations, geophone locations, and line geometry from each survey are utilized in the computer programs SIPIK, SIPT2, and SIPLOT and/or SIPwin (Rimrock Geophysics, 1995,1997, and 2002) which produces time-distance plots for each of the survey lines (see example, Plate E-2). The graphic curves reflect the actual time-distance plots generated by the program, showing the shot points and phone locations. The first curve, from left to right shows the forward spread from the first shot. The second, or split spread shot point creates two curves in opposite directions from the shot in the middle of the spread. The third curve represent the reverse shot from the distant end of the spread.

The data for the surveys performed generally show a three-layer case. The uppermost layer is generally thin as would be expected, reflecting the surficial materials (i.e., topsoil/colluvium and/or alluvium). Undulations in time-distance curves can be attributed to a lack of elevation corrections to the raw data, possible minor disturbances from noise (e.g., wind or traffic), decreased energy at distant geophones, and discontinuities in the subsurface.

The velocity-depth models, or cross-sections, generated are included as Plates E-3 through E-6 for SL-1 through SL-4, respectively. As can be seen on these plates, the boundaries between various seismic velocity layers appear to be somewhat undulatory, typical of fractured and weathered crystalline (i.e., granitic) rocks where there is a access to the subsurface for air and water. Fracture density/frequency also contributes to the variation in depth of weathering and therefore differences in seismic velocities.

Layer boundaries tend to mimic the surface topography, although variations are common depending upon the depth of weathering, fracturing, etc. Thickness of the surficial layer (i.e., colluvium/topsoil and/or alluvium, or weathered bedrock) averages about ±3 feet, but generally varies from ±2 to ±4 feet. Average velocity of Layer 1 materials is about ±1,517 feet per second (fps). This is typical for such material. The average thickness of Layer 2 (generally weathered bedrock) is about ±20 feet, but ranges from ±14 to ±34 feet. Average velocity of Layer 2 is about ±3,355 fps, with some variability. Average velocity in Layer 3 (unweathered bedrock), is about ±5,065 fps, with seismic velocities ranging from 3,889 to 7,802 fps. At depths where velocities are greater than about 5,000 to 6,000 fps, rippability is ambiguous and blasting usually is required.

An evaluation has been made of the seismic refraction line data to estimate the approximate depth to non-rippable trenching (i.e., utility excavation) and to non-rippable bedrock. Approximate cut-off velocities of ±3,800 and ±6,000 fps were used as a basis for non-rippable trenching (assuming a Cat 235 Hoe [a large trackhoe], or equivalent), and non-rippable bedrock (assuming a D9L, or equivalent), respectively. It should be noted that a conventional rubber-tired backhoe will experience non-productive trenching at seismic velocities much less than ±2,000 to 2,500 fps.

Bedrock excavatability with respect to trenching shallower than the approximate ±3,800 fps cut-off depth is expected to vary from easy to very difficult and the necessity for localized areas requiring blasting cannot be precluded. Similarly, bedrock rippability shallower than the approximate ±6,000 fps cut-off depth is expected to vary from easy to very difficult, and the necessity for localized areas requiring blasting cannot be entirely precluded.

Variations should be expected. As such, bedrock excavations from the surface downward may generate oversize rock. Isolated "floaters or corestones may also be encountered, and should be anticipated, based on our field mapping and rock outcrops exposed at the surface (see Plate 1). The bulk of the materials derived from the weathered portion of the bedrock (up to and including the ±3,800 to 6,000 fps cut-off) are anticipated to disintegrate to approximately 12 to 24 inches and smaller constituents. Any oversize materials (≥ 12 inches) generated would require special handling for use in fills, and may not be placed within 10 feet of finish grade or used as backfill in utility trenches.

Based upon our experience in this area, and the seismic refraction data obtained, the following table reflects our estimates of the rippability at the various seismic refraction survey lines; other interpretations are possible:

SEISMIC LINE NO.	GENERAL RIPPABILITY (ASSUMING A D9L DOZER OR CAT 235 HOE, OR EQUIVALENT)
SL-1	Rippable to a depth of ±45 feet on the north, and ±45 feet on the south. Non-trenchable below ±30 feet on the north, and ±19 feet on the south.
SL-2	Rippable to a depth of ±55 feet on the east, and ±55 feet on the west. Non-trenchable below ±24 feet on the east, and ±18 feet on the west.
SL-3	Rippable to a depth of ±35 feet on the north, and ±25 feet on the south. Non-trenchable below ±3 feet on the north, and ±2 feet on the south.
SL-4	Rippable to a depth of ±45 feet on the east, and ±45 feet on the west. Non-trenchable below ±14 feet on the east, and ±14 feet on the west.

Due to the nature of the surficially discontinuous and/or relatively near-surface granitic terrain in the northeastern part of the site, localized blasting may be anticipated in those areas to achieve proposed cut depths as well as street/roadway undercuts for utility construction in the future, or for foundations.

Using the 3,800 fps cut-off for non-rippable trenching (in lieu of street overexcavation), it is likely that very difficult ripping to possible blasting (e.g., "line-shooting") may be necessary for trenching of utilities along the proposed roadway alignments in the northeastern portion of the site. As an alternative to blasting for utilities, overexcavation of street areas during mass grading to 1 foot below the depth of the lowest utility should be considered. This is not a geotechnical requirement; however, it may be mandated by the governing agency.

Summary

In general, utilizing the seismic data in conjunction with relevant boring and test pit information, it appears the majority of the site (excepting the granitic knoll area in the northeastern part of the site) may be characterized as being mantled by a relatively thin layer of topsoil/colluvium to depths generally ranging from about ±2, up to about ±4 feet in thickness. Below that horizon (excepting the granitic knoll area in the northeastern part of the site), Quaternary fan deposits were encountered to a depth in excess of ±39½ feet in thickness. Underlying the surficial soils and weathered bedrock in the granitic knoll area in the northeastern part of the site, fresh and very dense granitic rock locally exists within ±25 to ±34 feet from the surface (see SL-3). Based on all of the above, it is anticipated that the need for overexcavation and/or line shooting may be necessary in some portions of the site. The need for localized blasting cannot be ruled out. It should be noted that a conventional rubber-tired backhoe will experience non-productive trenching at seismic velocities much less than ±2,000 to 2,500 fps. The seismic refraction data presented herein should be further reviewed in conjunction with future grading plans (when available).

Variations should be expected. As such, bedrock excavations from the surface downward may generate oversize rock. The bulk of the materials derived from the weathered portion of the bedrock (up to and including the ±3,800 fps and ±6,000 fps cut-offs) are anticipated to disintegrate to approximately 12- to 24-inch and smaller constituents. Any oversize materials generated would require special handling for use in fills, as outlined later in this report under "Rock Disposal." Due to the nature of the bedrock terrain, localized blasting may be anticipated on the northern portion of the site to achieve proposed cut depths.

PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

General

Based on our field exploration, laboratory testing and geotechnical engineering analysis, it is our opinion that the site appears suitable for the proposed development from a geotechnical engineering and geologic viewpoint, provided that the recommendations presented in the following sections are incorporated into the design and construction phases of site development. The primary geotechnical concerns with respect to the proposed development are:

- Depth to suitable bearing strata.
- Rock hardness/rippability, and potential for oversize materials requiring special handling and placement.
- Ongoing expansion and corrosion potential of site soils.
- Ongoing potential for perched water to occur during and after site development.
- Regional seismic activity.

The recommendations presented herein consider these as well as other aspects of the site. The engineering analyses performed concerning site preparation and the recommendations presented herein have been completed using the information provided by the client and obtained during our field work.

The conclusions and recommendations contained in this report shall not be considered valid unless the proposed development is reviewed and the recommendations of this report verified or modified in writing by this office. Foundation design parameters are considered preliminary until the foundation design, layout, and structural loads are provided to this office for review.

1. Soil engineering, observation, and testing services should be provided during grading to aid the contractor in removing unsuitable soils and in his effort to compact the fill.

2. Geologic observations should be performed during grading to verify and/or further evaluate geologic conditions. Although unlikely, if adverse geologic structures are encountered, supplemental recommendations and earthwork may be warranted.

3. Removal and recompaction of the topsoil/colluvium, alluvium, and weathered near surface fan deposits (additional ±1 to ±2 feet) will be required should settlement sensitive improvements be proposed within their influence. For preliminary planning purposes, these depths are estimated to range from ±2½ to ±4 feet across the site, with localized deeper removals on the order of ±8 feet deep, or deeper, if not removed by planned excavation. Moisture-density and consolidation test results indicate the materials are not uniform, are potentially subject to hydrocollapse and/or compression in their present condition, and may be subject to adverse differential settlement, if not mitigated during site grading operations.

4. Due to the nature of bedrock materials on the northeastern portion of the site oversize materials (boulders) will be encountered during grading. This may necessitate the construction of rock fills, rock fill blankets, or reduction of size during grading operations. Offsite disposal, placement in proposed non-structural fill areas, and/or landscape use of any oversized materials encountered may also be considered. As per UBC/CBC (ICBO, 1997 and 2001) requirements, no oversize materials greater than 12 inches in diameter should be placed within 10 feet of finish grade. Procedures for the construction of rock fills or rock fill blankets are outlined in the Fill Placement and Rock Disposal sections of this report.

5. In general and based upon the available data to date, groundwater is not expected to be a major factor in development of the site. However, due to the nature of the site materials, seepage may be encountered throughout the site along with seasonal perched water within any drainage areas. In addition, seepage may be encountered in "daylighted" joint systems within the granitic bedrock and/or alluvial fan deposits. Therefore, subdrainage systems for the control of localized groundwater seepage should be anticipated, both during and after grading.

6. Cavities or loose soils remaining after demolition and site clearance (including geotechnical test pits) should be cleaned out and observed by the soil engineer. The cavities should be replaced with fill materials that have been moisture conditioned to at least optimum moisture content and compacted to at least 90 percent of the laboratory standard.

Treatment of Existing Ground

1. All topsoil/colluvium, alluvium, and near-surface weathered fan deposits and/or weathered bedrock should be removed to competent alluvial fan deposits or dense bedrock, as defined herein, (i.e., removal bottoms should be greater than, or equal to, 85 percent saturation, and/or greater than, or equal to, 105 pcf dry density for

in-place native materials), which has been demonstrated and proven to the controlling authorities as acceptable in the past to mitigate the potential for hydroconsolidation. For preliminary planning purposes, these depths are estimated to range from ±4 to ±5 feet across the site, with localized deeper removals on the order of ±8 feet deep, or deeper. Variations from these thicknesses should be anticipated. Actual depths of removals will be evaluated in the field during grading by the soil engineer.

2. Subsequent to the above removals, the upper 12 inches of the exposed fan deposits and/or granitic bedrock should be scarified, brought to at least optimum moisture content, and recompacted to a minimum relative compaction of 90 percent of the laboratory standard.

3. Existing topsoil/colluvium and alluvium, etc., and removed natural ground materials may be reused as compacted fill provided that major concentrations of vegetation and miscellaneous trash and debris are removed prior to or during fill placement.

4. Localized deeper removal may be necessary due to buried drainage channel meanders or dry porous materials. The project soils engineer/geologist should observe all removal areas during the grading.

Fill Placement

1. Subsequent to ground preparation, fill materials should be brought to at least optimum moisture content, placed in thin 6- to 8-inch lifts and mechanically compacted to obtain a minimum relative compaction of 90 percent of the laboratory standard.

2. Fill materials should be cleansed of major vegetation and debris prior to placement.

3. Any oversized rock materials greater than 8 inches in diameter should be placed under the recommendations and supervision of the soils engineer and/or reduced in size and/or removed from the site. Should significant amounts of oversize rock be encountered, recommendations for rock fill placement will be provided by GSI. As per UBC/CBC (ICBO, 1997 and 2001) requirements, no oversize materials greater that 12 inches in diameter should be placed within 10 feet of finish grade.

4. Any import materials should be observed and determined suitable by the soils engineer prior to placement on the site. Foundation designs may be altered if import materials have a greater sulfate and/or expansion value than the onsite materials encountered in this investigation.

Transition Areas/Overexcavation

In order to reduce the potential for differential settlements between cut and fill materials, materials of differing expansion potentials, or dense bedrock, the entire cut portion of cut/fill transitions within proposed residential lots (per the UBC/CBC) should be overexcavated to a minimum depth of 3 feet below finish grade, or 2 feet below foundation elements, and/or a maximum ratio of fill thickness on the lot of 3:1 (h:v), whichever is more onerous, and replaced with compacted fill.

ROCK PLACEMENT GUIDELINES

Rock Disposal

We anticipate that soils to be utilized as fill material for the subject tract may contain rock. Appropriately, the need for rock disposal may be necessary during grading operations on the site. Generally for the purpose of this report, the materials may be described as either 8 inches or less, greater than 8 and less than 36 inches, and greater than 36 inches. These three categories set the basic dimensions for where and how the materials are to be placed.

Materials 8 Inches in Diameter or Less:

Since imported rock fragments along with the overburden materials are anticipated to be a part of the materials used in the grading of the site, a criteria is needed to facilitate the placement of these materials within guidelines which would be workable during the rough grading, post-grading improvements, and serve as acceptable compacted fill.

1. Fines and rock fragments 8 inches or less in diameter may be placed as compacted fill cap materials within the building pads, slopes, and street areas as described below. The rock fragments and fines should be brought to at least optimum moisture content and compacted to a minimum relative compaction of 90 percent of the laboratory standard.

2. The purpose for the 8-inch diameter limits is to allow reasonable sized rock fragments into the fill under selected conditions (optimum moisture or above) surrounded with compacted fines. The 12-inch diameter size also allows a greater volume of the rock fragments to be handled during grading, while staying in reasonable limits for later onsite excavation equipment (backhoes and trenchers) to excavate footings and utility lines.

3. Fill materials 8 inches or less in diameter should be placed, but not limited to, within the upper 10 feet of proposed fill pads, the upper 3 feet of overexcavated cut areas of cut/fill transition pads, and the entire street right-of-way width, including the proposed overexcavated areas and replacement fill areas, from the depth of the lowest utility to subgrade, or to a depth of 10 feet below finish grade. Overexcavation is discussed earlier in this report.

Materials Greater Than 8 and Less Than 36 Inches in Diameter:

1. During the process of bedrock excavation, a significant amount of rock fragments or constituents larger than 8 inches in diameter may be generated. These significant amounts of oversized materials between greater than 8 and less than 36 inches in diameter may be incorporated into the fills utilizing a series of rock blankets.

2. Each rock blanket should consist of rock fragments of approximately greater than 8 and less than 36 inches in diameter along with fines generated from the proposed cuts and overburden materials from removal areas. The blankets should be limited to 24 to 36 inches in thickness and should be placed with granular fines which are flooded into and around the rock fragments.

3. Rock blankets should be restricted to areas which are at least 1 foot below the lowest utility invert within the street right-of-way, 10 feet below finish grade on the proposed fill lots, and a minimum of 15 horizontal feet from any fill slope surface.

4. Compaction may be achieved by utilizing wheel rolling methods with scrapers and water trucks, track-walking by bulldozers, and sheepsfoot tampers.

5. Each rock blanket should be completed with its surface compacted prior to placement of any subsequent rock blanket or rock windrow.

Materials Greater Than 36 Inches in Diameter:

1. Oversize rock greater than 36 inches in diameter should be placed in single rock windrows. The windrows should be at least 15 feet or an equipment width apart, whichever is greatest.

2. The void spaces between rocks in windrows should be filled with the more granular soils by flooding them into place.

3. A minimum vertical distance of 3 feet between soil fill and rock lift should be maintained. Also, the windrows should be staggered from lift to lift. Rock windrows should not be placed closer than 15 feet from the face of fill slopes.

4. Larger rocks too difficult to be placed into windrows may be individually placed into a dozer trench. Each trench should be excavated into the compacted fill or dense natural ground a minimum of 1 foot deeper than the size of the rock to be buried. After the rocks are placed in the trench (not immediately adjacent to each other), granular fill material should be flooded into the trench to fill the voids.

5. The oversize rock trenches should be no closer together than 15 feet at a particular elevation and at least 15 feet from any slope face. Trenches at higher elevations should be staggered and there should be 4 feet of compacted fill between the top of one trench and the bottom of the next higher trench. Placement of rock into these trenches should be under the full-time inspection of the soils engineer.

6. Consideration should be given to using oversize materials in open space "greenbelt" areas that would be designated as non-structural fills.

SUBDRAINS

Subdrains may be necessary where local seepage along the contact between the proposed fill and underlying alluvial fan deposits and/or bedrock exist, or within the proposed fill along contrasting zones of permeabilities (e.g., sand vs. silt, or clay). Owing to the generally flat nature of the site, lack of canyons, lack of gradient at flowline elevations, and the lack of suitable cover (i.e., less than about 10 feet of fill), subdrains are generally not anticipated during grading, but may not be entirely precluded. If required, where removals are below the subdrain flowline, the removal materials may be reused as compacted fill provided they are granular, and at a moisture content of at least 2 percent over optimum moisture content (or 1.2 times optimum moisture content, whichever is greater). If necessary, actual locations of subdrains will be provided during the grading plan review stage or during grading, based on exposed conditions. The project civil engineer should locate and map any subdrain and outlet systems.

PRELIMINARY PAVEMENT DESIGN RECOMMENDATIONS

The governing agency may retain the authority to approve the final structural design sections after subgrade elevations and actual Resistance Values (R-values) have been obtained at the conclusion of earthwork. Typically actual pavement sections will likely vary, therefore final pavement sections should be based on actual R-value testing performed during, or shortly after site grading for the street improvements, by the controlling authorities.

The preliminary pavement sections presented in the following table are based on assumed Traffic Indices (T.I.'s) for a short local street, a general local road, a residential collector, an industrial collector or secondary highway, and the guidelines presented in the latest

revision to the California Department of Transportation "Highway Design Manual" fifth edition. It is our understanding that the minimum pavement section required by the County for a short local street is 3 inches of AC (asphaltic concrete) on 6 inches of Class 2 aggregate base for a T.I. of 5.0 to 6.0.

Based on the laboratory test results obtained (R=15 and R=41), the following ranges for preliminary pavement design are presented.

PRELIMINARY PAVEMENT THICKNESS			
STREET CLASSIFICATION	STANDARD PAVEMENT DESIGNS		
TRAFFIC INDEX (T.I.)	R-VALUE RANGE	AC (INCHES)	CLASS 2 BASE ROCK [1] (INCHES)
Short Local Street 5.0	15 41	3.0 3.0*	8.0 6.0*
General Local Road 5.5	15 41	3.0 3.0	10.0 6.0*
Residential Collector 6.5	15 41	3.6* 3.6*	12.5 6.5
Industrial Collector or Secondary Highway 7.5	15 41	4.3* 4.3*	14.5 7.5

[1] Assumed R-values for base rock R=78 - Cal-Trans standard Class 2 base rock. Values for T.I. (Traffic Index= 5.0, 5.5, 6.5, and 7.5).
* Minimum required by the County of Riverside

The preliminary range of pavement sections provided above are intended as a minimum guideline. If thinner or highly variable pavement sections are constructed, increased maintenance and repair could be expected. If the traffic index (T.I.), ADT (average daily traffic) or ADTT (average daily truck traffic) increases beyond that intended, as reflected by the traffic index used for design, increased maintenance and repair could be required for the pavement section.

SLOPE CONSIDERATIONS AND SLOPE DESIGN

All slopes should be designed and constructed in accordance with the minimum requirements of the UBC (ICBO, 1997), County of Riverside, the recommendations in Appendix F, and the following:

1. Fill slopes should be designed at a 2:1 (h:v) gradients or flatter and should not exceed about ±15 feet in height. Fill slopes should be properly built and compacted to a minimum relative compaction of 90 percent throughout, including the slope surfaces. Guidelines for slope construction are presented in Appendix F.

2. Cut slopes should be designed at gradients of 2:1 (h:v) and should not exceed ±15 feet in height. While stabilization of such slopes is not anticipated, locally adverse geologic conditions (e.g., daylighted joints/fractures or severely weathered bedrock) may be encountered which may require remedial grading or laying back of the slope to an angle flatter than the adverse geologic condition.

3. Local areas of highly to severely weathered bedrock may be present. Should these materials be exposed in cut slopes, the potential for long term maintenance or possible slope failure exists. Evaluation of cut slopes during grading would be necessary in order to identify any areas of severely weathered fan deposits and/or bedrock materials. Should any of these materials be exposed during construction, the soils engineer/geologist, would assess the magnitude and extent of the materials and their potential affect on long-term maintenance or possible slope failures. Recommendations would then be made at the time of the field inspection.

4. Loose debris and fines remaining on the face of the cut slopes should be removed during grading. This can be accomplished by a slope board or by hand scaling, as warranted.

5. Where loose materials are exposed on the cut slopes, the project's engineering geologist would require that the slope be cleaned as described above prior to making their final inspection. Final approval of the cut slope can only be made subsequent to the slope being fully cut and cleaned.

6. Cut slopes should be mapped by the project engineering geologist during grading to allow amendments to the recommendations should exposed conditions warrant alternation of the design or stabilization.

PRELIMINARY RECOMMENDATIONS - FOUNDATIONS

General

The foundation design and construction recommendations are based on laboratory testing and engineering analysis of onsite earth materials by GSI. Recommendations for conventional foundation and post-tensioned systems are provided in the following sections, and are not intended to preclude the transmission of water or water vapor through slabs and foundations. Mitigation of this potential can be provided upon request. The foundation systems may be used to support the proposed structures, provided they

are founded in competent bearing material. The proposed foundation systems should be designed and constructed in accordance with the guidelines contained in the UBC/CBC (ICBO, 1997 and 2001).

Conventional Foundation Design

1. Conventional spread and continuous footings may be used to support the proposed residential structures provided they are founded entirely in properly compacted fill or other competent bearing material.

2. Analyses indicate that an allowable bearing value of 1,500 pounds per square foot (psf) may be used for design of footings which maintain a minimum width of 12 inches (continuous) and 24 inches square (isolated), and a minimum depth of at least 12 inches into the compacted fill. Isolated, square footings should extend a minimum of 18 inches into the compacted fill. The bearing value may be increased by one-third for seismic or other temporary loads. This value may be increased by 20 percent for each additional 12 inches in depth to a maximum of 2,000 psf. An increase in bearing value for footing width is recommended, only in the case of retaining wall footings. The increase should be limited to 100 psf for each additional foot of width. Continuous perimeter footings for soils with an E.I. greater than 20 should be designed in accordance with the UBC/CBC (ICBO, 1997 and 2001).

3. For lateral sliding resistance, a 0.35 coefficient of friction may be utilized for a concrete to soil contact when multiplied by the dead load.

4. Passive earth pressure may be computed as an equivalent fluid having a density of 250 pcf with a maximum earth pressure of 2,500 psf.

5. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

6. All footings should maintain a minimum 7-foot horizontal distance between the base of the footing and any adjacent descending slope, and minimally comply with the guidelines depicted on Figure No. 18-I-1 of the UBC/CBC (ICBO, 1997 and 2001).

Construction

The following foundation construction recommendations are presented as a minimum criteria from a soils engineering viewpoint. The onsite soils expansion potentials are generally very low to Low (E.I. 0 to 50). However, based on our experience medium expansive soils may not be precluded from occurring onsite. Post-tensioned foundations will likely be recommended for medium expansive soils (i.e., E.I.>50). Therefore, recommendations for very low to medium expansion potentials, are included in the following sections.

Accordingly, the following foundation construction recommendations assume that the soils in the top 5 feet from finish grade may have a very low to medium expansion potential. Recommendations by the project's design-structural engineer or architect, which may exceed the soils engineer's recommendations, should take precedence over the following minimum requirements. Final foundation design will be provided based on the expansion potential of the near surface soils encountered during grading.

Expansion Classification - Very Low to Low (E.I. 0 to 50)

1. Conventional continuous footings should be founded at a minimum depth of 12 inches below the lowest adjacent ground surface for one-story floor loads and 18 inches below the lowest adjacent ground surface for two-story floor loads. Interior footings may be founded at a depth of 12 inches below the lowest adjacent ground surface, excluding the landscape zone. A minimum of 2 feet of compacted fill is recommended below foundation elements.

   Footings for one-story floor loads should have a minimum width of 12 inches, and footings for two-story floor loads should have a minimum width of 15 inches. All footings should have one No. 4 reinforcing bar placed at the top and one No. 4 reinforcing bar placed at the bottom of the footing. Isolated interior or exterior piers and columns should be founded at a minimum depth of 18 inches below the lowest adjacent ground surface.

2. A grade beam, reinforced as above, and at least 12 inches square, should be provided across the large entrances. The base of the reinforced grade beam should be at the same elevation as the adjoining footings.

3. Concrete slabs in structural areas, including garage slabs, should be underlain with a vapor barrier consisting of a minimum of 10-mil, polyvinyl-chloride membrane with all laps sealed, per the UBC/CBC. This membrane should be and covered with a minimum of 2 inches of sand to aid in uniform curing of the concrete and prevent puncturing of the vapor barrier.

4. Concrete slabs, including garage slabs, should be a minimum of 4 inches thick, and reinforced with No. 3 reinforcement bars placed on 18-inch centers, in two horizontally perpendicular directions (i.e., long axis and short axis). All slab reinforcement should be supported to ensure proper mid-slab height positioning during placement of the concrete. "Hooking" of reinforcement is not an acceptable method of positioning.

5. Garage slabs should be poured separately from other structural footings and be quartered with expansion joints or saw cuts. A positive separation from the footings should be maintained with expansion joint material to permit relative movement.

6. The structural slabs should have an actual, minimum thickness of 4 inches, and the slab subgrade should be free of loose and uncompacted material prior to placing concrete.

7. Specific presaturation is not required for these soil conditions; however, the moisture content of the subgrade soils should be equal to or greater than optimum moisture to a depth of 12 inches below the adjacent ground grade in the slab areas, and verified by this office within 72 hours of the vapor barrier placement.

8. Soils generated from footing excavations to be used onsite should be compacted to a minimum relative compaction 90 percent of the laboratory standard, whether it is to be placed inside the foundation perimeter or in the yard/right-of-way areas. This material must not alter positive drainage patterns that direct drainage away from the structural areas and toward the street.

9. Foundations near the top of slope should be deepened to conform to the latest edition of the UBC/CBC (ICBO, 1997 and 2001) and provide a minimum of 7 feet horizontal distance from the slope face. Rigid block wall designs located along the top of slope should be reviewed by a soils engineer.

10. Proposed pools and other appurtenant structures should consider that excavation difficulties could be encountered in bedrock areas at depths greater than approximately ±3 to ±10 feet below proposed building pad grades.

11. As an alternative, an engineered post-tension foundation system may be used.

PRELIMINARY POST-TENSIONED SLAB DESIGN

The recommendations presented below should be followed in addition to those contained in the previous sections, as appropriate. As indicated previously, post-tensioned foundations will likely be recommended for medium expansive soils (i.e., E.I.>50). The information and recommendations presented below in this section are not meant to supercede design by a registered structural engineer or civil engineer familiar with post-tensioned slab design. Post-tensioned slabs should be designed using sound engineering practice and be in accordance with local and/or national code requirements. Upon request, GSI can provide additional data/consultation regarding soil parameters as related to post-tensioned slab design.

From a soil expansion/shrinkage standpoint, a common contributing factor to distress of structures using post-tensioned slabs is fluctuation of moisture in soils underlying the perimeter of the slab, compared to the center, causing a "dishing" or "arching" of the slabs. To mitigate this possibility, a combination of soil presaturation and construction of a perimeter cut off wall should be employed.

Perimeter cut-off walls should be a minimum of 18 inches deep for medium expansive soils. The cut-off walls may be integrated into the slab design or independent of the slab. The cutoff walls should be a minimum of 6 inches thick. For medium expansive soils, slab underlayment should consist of 4 inches of washed sand with a vapor barrier consisting of 10-mil polyvinyl chloride or equivalent placed mid-depth within the sand.

Specific soil presaturation is required if medium expansive soils are exposed at finish grade. The moisture content of the slab subgrade soils should be equal to, or greater than, 120 percent of the soil's optimum moisture content to a depth of 24 inches for medium expansive soils.

Post-Tensioning Institute Method

Post-tensioned slabs should have sufficient stiffness to resist excessive bending due to non-uniform swell and shrinkage of subgrade soils. The differential movement can occur at the corner, edge, or center of the slab. The potential for differential uplift can be evaluated using Section 1816 of the UBC/CBC (ICBO, 1997 and 2001), based on design specifications of the Post-Tensioning Institute. The following table presents suggested minimum coefficients to be used in the Post-Tensioning Institute design method.

Thornthwaite Moisture Index	-20 inches/year
Correction Factor for Irrigation	20 inches/year
Depth to Constant Soil Suction	7 feet
Constant soil Suction (pf)	3.6
Modulus of Subgrade Reaction (pci)	75
Moisture Velocity	0.7 inches/month

The coefficients are considered minimums and may not be adequate to represent worst case conditions such as adverse drainage and/or improper landscaping and maintenance. The above parameters are applicable provided structures have positive drainage that is maintained away from structures. Therefore, it is important that information regarding drainage, site maintenance, settlements, and effects of expansive soils be passed on to future owners.

Based on the above parameters, the following values were obtained from figures or tables of Section 1816 of the UBC/CBC (ICBO, 1997 and 2001). The values may not be appropriate to account for possible differential settlement of the slab due to other factors. If a stiffer slab is desired, higher values of y_m may be warranted.

EXPANSION INDEX OF SOIL SUBGRADE	VERY LOW EXPANSION (E.I. = 0-20)	LOW EXPANSION (E.I. = 21-50)	MEDIUM EXPANSION (E.I. = 51-90)
e_m center lift	5.0 feet	5.0 feet	5.5 feet
e_m edge lift	2.5 feet	3.5 feet	4.0 feet
y_m center lift	1.0 inch	1.7 inches	2.7 inches
y_m edge lift	0.3 inch	0.75 inch	0.75 inch

Deepened footings/edges around the slab perimeter must be used to minimize non-uniform surface moisture migration (from an outside source) beneath the slab. An edge depth of 12 inches should be considered a minimum. The bottom of the deepened footing/edge should be designed to resist tension, using cable or reinforcement per the structural engineer. Other applicable recommendations presented under conventional foundation and the California Foundation Slab Method should be adhered to during the design and construction phase of the project.

PRELIMINARY FOUNDATION SETTLEMENTS

In addition to designing slab systems (post-tension or other) for the soil conditions described herein, the estimated settlement and angular distortion values that an individual structure (including walls, spas, pools, or other settlement-sensitive improvements, etc.), could be subjected to should be evaluated by a structural engineer. The levels of angular distortion were evaluated on a 40-foot length assumed as the minimum dimension of buildings; if, from a structural standpoint, a decreased or increased length over which the differential settlement is assumed to occur is justified, this change should be incorporated into the design.

The site is underlain at depth by Quaternary fan deposits and/or granitic bedrock. A preliminary evaluation of primary settlement and secondary compression within the area under the purview of this report has been conducted. The calculated estimate for the total settlement in approximately 2 inches over the life of the structure. Worst-case differential settlement has been calculated as 1 inch in 40 feet (i.e., at least 1 inch in a 40-foot span [1/480]).

Therefore, in addition to designing slab systems for the above soil conditions, the following settlement values should be utilized by the project structural engineer.

ESTIMATED TOTAL SETTLEMENT (Inches)	ESTIMATED DIFFERENTIAL SETTLEMENT (Inches)	ESTIMATED ANGULAR DISTORTION
2.0	1.0	1/480

Any post-construction settlement of the fill should be readily mitigated by proper foundation design, provided the design parameters, provided in this report, are properly utilized in final design of the residential foundation systems. In addition to the above, the structural engineer should also consider estimated settlements due to short duration seismic loading and applicable load combinations, as required by the controlling authorities and/or the UBC/CBC (ICBO, 1997 and 2001). Alternatives to Post- Tensioning Institute methodology (i.e., "spanability") may be used if equivalent systems can be proposed which accommodate the angular distortions, expansion parameters, and settlements noted for the project. If alternatives to Post-Tensioning Institute are suggested by the structural consultant, this office should review the final foundation plans.

PRELIMINARY WALL DESIGN PARAMETERS

Conventional Retaining Walls

The design parameters provided below assume that either non expansive soils (typically Class 2 permeable filter material or Class 3 aggregate base) or native onsite materials (up to and including an E.I. of 65) are used to backfill any retaining walls. The type of backfill (i.e., select or native), should be specified by the wall designer, and clearly shown on the plans. Building walls, below grade, should be water-proofed or damp-proofed, depending on the degree of moisture protection desired. The foundation system for the proposed retaining walls should be designed in accordance with the recommendations presented in this and preceding sections of this report, as appropriate. Footings should be embedded a minimum of 18 inches below adjacent grade (excluding landscape layer, 6 inches) and should be 24 inches in width. There should be no increase in bearing for footing width. Recommendations for specialty walls (i.e., crib, earthstone, geogrid, etc.) can be provided upon request, and would be based on site specific conditions.

Restrained Walls

Any retaining walls that will be restrained prior to placing and compacting backfill material or that have re-entrant or male corners, should be designed for an at-rest equivalent fluid pressure (EFP) of 65 pounds per cubic foot (pcf), plus any applicable surcharge loading. For areas of male or re-entrant corners, the restrained wall design should extend a minimum distance of twice the height of the wall (2H) laterally from the corner.

Cantilevered Walls

The recommendations presented below are for cantilevered retaining walls up to 10 feet high. Design parameters for walls less than 3 feet in height may be superceded by City and/or County standard design. Active earth pressure may be used for retaining wall design, provided the top of the wall is not restrained from minor deflections. An equivalent fluid pressure approach may be used to compute the horizontal pressure against the wall. Appropriate fluid unit weights are given below for specific slope gradients of the retained material. These do not include other superimposed loading conditions due to traffic, structures, seismic events or adverse geologic conditions. When wall configurations are finalized, the appropriate loading conditions for superimposed loads can be provided upon request.

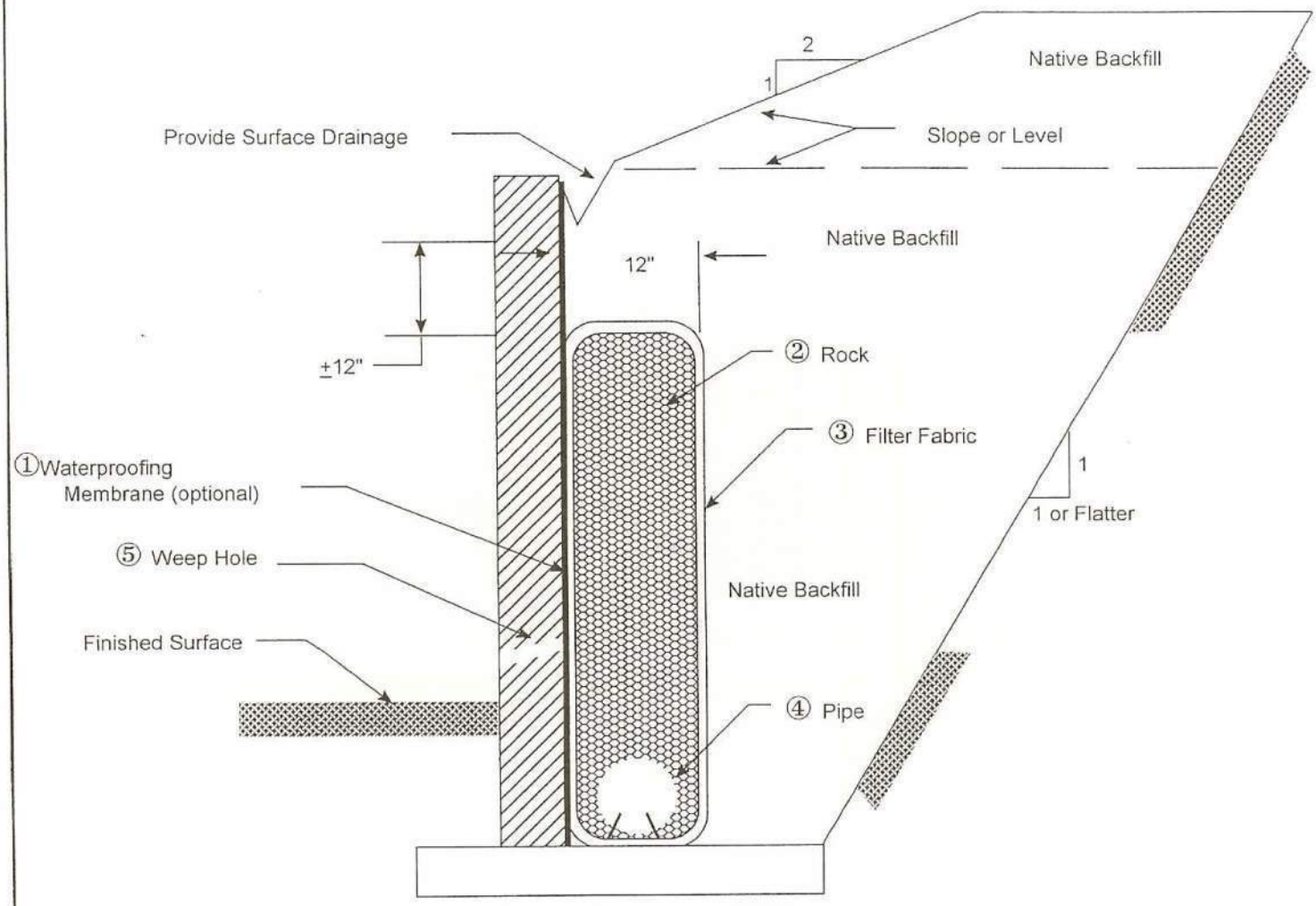
SURFACE SLOPE OF RETAINED MATERIAL (HORIZONTAL:VERTICAL)	EQUIVALENT FLUID WEIGHT P.C.F. (SELECT BACKFILL)	EQUIVALENT FLUID WEIGHT P.C.F. (NATIVE BACKFILL)
Level*	35	45
2 to 1	50	60
* Level backfill behind a retaining wall is defined as compacted earth materials, properly drained, without a slope for a distance of 2H behind the wall.		

Retaining Wall Backfill and Drainage

Positive drainage must be provided behind all retaining walls in the form of gravel wrapped in geofabric and outlets. A backdrain system is considered necessary for retaining walls that are 2 feet or greater in height. Details 1, 2, and 3, present the back drainage options discussed below. Backdrains should consist of a 4-inch diameter perforated PVC or ABS pipe encased in either Class 2 permeable filter material or ¾-inch to 1½-inch gravel wrapped in approved filter fabric (Mirafi 140 or equivalent). For low expansive backfill, the filter material should extend a minimum of 1 horizontal foot behind the base of the walls and upward at least 1 foot. For native backfill that has up to medium expansion potential, continuous Class 2 permeable drain materials should be used behind the wall. This material should be continuous (i.e., full height) behind the wall, and it should be constructed in accordance with the enclosed Detail 1 (Typical Retaining Wall Backfill and Drainage Detail). For limited access and confined areas, (panel) drainage behind the wall may be constructed in accordance with Detail 2 (Retaining Wall Backfill and Subdrain Detail Geotextile Drain). Materials with an E.I. potential of greater than 65 should not be used as backfill for retaining walls. For more onerous expansive situations, backfill and drainage behind the retaining wall should conform with Detail 3 (Retaining Wall And Subdrain Detail Clean Sand Backfill).

DETAILS

N . T . S .



① **WATERPROOFING MEMBRANE (optional):**
Liquid boot or approved equivalent.

② **ROCK:**
3/4 to 1-1/2" (inches) rock.

③ **FILTER FABRIC:**
Mirafi 140N or approved equivalent; place fabric flap behind core.

④ **PIPE:**
4" (inches) diameter perforated PVC. schedule 40 or approved alternative with minimum of 1% gradient to proper outlet point (Perforations down).

⑤ **WEEP HOLE:**
Minimum 2" (inches) diameter placed at 20' (feet) on centers along the wall, and 3" (inches) above finished surface (No weep holes for basement walls.).

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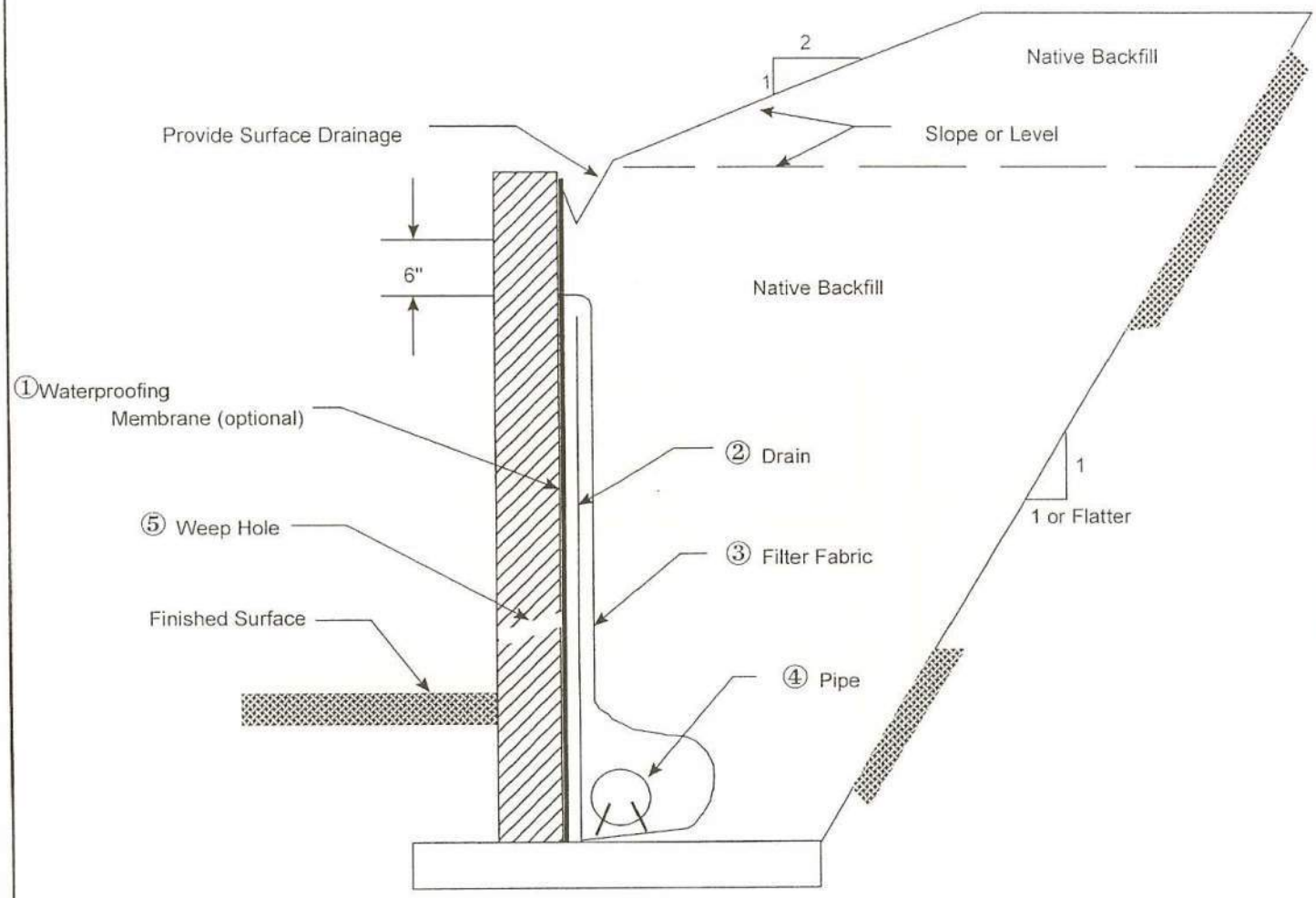
TYPICAL RETAINING WALL BACKFILL AND DRAINAGE DETAIL

DETAIL 1

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DETAILS

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① **WATERPROOFING MEMBRANE (optional):**
Liquid boot or approved equivalent.

② **DRAIN:**
Miradrain 6000 or J-drain 200 or equivalent for non-waterproofed walls.
Miradrain 6200 or J-drain 200 or equivalent for waterproofed walls (All Perforations down).

③ **FILTER FABRIC:**
Mirafi 140N or approved equivalent; place fabric flap behind core.

④ **PIPE:**
4" (inches) diameter perforated PVC. schedule 40 or approved alternative with minimum of 1% gradient to proper outlet point.

⑤ **WEEP HOLE:**
Minimum 2" (inches) diameter placed at 20' (feet) on centers along the wall, and 3" (inches) above finished surface. (No weep holes for basement walls.)

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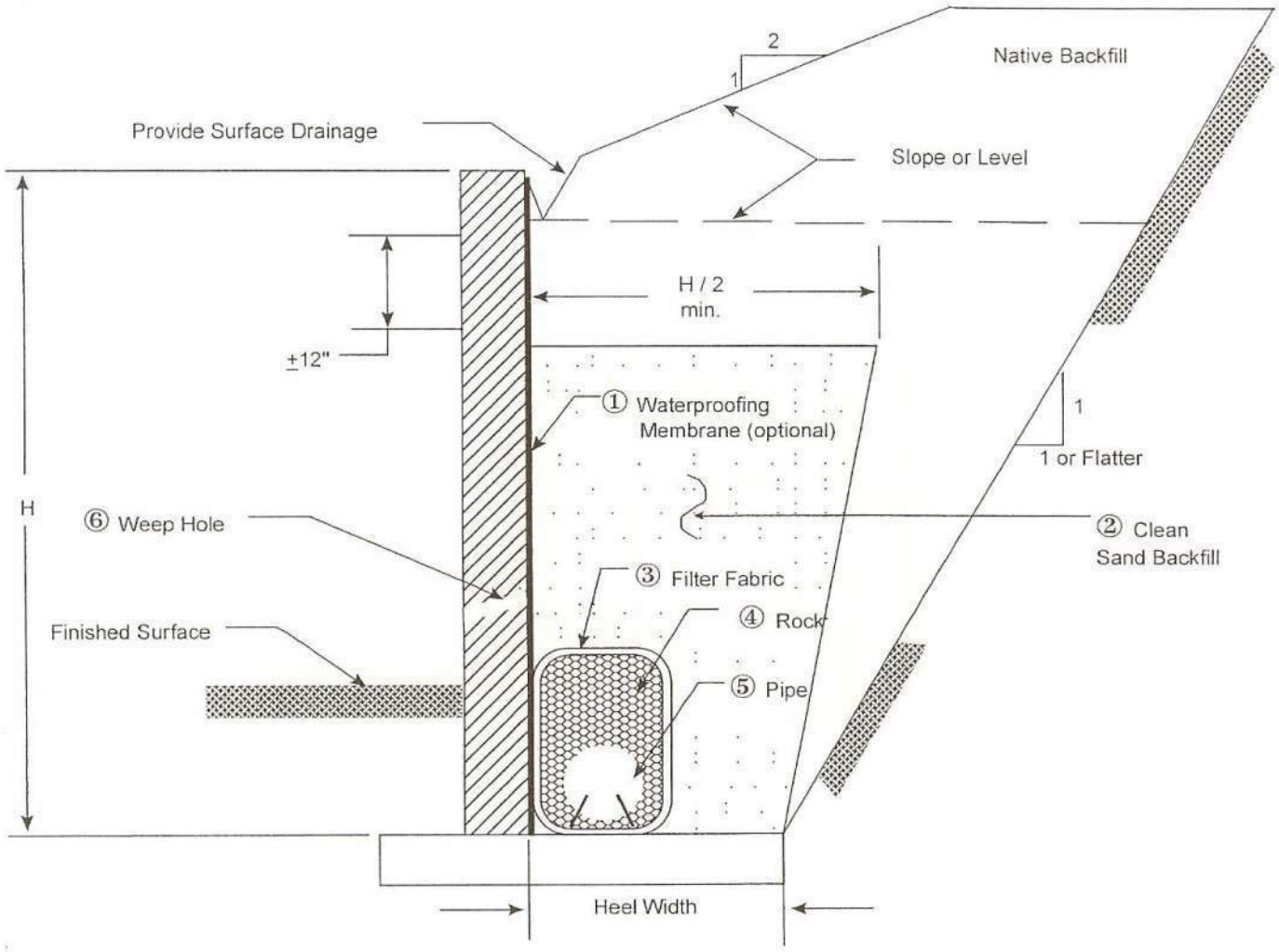
RETAINING WALL BACKFILL AND SUBDRAIN DETAIL GEOTEXTILE DRAIN

DETAIL 2

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DETAILS

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① **WATERPROOFING MEMBRANE (optional):**
Liquid boot or approved equivalent.

② **CLEAN SAND BACKFILL:**
Must have sand equivalent value of 30 or greater; can be densified by water jetting.

③ **FILTER FABRIC:**
Mirafi 140N or approved equivalent.

④ **ROCK:**
1 cubic foot per linear feet of pipe or 3/4 to 1-1/2" (inches) rock.

⑤ **PIPE:**
4" (inches) diameter perforated PVC. schedule 40 or approved alternative with minimum of 1% gradient to proper outlet point (Perforations down).

⑥ **WEEP HOLE:**
Minimum 2" (inches) diameter placed at 20' (feet) on centers along the wall, and 3" (inches) above finished surface. (No weep holes for basement walls.)

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RETAINING WALL AND SUBDRAIN DETAIL CLEAN SAND BACKFILL

DETAIL 3

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Outlets should consist of a 4-inch diameter solid PVC or ABS pipe spaced no greater than ±100 feet apart, with a minimum of two outlets, one on each end. The use of weep holes, only, in walls higher than 2 feet, is not recommended. The surface of the backfill should be sealed by pavement or the top 18 inches compacted with native soil (E.I. ≤90). Proper surface drainage should also be provided. For additional mitigation, consideration should be given to applying a water-proof membrane to the back of all retaining structures. The use of a waterstop should be considered for all concrete and masonry joints.

Wall/Retaining Wall Footing Transitions

Site walls are anticipated to be founded on footings designed in accordance with the recommendations in this report. Should wall footings transition from cut to fill, the civil designer may specify either:

a) A minimum of a 2-foot overexcavation and recompaction of cut materials for a distance of 2H, from the point of transition.

b) Increase of the amount of reinforcing steel and wall detailing (i.e., expansion joints or crack control joints) such that a angular distortion of 1/360 for a distance of 2H on either side of the transition may be accommodated. Expansion joints should be placed no greater than 20 feet on-center, in accordance with the structural engineer's/wall designer's recommendations, regardless of whether or not transition conditions exist. Expansion joints should be sealed with a flexible, non-shrink grout.

c) Embed the footings entirely into native formational material (i.e., deepened footings).

If transitions from cut to fill transect the wall footing alignment at an angle of less than 45 degrees (plan view), then the designer should follow recommendation "a" (above) and until such transition is between 45 and 90 degrees to the wall alignment.

TOP-OF-SLOPE WALLS/FENCES/IMPROVEMENTS

Slope Creep

Soils at the site may be expansive and therefore, may become desiccated when allowed to dry. Such soils are susceptible to surficial slope creep, especially with seasonal changes in moisture content. Typically in southern California, during the hot and dry summer period, these soils become desiccated and shrink, thereby developing surface cracks. The extent and depth of these shrinkage cracks depend on many factors such as the nature and expansivity of the soils, temperature and humidity, and extraction of moisture from surface soils by plants and roots. When seasonal rains occur, water percolates into the cracks and fissures, causing slope surfaces to expand, with a

corresponding loss in soil density and shear strength near the slope surface. With the passage of time and several moisture cycles, the outer 3 to 5 feet of slope materials experience a very slow, but progressive, outward and downward movement, known as slope creep. For slope heights greater than 10 feet, this creep related soil movement will typically impact all rear yard flatwork and other secondary improvements that are located within about 15 feet from the top of slopes, such as swimming pools, concrete flatwork, etc., and in particular top of slope fences/walls. This influence is normally in the form of detrimental settlement, and tilting of the proposed improvements. The dessication/swelling and creep discussed above continues over the life of the improvements, and generally becomes progressively worse. Accordingly, the developer should provide this information to any homeowners and homeowners association.

Top of Slope Walls/Fences

Due to the potential for slope creep for slopes higher than about 10 feet, some settlement and tilting of the walls/fence with the corresponding distresses, should be expected. To mitigate the tilting of top of slope walls/fences, we recommend that the walls/fences be constructed on deepened foundations without any consideration for creep forces, where the expansion index of the materials comprising the outer 15 feet of the slope is less than 50, or a combination of grade beam and caisson foundations, for expansion indices greater than 50 comprising the slope, with creep forces taken into account. The grade beam should be at a minimum of 12 inches by 12 inches in cross section, supported by drilled caissons, 12 inches minimum in diameter, placed at a maximum spacing of 6 feet on center, and with a minimum embedment length of 7 feet below the bottom of the grade beam. The strength of the concrete and grout should be evaluated by the structural engineer of record. The proper ASTM tests for the concrete and mortar should be provided along with the slump quantities. The concrete used should be appropriate to mitigate sulfate corrosion, as warranted. The design of the grade beam and caissons should be in accordance with the recommendations of the project structural engineer, and include the utilization of the following geotechnical parameters:

Creep Zone: 5-foot vertical zone below the slope face and projected upward parallel to the slope face.

Creep Load: The creep load projected on the area of the grade beam should be taken as an equivalent fluid approach, having a density of 60 pcf. For the caisson, it should be taken as a uniform 900 pounds per linear foot of caisson's depth, located above the creep zone.

Point of Fixity: Located a distance of 1.5 times the caisson's diameter, below the creep zone.

Passive Resistance: Passive earth pressure of 300 psf per foot of depth per foot of caisson diameter, to a maximum value of 4,500 psf may be used to determine caisson depth and spacing, provided that they meet or exceed the minimum requirements stated above. To determine the total lateral resistance, the contribution of the creep prone zone above the point of fixity, to passive resistance, should be disregarded.

Allowable Axial Capacity:

Shaft capacity : 350 psf applied below the point of fixity over the surface area of the shaft.

Tip capacity: 4,500 psf.

DRIVEWAY, FLATWORK, AND OTHER IMPROVEMENTS

The soil materials on site may be expansive. The effects of expansive soils are cumulative, and typically occur over the lifetime of any improvements. On relatively level areas, when the soils are allowed to dry, the dessication and swelling process tends to cause heaving and distress to flatwork and other improvements. The resulting potential for distress to improvements may be reduced, but not totally eliminated. To that end, it is recommended that the developer should notify any homeowners or homeowners association of this long-term potential for distress. To reduce the likelihood of distress, the following recommendations are presented for all exterior flatwork:

1. The subgrade area for concrete slabs should be compacted to achieve a minimum 90 percent relative compaction, and then be presoaked to 2 to 3 percentage points above (or 125 percent of) the soils' optimum moisture content, to a depth of 18 inches below subgrade elevation. If very low expansive soils are present, only optimum moisture content, or greater, is required and specific presoaking is not warranted. The moisture content of the subgrade should be proof tested within 72 hours prior to pouring concrete.

2. Concrete slabs should be cast over a non-yielding surface, consisting of a 4-inch layer of crushed rock, gravel, or clean sand, that should be compacted and level prior to pouring concrete. If very low expansive soils are present, the rock or gravel or sand may be deleted. The layer or subgrade should be wet-down completely prior to pouring concrete, to minimize loss of concrete moisture to the surrounding earth materials.

3. Exterior slabs should be a minimum of 4 inches thick. Driveway slabs and approaches should additionally have a thickened edge (12 inches) adjacent to all landscape areas, to help impede infiltration of landscape water under the slab.

4. The use of transverse and longitudinal control joints are recommended to help control slab cracking due to concrete shrinkage or expansion. Two ways to mitigate such cracking are: a) add a sufficient amount of reinforcing steel, increasing tensile strength of the slab; and, b) provide an adequate amount of control and/or expansion joints to accommodate anticipated concrete shrinkage and expansion.

   In order to reduce the potential for unsightly cracks, slabs should be reinforced at mid-height with a minimum of No. 3 bars placed at 18 inches on center, in each direction. If subgrade soils within the top 7 feet from finish grade are very low expansive soils (i.e., E.I. $\leq$20), then 6x6-W1.4xW1.4 welded-wire mesh may be substituted for the rebar, provided the reinforcement is placed on chairs, at slab mid-height. The exterior slabs should be scored or saw cut, ½ to ⅜ inches deep, often enough so that no section is greater than 10 feet by 10 feet. For sidewalks or narrow slabs, control joints should be provided at intervals of every 6 feet. The slabs should be separated from the foundations and sidewalks with expansion joint filler material.

5. No traffic should be allowed upon the newly poured concrete slabs until they have been properly cured to within 75 percent of design strength. Concrete compression strength should be a minimum of 2,500 psi.

6. Driveways, sidewalks, and patio slabs adjacent to the house should be separated from the house with thick expansion joint filler material. In areas directly adjacent to a continuous source of moisture (i.e., irrigation, planters, etc.), all joints should be additionally sealed with flexible mastic.

7. Planters and walls should not be tied to the house.

8. Overhang structures should be supported on the slabs, or structurally designed with continuous footings tied in at least two directions. If very low expansion soils are present, footings need only be tied in one direction.

9. Any masonry landscape walls that are to be constructed throughout the property should be grouted and articulated in segments no more than 20 feet long. These segments should be keyed or doweled together.

10. Utilities should be enclosed within a closed utilidor (vault) or designed with flexible connections to accommodate differential settlement and expansive soil conditions.

11. Positive site drainage should be maintained at all times. Finish grade on the lots should provide a minimum of 1 to 2 percent fall to the street, as indicated herein. It should be kept in mind that drainage reversals could occur, including post-construction settlement, if relatively flat yard drainage gradients are not periodically maintained by the homeowner or homeowners association.

12. Air conditioning (A/C) units should be supported by slabs that are incorporated into the building foundation or constructed on a rigid slab with flexible couplings for plumbing and electrical lines. A/C waste water lines should be drained to a suitable non-erosive outlet.

13. Shrinkage cracks could become excessive if proper finishing and curing practices are not followed. Finishing and curing practices should be performed per the Portland Cement Association Guidelines. Mix design should incorporate rate of curing for climate and time of year, sulfate content of soils, corrosion potential of soils, and fertilizers used on site.

DEVELOPMENT CRITERIA

Slope Deformation

Compacted fill slopes designed using customary factors of safety for gross or surficial stability and constructed in general accordance with the design specifications should be expected to undergo some differential vertical heave or settlement in combination with differential lateral movement in the out-of-slope direction, after grading. This post-construction movement occurs in two forms: slope creep, and lateral fill extension (LFE). Slope creep is caused by alternate wetting and drying of the fill soils which results in slow downslope movement. This type of movement is expected to occur throughout the life of the slope, and is anticipated to potentially affect improvements or structures (e.g., separations and/or cracking), placed near the top-of-slope, up to a maximum distance of approximately 15 feet from the top-of-slope, depending on the slope height. This movement generally results in rotation and differential settlement of improvements located within the creep zone. LFE occurs due to deep wetting from irrigation and rainfall on slopes comprised of expansive materials. Although some movement should be expected, long-term movement from this source may be minimized, but not eliminated, by placing the fill throughout the slope region, wet of the fill's optimum moisture content.

It is generally not practical to attempt to eliminate the effects of either slope creep or LFE. Suitable mitigative measures to reduce the potential of lateral deformation typically include: setback of improvements from the slope faces (per the 1997 UBC and/or adopted California Building Code), positive structural separations (i.e., joints) between improvements, and stiffening and deepening of foundations. Expansion joints in walls should be placed no greater than 20 feet on-center, and in accordance with the structural

engineer's recommendations. All of these measures are recommended for design of structures and improvements. The ramifications of the above conditions, and recommendations for mitigation, should be provided to each homeowner and/or any homeowners association.

Slope Maintenance and Planting

Water has been shown to weaken the inherent strength of all earth materials. Slope stability is significantly reduced by overly wet conditions. Positive surface drainage away from slopes should be maintained and only the amount of irrigation necessary to sustain plant life should be provided for planted slopes. Over-watering should be avoided as it adversely affects site improvements, and causes perched groundwater conditions. Graded slopes constructed utilizing onsite materials would be erosive. Eroded debris may be minimized and surficial slope stability enhanced by establishing and maintaining a suitable vegetation cover soon after construction. Compaction to the face of fill slopes would tend to minimize short-term erosion until vegetation is established. Plants selected for landscaping should be light weight, deep rooted types that require little water and are capable of surviving the prevailing climate. Jute-type matting or other fibrous covers may aid in allowing the establishment of a sparse plant cover. Utilizing plants other than those recommended above will increase the potential for perched water, staining, mold, etc., to develop. A rodent control program to prevent burrowing should be implemented. Irrigation of natural (ungraded) slope areas is generally not recommended. These recommendations regarding plant type, irrigation practices, and rodent control should be provided to each homeowner. Over-steepening of slopes should be avoided during building construction activities and landscaping.

Drainage

Adequate lot surface drainage is a very important factor in reducing the likelihood of adverse performance of foundations, hardscape, and slopes. Surface drainage should be sufficient to prevent ponding of water anywhere on a lot, and especially near structures and tops of slopes. Lot surface drainage should be carefully taken into consideration during fine grading, landscaping, and building construction. Therefore, care should be taken that future landscaping or construction activities do not create adverse drainage conditions. Positive site drainage within lots and common areas should be provided and maintained at all times. Drainage should not flow uncontrolled down any descending slope. Water should be directed away from foundations and not allowed to pond and/or seep into the ground. In general, the area within 5 feet around a structure should slope away from the structure. We recommend that unpaved lawn and landscape areas have a minimum gradient of 1 percent sloping away from structures, and whenever possible, should be above adjacent paved areas. Consideration should be given to avoiding construction of planters adjacent to structures (buildings, pools, spas, etc.). Pad drainage should be directed toward the street or other approved area(s). Although not a geotechnical requirement, roof gutters, down spouts, or other appropriate means may be utilized to

control roof drainage. Down spouts, or drainage devices should outlet a minimum of 5 feet from structures or into a subsurface drainage system. Areas of seepage may develop due to irrigation or heavy rainfall, and should be anticipated. Minimizing irrigation will lessen this potential. If areas of seepage develop, recommendations for minimizing this effect could be provided upon request.

Toe of Slope Drains/Toe Drains

Where significant slopes intersect pad areas, surface drainage down the slope allows for some seepage into the subsurface materials, sometimes creating conditions causing or contributing to perched and/or ponded water. Toe of slope/toe drains may be beneficial in the mitigation of this condition due to surface drainage. The general criteria to be utilized by the design engineer for evaluating the need for this type of drain is as follows:

- Is there a source of irrigation above or on the slope that could contribute to saturation of soil at the base of the slope?

- Are the slopes hard rock and/or impermeable, or relatively permeable, or; do the slopes already have or are they proposed to have subdrains (i.e., stabilization fills, etc.)?

- Are there cut-fill transitions (i.e., fill over bedrock), within the slope?

- Was the lot at the base of the slope overexcavated or is it proposed to be overexcavated? Overexcavated lots located at the base of a slope could accumulate subsurface water along the base of the fill cap.

- Are the slopes north facing? North facing slopes tend to receive less sunlight (less evaporation) relative to south facing slopes and are more exposed to the currently prevailing seasonal storm tracks.

- What is the slope height? It has been our experience that slopes with heights in excess of approximately 10 feet tend to have more problems due to storm runoff and irrigation than slopes of a lesser height.

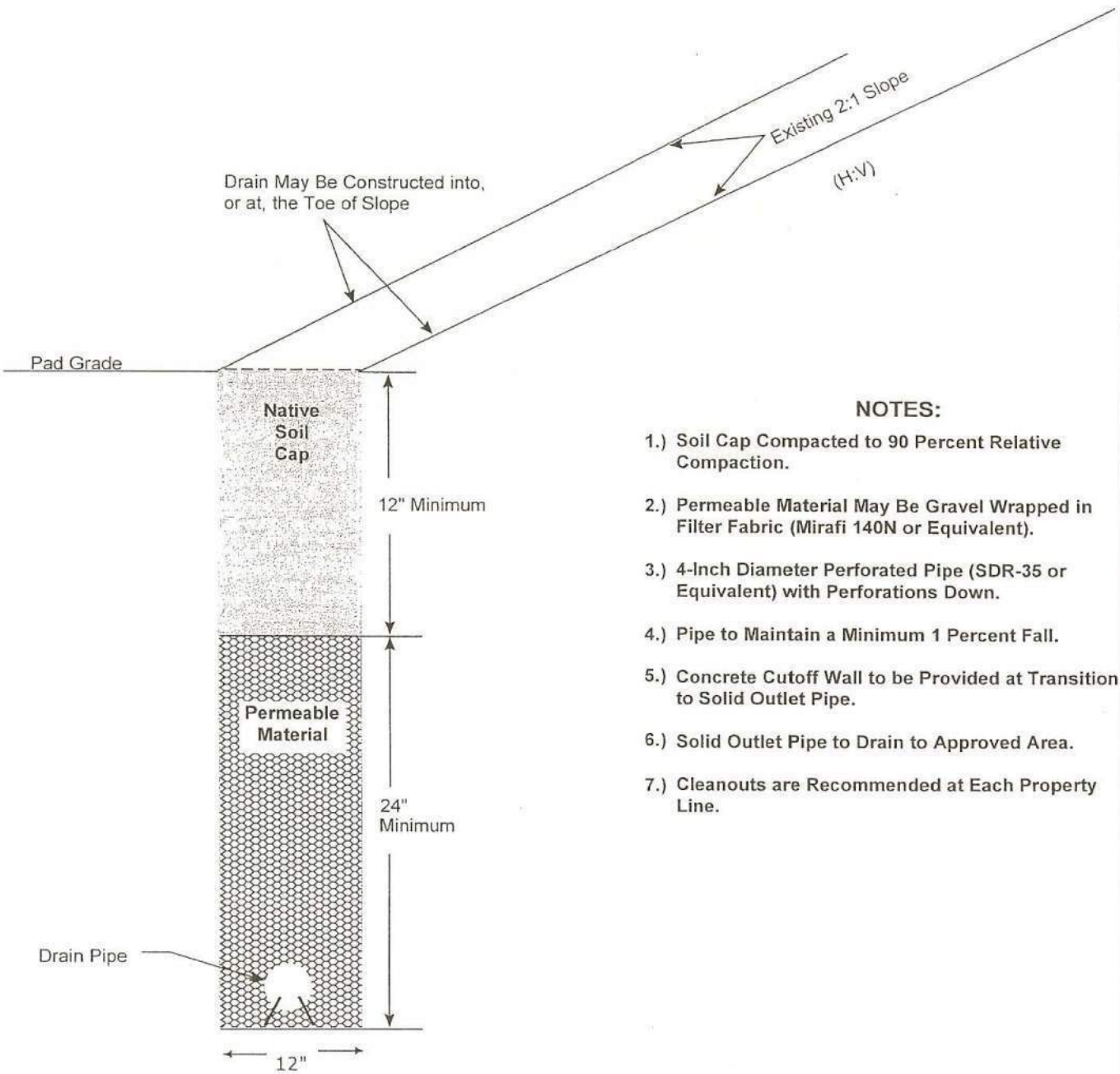
- Do the slopes "toe out" into a residential lot or a lot where perched or ponded water may adversely impact its proposed use?

Based on these general criteria, the construction of toe drains may be considered by the design engineer along the toe of slopes, or at retaining walls in slopes, descending to the rear of such lots. Following are Detail 4 (Schematic Toe Drain Detail) and Detail 5 (Subdrain Along Retaining Wall Detail). Other drains may be warranted due to unforeseen conditions, homeowner irrigation, or other circumstances. Where drains are constructed

DETAILS

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SCHEMATIC TOE DRAIN DETAIL



NOTES:

1.) Soil Cap Compacted to 90 Percent Relative Compaction.

2.) Permeable Material May Be Gravel Wrapped in Filter Fabric (Mirafi 140N or Equivalent).

3.) 4-Inch Diameter Perforated Pipe (SDR-35 or Equivalent) with Perforations Down.

4.) Pipe to Maintain a Minimum 1 Percent Fall.

5.) Concrete Cutoff Wall to be Provided at Transition to Solid Outlet Pipe.

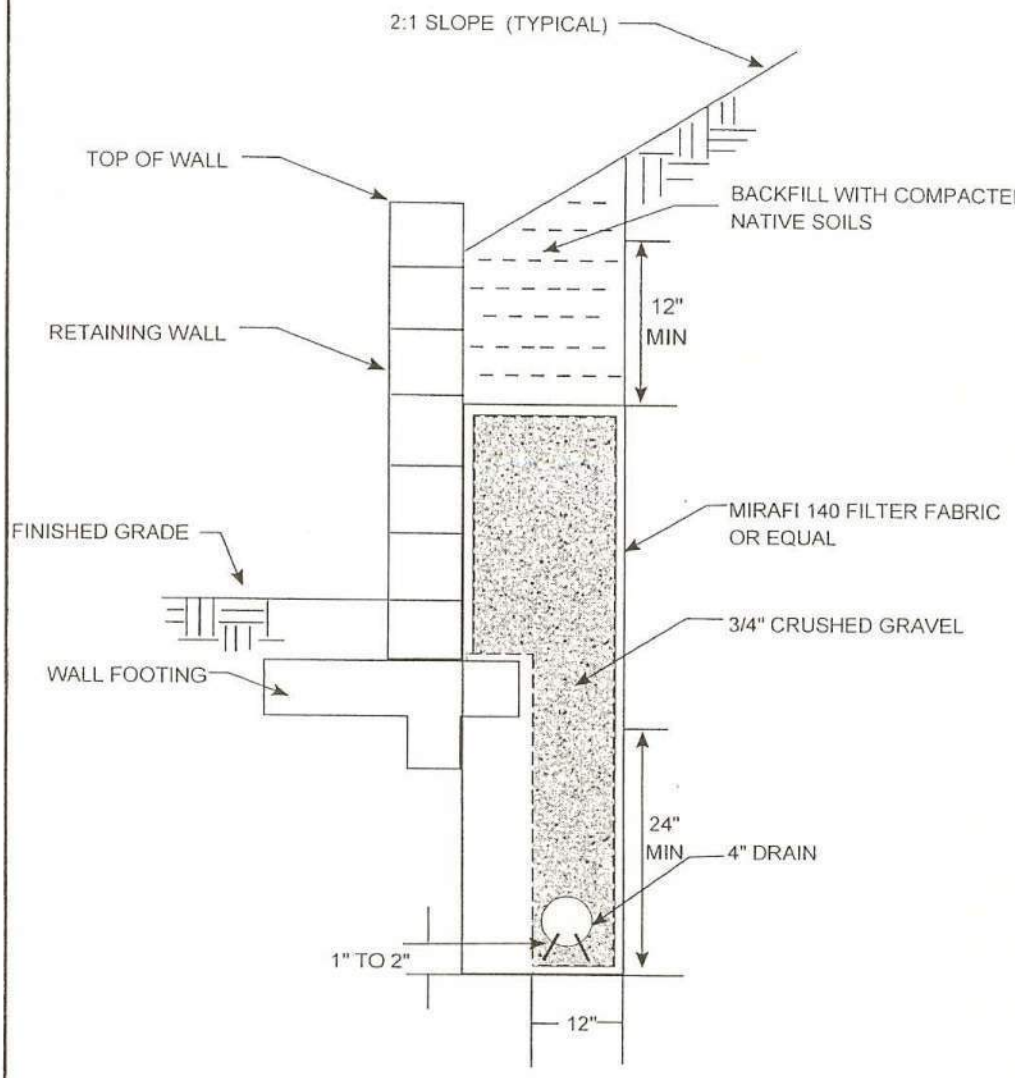
6.) Solid Outlet Pipe to Drain to Approved Area.

7.) Cleanouts are Recommended at Each Property Line.

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	DETAIL 4
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DETAILS

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NOTES:

1.) **Soil Cap Compacted to 90 Percent Relative Compaction.**

2.) **Permeable Material May Be Gravel Wrapped in Filter Fabric (Mirafi 140N or Equivalent).**

3.) **4-Inch Diameter Perforated Pipe (SDR-35 or Equivalent) with Perforations Down.**

4.) **Pipe to Maintain a Minimum 1 Percent Fall.**

5.) **Concrete Cutoff Wall to be Provided at Transition to Solid Outlet Pipe.**

6.) **Solid Outlet Pipe to Drain to Approved Area.**

7.) **Cleanouts are Recommended at Each Property Line.**

8.) **Compacted Effort Should Be Applied to Drain Rock.**

SUBDRAIN ALONG RETAINING WALL DETAIL

NOT TO SCALE

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SUBDRAIN ALONG RETAINING WALL DETAIL

DETAIL 5

during grading, including subdrains, the locations/elevations of such drains should be surveyed, and recorded on the final as-built grading plans by the design engineer. It is recommended that the above be disclosed to all interested parties, including homeowners and any homeowners association.

Erosion Control

Cut and fill slopes will be subject to surficial erosion during and after grading. Onsite earth materials have a moderate to high erosion potential. Consideration should be given to providing hay bales and silt fences for the temporary control of surface water, from a geotechnical viewpoint.

Landscape Maintenance

Only the amount of irrigation necessary to sustain plant life should be provided. Over-watering the landscape areas will adversely affect proposed site improvements. We would recommend that any proposed open-bottom planters adjacent to proposed structures be eliminated for a minimum distance of 10 feet. As an alternative, closed-bottom type planters could be utilized. An outlet placed in the bottom of the planter, could be installed to direct drainage away from structures or any exterior concrete flatwork. If planters are constructed adjacent to structures, the sides and bottom of the planter should be provided with a moisture barrier to prevent penetration of irrigation water into the subgrade. Provisions should be made to drain the excess irrigation water from the planters without saturating the subgrade below or adjacent to the planters. Graded slope areas should be planted with drought resistant vegetation. Consideration should be given to the type of vegetation chosen and their potential effect upon surface improvements (i.e., some trees will have an effect on concrete flatwork with their extensive root systems). From a geotechnical standpoint leaching is not recommended for establishing landscaping. If the surface soils are processed for the purpose of adding amendments, they should be recompacted to 90 percent minimum relative compaction.

Gutters and Downspouts

As previously discussed in the drainage section, the installation of gutters and downspouts should be considered to collect roof water that may otherwise infiltrate the soils adjacent to the structures. If utilized, the downspouts should be drained into PVC collector pipes or other non-erosive devices (e.g., paved swales or ditches; below grade, solid tight-lined PVC pipes; etc.), that will carry the water away from the house, to an appropriate outlet, in accordance with the recommendations of the design civil engineer. Downspouts and gutters are not a requirement; however, from a geotechnical viewpoint, provided that positive drainage is incorporated into project design (as discussed previously).

Subsurface and Surface Water

Subsurface and surface water are not anticipated to affect site development, provided that the recommendations contained in this report are incorporated into final design and construction and that prudent surface and subsurface drainage practices are incorporated into the construction plans. Perched groundwater conditions along zones of contrasting permeabilities may not be precluded from occurring in the future due to site irrigation, poor drainage conditions, or damaged utilities, and should be anticipated. Should perched groundwater conditions develop, this office could assess the affected area(s) and provide the appropriate recommendations to mitigate the observed groundwater conditions. Groundwater conditions may change with the introduction of irrigation, rainfall, or other factors.

Site Improvements

If in the future, any additional improvements (e.g., pools, spas, etc.) are planned for the site, recommendations concerning the geological or geotechnical aspects of design and construction of said improvements could be provided upon request. Pools and/or spas should not be constructed without specific design and construction recommendations from GSI, and this construction recommendation should be provided to the homeowners, any homeowners association, and/or other interested parties. This office should be notified in advance of any fill placement, grading of the site, or trench backfilling after rough grading has been completed. This includes any grading, utility trench and retaining wall backfills, flatwork, etc.

Tile Flooring

Tile flooring can crack, reflecting cracks in the concrete slab below the tile, although small cracks in a conventional slab may not be significant. Therefore, the designer should consider additional steel reinforcement for concrete slabs-on-grade where tile will be placed. The tile installer should consider installation methods that reduce possible cracking of the tile such as slipsheets. Slipsheets or a vinyl crack isolation membrane (approved by the Tile Council of America/Ceramic Tile Institute) are recommended between tile and concrete slabs on grade.

Additional Grading

This office should be notified in advance of any fill placement, supplemental regrading of the site, or trench backfilling after rough grading has been completed. This includes completion of grading in the street, driveway approaches, driveways, parking areas, and utility trench and retaining wall backfills.

Footing Trench Excavation

All footing excavations should be observed by a representative of this firm subsequent to trenching and prior to concrete form and reinforcement placement. The purpose of the observations is to evaluate that the excavations have been made into the recommended bearing material and to the minimum widths and depths recommended for construction. If loose or compressible materials are exposed within the footing excavation, a deeper footing or removal and recompaction of the subgrade materials would be recommended at that time. Footing trench spoil and any excess soils generated from utility trench excavations should be compacted to a minimum relative compaction of 90 percent, if not removed from the site.

Trenching/Temporary Construction Backcuts

Considering the nature of the onsite earth materials, it should be anticipated that caving or sloughing could be a factor in subsurface excavations and trenching. Shoring or excavating the trench walls/backcuts at the angle of repose (typically 25 to 45 degrees [except as specifically superceded within the text of this report]), should be anticipated. All excavations should be observed by an engineering geologist or soil engineer from GSI, prior to workers entering the excavation or trench, and minimally conform to CAL-OSHA, state, and local safety codes. Should adverse conditions exist, appropriate recommendations would be offered at that time. The above recommendations should be provided to any contractors and/or subcontractors, or homeowners, etc., that may perform such work.

Utility Trench Backfill

1. All interior utility trench backfill should be brought to at least 2 percent above optimum moisture content and then compacted to obtain a minimum relative compaction of 90 percent of the laboratory standard. As an alternative for shallow (12-inch to 18-inch) under-slab trenches, sand having a sand equivalent value of 30 or greater may be utilized and jetted or flooded into place. Observation, probing and testing should be provided to evaluate the desired results.

2. Exterior trenches adjacent to, and within areas extending below a 1:1 plane projected from the outside bottom edge of the footing, and all trenches beneath hardscape features and in slopes, should be compacted to at least 90 percent of the laboratory standard. Sand backfill, unless excavated from the trench, should not be used in these backfill areas. Compaction testing and observations, along with probing, should be accomplished to evaluate the desired results.

3. All trench excavations should conform to CAL-OSHA, state, and local safety codes.

4. Utilities crossing grade beams, perimeter beams, or footings should either pass below the footing or grade beam utilizing a hardened collar or foam spacer, or pass through the footing or grade beam in accordance with the recommendations of the structural engineer.

SUMMARY OF RECOMMENDATIONS REGARDING GEOTECHNICAL OBSERVATION AND TESTING

We recommend that observation and/or testing be performed by GSI at each of the following construction stages:

- During grading/recertification.
- During excavation.
- During placement of subdrains, toe drains, or other subdrainage devices, prior to placing fill and/or backfill.
- After excavation of building footings, retaining wall footings, and free standing walls footings, prior to the placement of reinforcing steel or concrete.
- Prior to pouring any slabs or flatwork, after presoaking/presaturation of building pads and other flatwork subgrade, before the placement of concrete, reinforcing steel, capillary break (i.e., sand, pea-gravel, etc.), or vapor barriers (i.e., visqueen, etc.).
- During retaining wall subdrain installation, prior to backfill placement.
- During placement of backfill for area drain, interior plumbing, utility line trenches, and retaining wall backfill.
- During slope construction/repair.
- When any unusual soil conditions are encountered during any construction operations, subsequent to the issuance of this report.
- When any developer or homeowner improvements, such as flatwork, spas, pools, walls, etc., are constructed, prior to construction.
- A report of geotechnical observation and testing should be provided at the conclusion of each of the above stages, in order to provide concise and clear documentation of site work, and/or to comply with code requirements.

- GSI should review project sales documents to homeowners/homeowners associations for geotechnical aspects, including irrigation practices, the conditions outlined above, etc., prior to any sales. At that stage, GSI will provide homeowners maintenance guidelines which should be incorporated into such documents.

OTHER DESIGN PROFESSIONALS/CONSULTANTS

The design civil engineer, structural engineer, post-tension designer, architect, landscape architect, wall designer, etc., should review the recommendations provided herein, incorporate those recommendations into all their respective plans, and by explicit reference, make this report part of their project plans. This report presents minimum design criteria for the design of slabs, foundations and other elements possibly applicable to the project. These criteria should not be considered as substitutes for actual designs by the structural engineer/designer. Please note that the recommendations contained herein are not intended to preclude the transmission of water or vapor through the slab or foundation. The structural engineer/foundation and/or slab designer should provide recommendations to not allow water or vapor to enter into the structure so as to cause damage to another building component, or so as to limit the installation of the type of flooring materials typically used for the particular application.

The structural engineer/designer should analyze actual soil-structure interaction and consider, as needed, bearing, expansive soil influence, and strength, stiffness and deflections in the various slab, foundation, and other elements in order to develop appropriate, design-specific details. As conditions dictate, it is possible that other influences will also have to be considered. The structural engineer/designer should consider all applicable codes and authoritative sources where needed. If analyses by the structural engineer/designer result in less critical details than are provided herein as minimums, the minimums presented herein should be adopted. It is considered likely that some, more restrictive details will be required.

If the structural engineer/designer has any questions or requires further assistance, they should not hesitate to call or otherwise transmit their requests to GSI. In order to mitigate potential distress, the foundation and/or improvement's designer should confirm to GSI and the governing agency, in writing, that the proposed foundations and/or improvements can tolerate the amount of differential settlement and/or expansion characteristics and other design criteria specified herein.

PLAN REVIEW

Final project plans (grading, precise grading, foundation, retaining wall, landscaping, etc.), should be reviewed by this office prior to construction, so that construction is in accordance with the conclusions and recommendations of this report. Based on our review, supplemental recommendations and/or further geotechnical studies may be warranted.

LIMITATIONS

The materials encountered on the project site and utilized for our analysis are believed representative of the area; however, soil and bedrock materials vary in character between excavations and natural outcrops or conditions exposed during mass grading. Site conditions may vary due to seasonal changes or other factors.

Inasmuch as our study is based upon our review and engineering analyses and laboratory data, the conclusions and recommendations are professional opinions. These opinions have been derived in accordance with current standards of practice, and no warranty, either express or implied, is given. Standards of practice are subject to change with time. GSI assumes no responsibility or liability for work or testing performed by others, or their inaction; or work performed when GSI is not requested to be onsite, to evaluate if our recommendations have been properly implemented. Use of this report constitutes an agreement and consent by the user to all the limitations outlined above, notwithstanding any other agreements that may be in place. In addition, this report may be subject to review by the controlling authorities. Thus, this report brings to completion our scope of services for this portion of the project. All samples will be disposed of after 30 days, unless specifically requested by the client, in writing.

APPENDIX A

REFERENCES

APPENDIX A

REFERENCES

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APPENDIX B

BORING LOGS AND TEST PIT LOGS

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions			Group Symbols	Typical Names
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels 50% or more of coarse fraction retained on No. 4 sieve	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravel with	GM	Silty gravels gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands more than 50% of coarse fraction passes No. 4 sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils 50% or more passes No. 200 sieve	Silts and Clays Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, mucic, and other highly organic soils

CONSISTENCY OR RELATIVE DENSITY

CRITERIA

Standard Penetration Test

Penetration Resistance N (blows/ft)	Relative Density
0 - 4	Very loose
4 - 10	Loose
10 - 30	Medium
30 - 50	Dense
> 50	Very dense

Standard Penetration Test

Penetration Resistance N (blows/ft)	Consistency	Unconfined Compressive Strength (tons/ft^2)
<2	Very Soft	<0.25
2 - 4	Soft	0.25 - .050
4 - 8	Medium	0.50 - 1.00
8 - 15	Stiff	1.00 - 2.00
15 - 30	Very Stiff	2.00 - 4.00
>30	Hard	>4.00

	3"	3/4"	#4	#10	#40	#200 U.S. Standard Sieve
Unified Soil Classification	Cobbles	Gravel		Sand		Silt or Clay
		coarse	fine	coarse	medium	fine

MOISTURE CONDITIONS

Dry	Absence of moisture: dusty, dry to the touch
Slightly Moist	Below optimum moisture content for compaction
Moist	Near optimum moisture content
Very Moist	Above optimum moisture content
Wet	Visible free water; below water table

MATERIAL QUANTITY

trace	0 - 5 %
few	5 - 10 %
little	10 - 25 %
some	25 - 45 %

OTHER SYMBOLS

C Core Sample
S SPT Sample
B Bulk Sample
▼ Groundwater
Qp Pocket Penetrometer

BASIC LOG FORMAT:
Group name, Group symbol, (grain size), color, moisture, consistency or relative density. Additional comments: odor, presence of roots, mica, gypsum, coarse grained particles, etc.

EXAMPLE:
Sand (SP), fine to medium grained, brown, moist, loose, trace silt, little fine gravel, few cobbles up to 4" in size, some hair roots and rootlets.

File:Mgr: c:\SoilClassif.wpd

PLATE B-1

BORING LOG

GeoSoils, Inc.

W.O. 4787-A-SC

PROJECT: SO CAL LAND MANAGEMENT
Tract 31687, Romoland

BORING B-1 SHEET 1 OF 2

DATE EXCAVATED 5-20-05

SAMPLE METHOD: 8" Hollow Stem Auger, 130 Lb @ 30" Drop

Standard Penetration Test

Undisturbed, Ring Sample

Groundwater

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Description of Material
				SM				**COLLUVIUM/TOPSOIL:** @ 0' SILTY SAND, light brown, dry, loose.
			48	SM/SC	124.2	12.5	100	**QUATERNARY FAN DEPOSITS:** @ 2' SILTY to CLAYEY SAND, reddish brown, saturated, dense.
5			69		126.6	10.4	89	@ 5' SILTY to CLAYEY SAND, medium to reddish brown, wet, dense.
10			27	SM		11.6		@ 10' SILTY SAND, brown, wet, medium dense; fine to coarse grained.
15			25		124.7	8.9	72	@ 15' SILTY SAND, reddish brown, moist, medium dense.
20			42			7.0		@ 20' As per 15', dense.
25			23/ 50-6"		117.9	8.3	55	@ 25' SILTY SAND, reddish brown, moist, dense; well indurated.

BORING LOG

GeoSoils, Inc.

W.O. 4787-A-SC

PROJECT: SO CAL LAND MANAGEMENT
Tract 31687, Romoland

BORING B-1 SHEET 2 OF 2

DATE EXCAVATED 5-20-05

SAMPLE METHOD: 8" Hollow Stem Auger, 130 Lb @ 30" Drop

Standard Penetration Test

Undisturbed, Ring Sample

Groundwater

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Description of Material
			34	SM		7.0		@ 30' SILTY SAND, reddish yellow, damp, dense.
35			50-6"		110.4	8.8	47	@ 35' SILTY SAND, reddish yellow, damp, very dense.
			20/ 50-5"			8.0		@ 38' SILTY SAND, red, damp, very dense.
40								Practical Refusal @ 39½' No Groundwater/Caving Encountered Backfilled 5-20-2005
45								
50								
55								

BORING LOG

GeoSoils, Inc.

W.O. 4787-A-SC

PROJECT: SO CAL LAND MANAGEMENT
Tract 31687, Romoland

BORING B-2 SHEET 1 OF 1

DATE EXCAVATED 5-20-05

SAMPLE METHOD: 8" Hollow Stem Auger, 130 Lb @ 30" Drop

Standard Penetration Test

Undisturbed, Ring Sample

Groundwater

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Description of Material
				SM				**COLLUVIUM/TOPSOIL:** @ 0' SILTY SAND, light brown, dry, loose to medium dense.
			40	SM/SC	129.0	10.1	95	@ 2½' **QUATERNARY FAN DEPOSITS:** @ 3' SILTY to CLAYEY SAND, reddish brown, wet, dense; minor stage II carbonate veins and veinlets.
5								
			39	SM	123.1	5.6	43	@ 7' SILTY SAND, brown, damp, dense; well indurated, abundant clay film on ped faces.
10								
			27	SM/SC		8.9		@ 12' SILTY to CLAYEY SAND, reddish brown to red, moist, medium dense.
15								
			40/ 50-3"	SM	123.0	10.1	77	@ 17' SILTY SAND, red, wet, very dense.
20								
			69			6.3		@ 22' As per 17', damp.
25								
			40/ 50-3"		11.2	3.0	17	@ 27' SILTY SAND, reddish brown, dry, very dense.
								Total Depth = 28' No Groundwater/Caving Encountered Backfilled 5-20-2005

BORING LOG

GeoSoils, Inc.

W.O. 4787-A-SC

PROJECT: SO CAL LAND MANAGEMENT
Tract 31687, Romoland

BORING B-3 SHEET 1 OF 2

DATE EXCAVATED 5-20-05

SAMPLE METHOD: 8" Hollow Stem Auger, 130 Lb @ 30" Drop

Standard Penetration Test

Undisturbed, Ring Sample

Groundwater

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Description of Material
				SC				**COLLUVIUM/TOPSOIL:**
		▨	24		128.7	8.7	81	@ 0' CLAYEY SAND, dark brown, wet, loose to medium dense.
								@ 1' As per 0'.
				SM				**QUATERNARY FAN DEPOSITS:**
								@ 2½' SILTY SAND, reddish brown, moist, medium dense to dense.
5		▨	16			5.3		@ 5' SILTY SAND, brown, moist, medium dense.
10		▨	29/ 50-5"		128.5	9.6	88	@ 10' SILTY SAND, reddish yellow, wet, very dense; well indurated.
15		▨	63			9.2		@ 15' SILTY SAND, reddish brown, wet, very dense.
20		▨	33/ 50-5"		125.6	6.5	54	@ 20' SILTY SAND, yellowish brown, moist, very dense.
25		▨	63			5.3		@ 25' SILTY SAND, reddish brown, moist, very dense.

BORING LOG

GeoSoils, Inc.

W.O. 4787-A-SC

PROJECT: SO CAL LAND MANAGEMENT
Tract 31687, Romoland

BORING B-3 SHEET 2 OF 2

DATE EXCAVATED 5-20-05

SAMPLE METHOD: 8" Hollow Stem Auger, 130 Lb @ 30" Drop

Standard Penetration Test

Undisturbed, Ring Sample

Groundwater

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Description of Material
		▨	50-6"	SM	11.0	10.4	55	@ 30' SILTY SAND, reddish yellow, moist, very dense; well indurated.
								Total Depth = 31'
								No Groundwater/Caving Encountered
								Backfilled 5-20-2005
35								
40								
45								
50								
55								

LOG OF EXPLORATORY TEST PITS

TEST PIT NO.	DEPTH (ft.)	GROUP SYMBOL	SAMPLE DEPTH (ft.)	MOISTURE (%)	FIELD DRY DENSITY (pcf)	DESCRIPTION
TP-1	0-2½	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, light brown, dry, loose to medium dense.
	2½-8	SM				**QUATERNARY FAN DEPOSITS:** SILTY SAND, reddish brown, damp, medium dense to dense w/depth; fine to coarse grained.
						Total Depth = 8' No Groundwater/Caving Encountered Backfilled 5-19-2005
TP-2	0-5	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, brown, dry to damp, loose to medium dense.
	5-9	SM	Bulk @ 5-6			**QUATERNARY FAN DEPOSITS:** SILTY SAND, dark brown, damp to moist, medium dense to dense w/depth.
						Total Depth = 9' No Groundwater/Caving Encountered Backfilled 5-19-2005

LOG OF EXPLORATORY TEST PITS

TEST PIT NO.	DEPTH (ft.)	GROUP SYMBOL	SAMPLE DEPTH (ft.)	MOISTURE (%)	FIELD DRY DENSITY (pcf)	DESCRIPTION
TP-3	0-6	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, light brown, dry to damp, loose; minor roots and rootlets.
	6-7	SM				**BEDROCK - CRETACEOUS GRANITICS:** QUARTZ DIORITE degrades to SILTY SAND, gray, dry, dense; moderately weathered
						Total Depth = 7' No Groundwater/Caving Encountered Backfilled 5-19-2005
TP-4	0-2	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, light brown, dry, loose.
	2-5	SM				**BEDROCK - CRETACEOUS GRANITICS:** QUARTZ DIORITE degrades to SILTY SAND, gray, dry, medium dense to dense.
						Total Depth = 5' No Groundwater/Caving Encountered Backfilled 5-19-2005

LOG OF EXPLORATORY TEST PITS

TEST PIT NO.	DEPTH (ft.)	GROUP SYMBOL	SAMPLE DEPTH (ft.)	MOISTURE (%)	FIELD DRY DENSITY (pcf)	DESCRIPTION
TP-5	0-3	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, light brown, dry, lose; abundant rootlets.
	3-5	SM				**BEDROCK - CRETACEOUS GRANITICS:** QUARTZ DIORITE degrades to SILTY SAND, gray, dry, medium dense to dense w/depth; weathered.
						Total Depth = 5' No Groundwater/Caving Encountered Backfilled 5-19-2005
TP-6	0-5	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, light brown, dry, loose.
	5-6	SM				**BEDROCK - CRETACEOUS GRANITICS:** QUARTZ DIORITE degrades to SILTY SAND, gray, dry, medium dense to dense w/depth; weathered near surface.
						Total Depth = 6' No Groundwater/Caving Encountered Backfilled 5-19-2005

LOG OF EXPLORATORY TEST PITS

TEST PIT NO.	DEPTH (ft.)	GROUP SYMBOL	SAMPLE DEPTH (ft.)	MOISTURE (%)	FIELD DRY DENSITY (pcf)	DESCRIPTION
TP-7	0-3	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, light brown, dry, loose.
	3-8	SM				**ALLUVIUM (YOUNGER):** SILTY SAND, medium brown, damp to moist, loose; caving encountered.
	8-10	SM				**BEDROCK - CRETACEOUS GRANITICS:** QUARTZ DIORITE degrades to SILTY SAND, gray, dry to damp, medium dense to dense w/depth; weathered near surface.
						Total Depth = 10' No Groundwater Encountered Backfilled 5-19-2005
TP-8	0-2	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, light reddish brown, dry, loose to medium dense.
	2-4	SM				**QUATERNARY FAN DEPOSITS:** SILTY SAND, reddish brown, damp, medium dense to dense.
						Total Depth = 4' No Groundwater/Caving Encountered Backfilled 5-19-2005

LOG OF EXPLORATORY TEST PITS

TEST PIT NO.	DEPTH (ft.)	GROUP SYMBOL	SAMPLE DEPTH (ft.)	MOISTURE (%)	FIELD DRY DENSITY (pcf)	DESCRIPTION
TP-9	0-2	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, light brown, dry, loose to medium dense.
	2-5½	SM				**QUATERNARY FAN DEPOSITS:** SILTY SAND, dark reddish brown, damp to moist, medium dense to dense.
						Total Depth = 5½' No Groundwater/Caving Encountered Backfilled 5-19-2005
TP-10	0-2	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, light reddish brown, dry, loose.
	2-4½	SM				**QUATERNARY FAN DEPOSITS:** SILTY SAND, reddish brown, damp, medium dense to dense.
						Total Depth = 4½' No Groundwater/Caving Encountered Backfilled 5-19-2005

LOG OF EXPLORATORY TEST PITS

TEST PIT NO.	DEPTH (ft.)	GROUP SYMBOL	SAMPLE DEPTH (ft.)	MOISTURE (%)	FIELD DRY DENSITY (pcf)	DESCRIPTION
TP-11	0-2½	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, brown, dry, loose; minor rootlets.
	2½-6	SM				**QUATERNARY FAN DEPOSITS:** SILTY SAND, reddish brown, damp, medium dense to dense w/depth.
						Total Depth = 6' No Groundwater/Caving Encountered Backfilled 5-19-2005
TP-12	0-2	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, light brown, dry, loose to medium dense; minor rootlets, porous.
	2-6	SM				**QUATERNARY FAN DEPOSITS:** SILTY SAND, reddish brown, damp, medium dense to dense.
						Total Depth = 6' No Groundwater/Caving Encountered Backfilled 5-19-2005

LOG OF EXPLORATORY TEST PITS

TEST PIT NO.	DEPTH (ft.)	GROUP SYMBOL	SAMPLE DEPTH (ft.)	MOISTURE (%)	FIELD DRY DENSITY (pcf)	DESCRIPTION
TP-13	0-2½	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, brown, dry, loose; porous, minor rootlets.
	2½-6	SM				**QUATERNARY FAN DEPOSITS:** SILTY SAND, reddish brown, damp to moist, medium dense to dense w/depth.
						Total Depth = 6' No Groundwater/Caving Encountered Backfilled 5-19-2005
TP-14	0-2	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, light brown, dry, loose; porous.
	2-5	SM				**QUATERNARY FAN DEPOSITS:** SILTY SAND, reddish brown, dry to moist, medium dense to dense.
						Total Depth = 5' No Groundwater/Caving Encountered Backfilled 5-19-2005

LOG OF EXPLORATORY TEST PITS

TEST PIT NO.	DEPTH (ft.)	GROUP SYMBOL	SAMPLE DEPTH (ft.)	MOISTURE (%)	FIELD DRY DENSITY (pcf)	DESCRIPTION
TP-15	0-2½	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, light reddish brown, dry, loose to medium dense.
	2½-6	SM				**QUATERNARY FAN DEPOSITS:** SILTY SAND, reddish brown, dry to moist at depth, medium dense to dense.
						Total Depth = 6' No Groundwater/Caving Encountered Backfilled 5-19-2005
TP-16	0-2	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, light reddish brown, dry to damp, loose to medium dense; porous.
	2-5½	SM				**QUATERNARY FAN DEPOSITS:** SILTY SAND, reddish brown, dry to damp, medium dense to dense.
						Total Depth = 5½' No Groundwater/Caving Encountered Backfilled 5-19-2005

LOG OF EXPLORATORY TEST PITS

TEST PIT NO.	DEPTH (ft.)	GROUP SYMBOL	SAMPLE DEPTH (ft.)	MOISTURE (%)	FIELD DRY DENSITY (pcf)	DESCRIPTION
TP-17	0-1½	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, light brown, dry, loose to medium dense; porous.
	1½-5	SM				**QUATERNARY FAN DEPOSITS:** SILTY SAND, reddish brown, dry to damp, medium dense to dense.
						Total Depth = 5' No Groundwater/Caving Encountered Backfilled 5-19-2005
TP-18	0-2	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, light reddish brown, dry, loose to medium dense.
	2-6	SM				**QUATERNARY FAN DEPOSITS:** SILTY SAND, reddish brown, dry to damp, medium dense to dense.
						Total Depth = 6' No Groundwater/Caving Encountered Backfilled 5-19-2005

LOG OF EXPLORATORY TEST PITS

TEST PIT NO.	DEPTH (ft.)	GROUP SYMBOL	SAMPLE DEPTH (ft.)	MOISTURE (%)	FIELD DRY DENSITY (pcf)	DESCRIPTION
TP-19	0-2	SM				**COLLUVIUM/TOPSOIL:** SILTY SAND, light brown, dry, loose.
	2-5½	SM				**QUATERNARY FAN DEPOSITS:** SILTY SAND, reddish brown, dry to damp, medium dense to dense w/depth.
						Total Depth = 5½' No Groundwater/Caving Encountered Backfilled 5-19-2005

APPENDIX C

EQFAULT, EQSEARCH, AND FRISKSP

MAXIMUM EARTHQUAKES

Southern Calif. Land Management

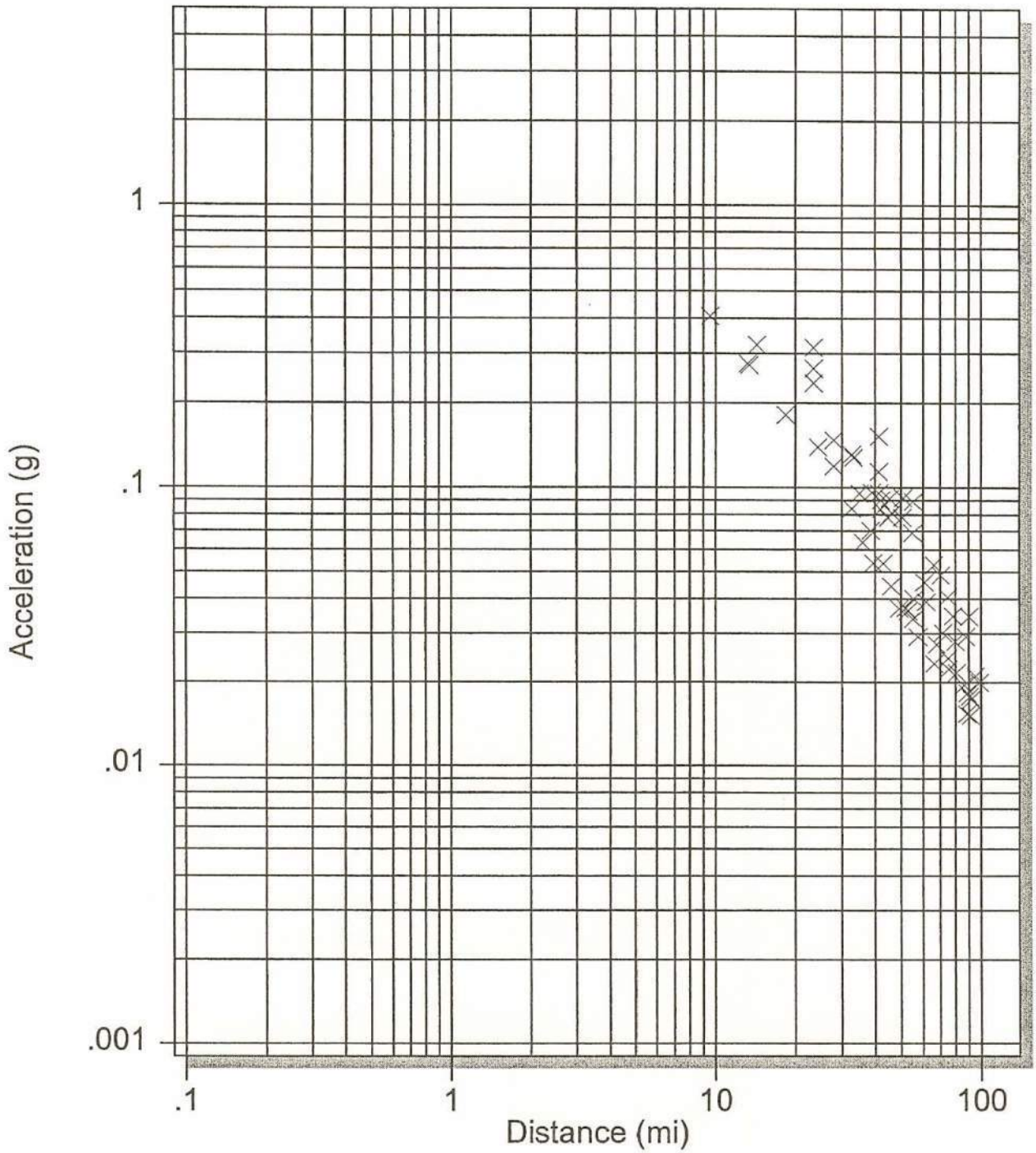


Figure C-1

EARTHQUAKE EPICENTER MAP

Southern Calif. Land Management

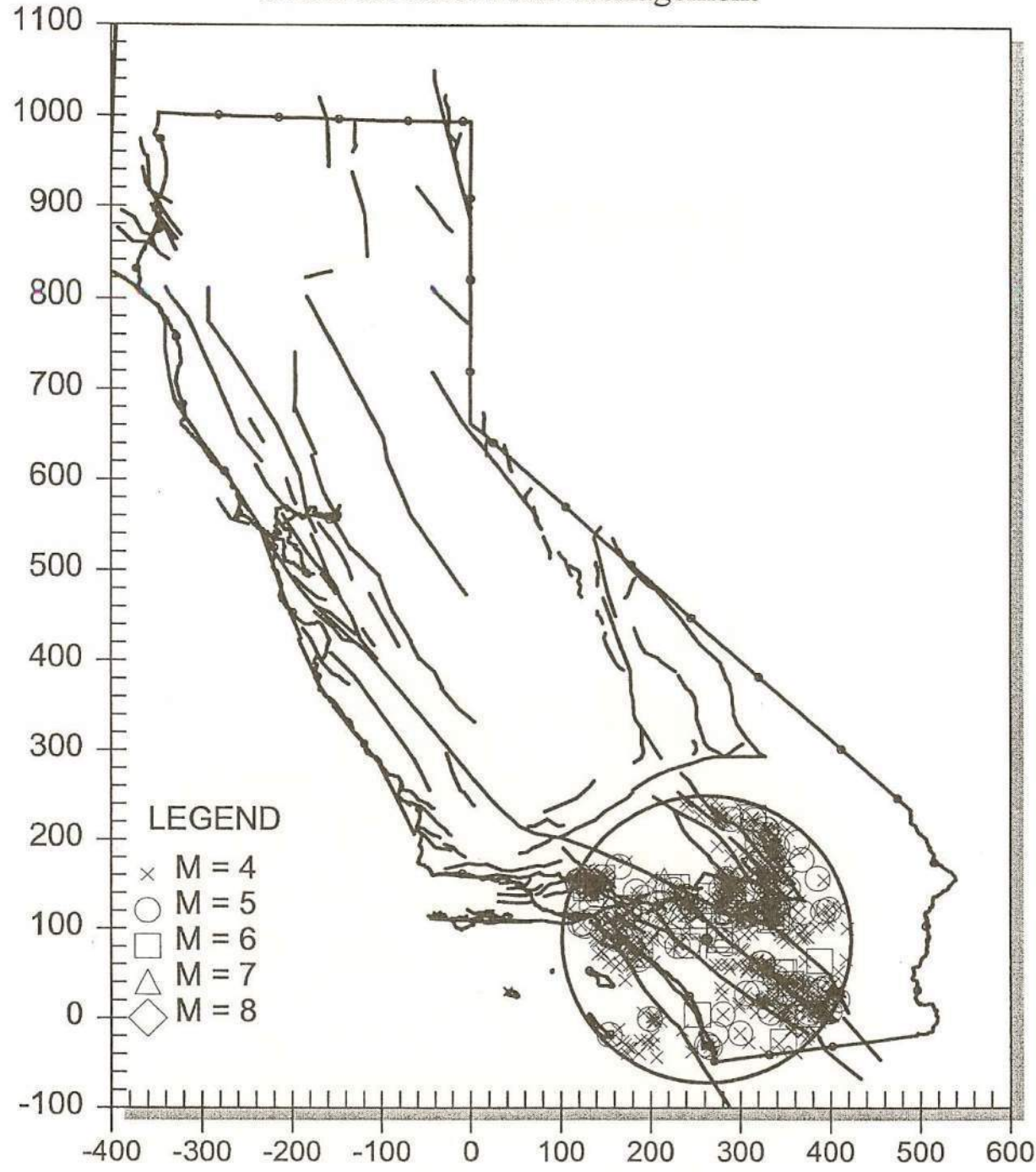


Figure C-2

EARTHQUAKE RECURRENCE CURVE

Southern Calif. Land Management

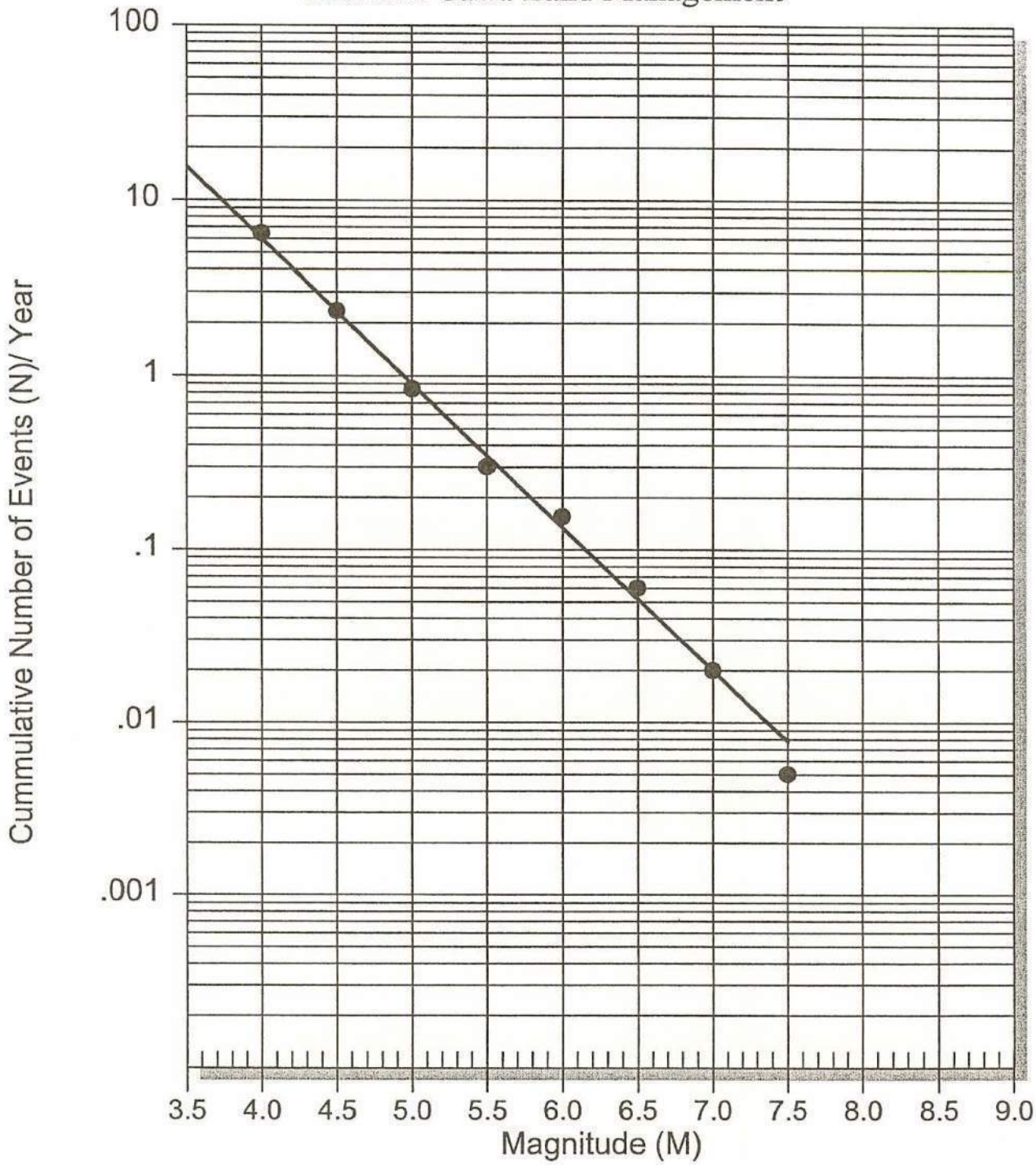


Figure C-3

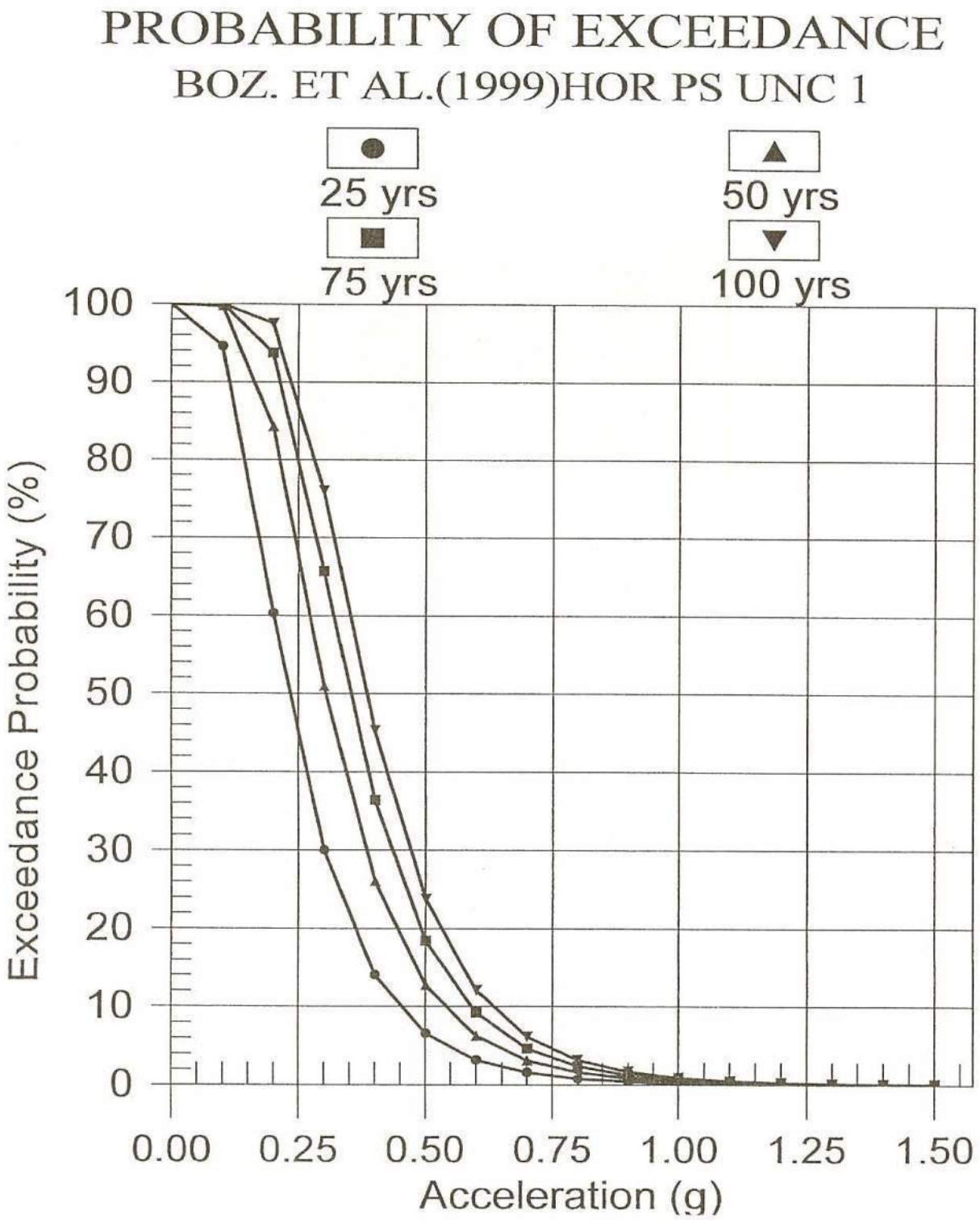

PROBABILITY OF EXCEEDANCE
BOZ. ET AL.(1999)HOR PS UNC 1
25 yrs
50 yrs
75 yrs
100 yrs
Exceedance Probability (%)
100
90
80
70
60
50
40
30
20
10
0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
Acceleration (g)

Figure C-4

RETURN PERIOD vs. ACCELERATION

BOZ. ET AL.(1999)HOR PS UNC 1

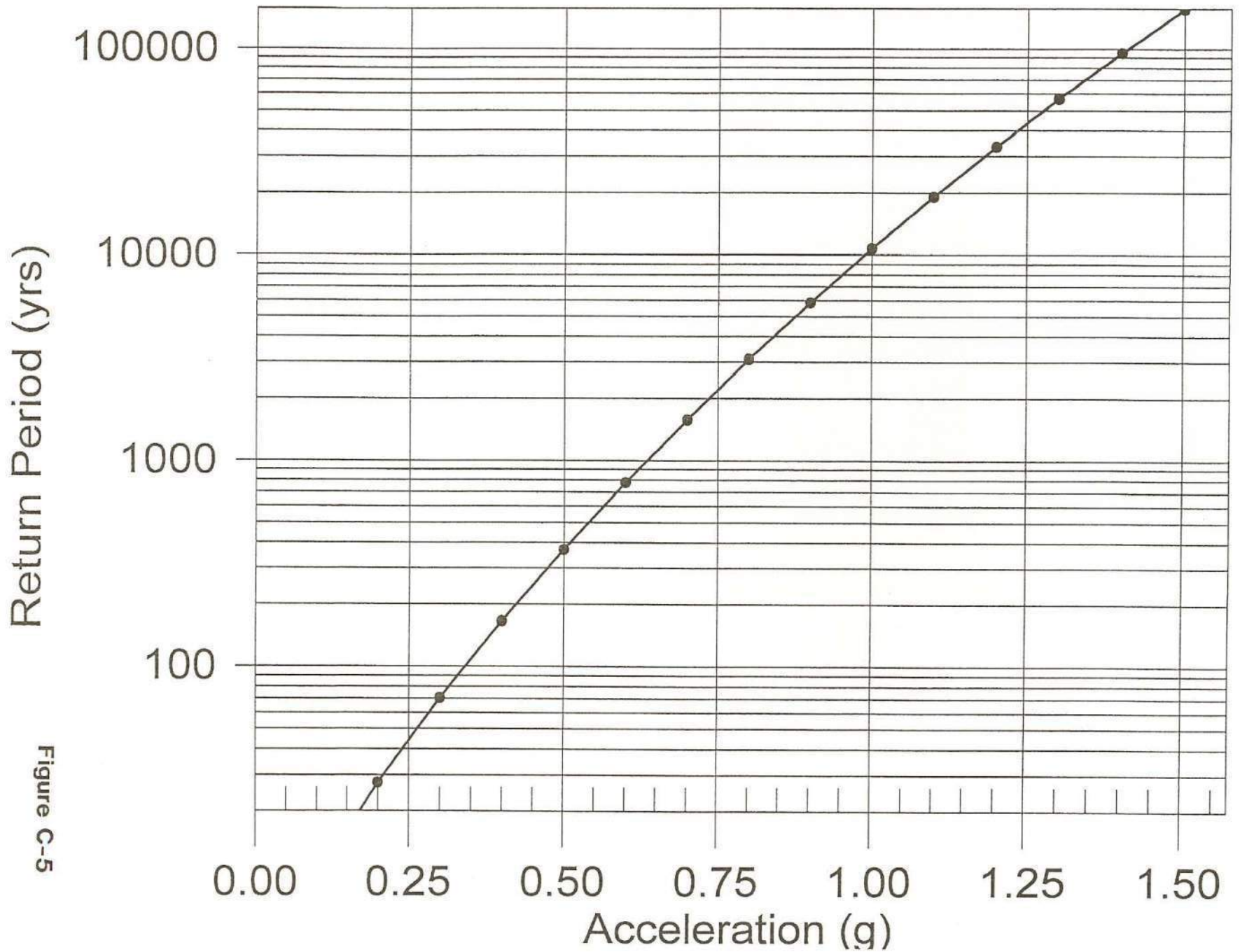
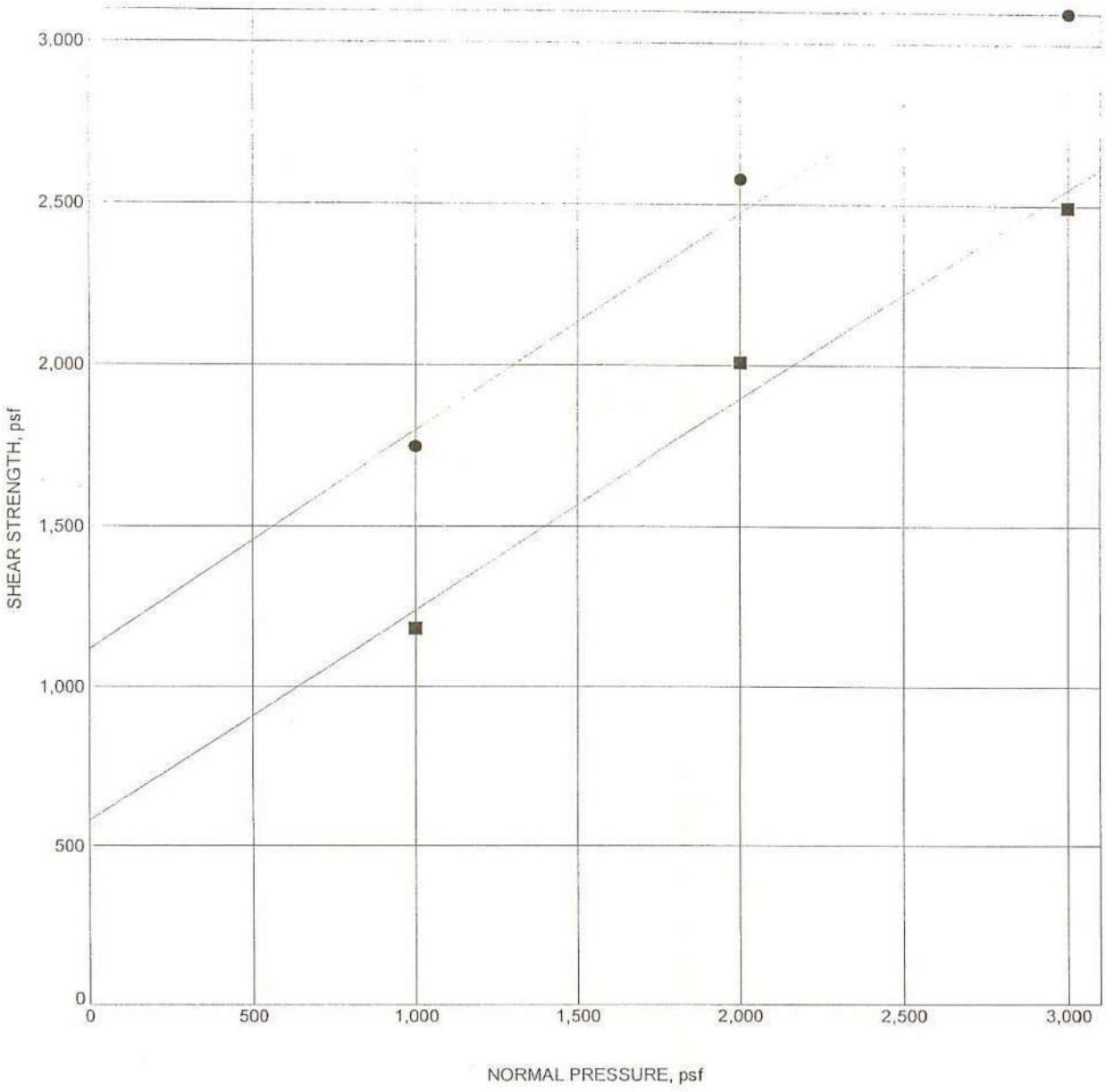


Figure C-5

APPENDIX D

LABORATORY TEST RESULTS



	Sample	Depth/El.	Primary/Residual Shear	Sample Type	γ_d	MC%	c	ϕ
●	B-1	5.0	Primary Shear	Undisturbed	126.3	10.4	1118	34
■	B-1	5.0	Residual Shear	Undisturbed	126.3	10.4	582	33

Note: Sample Innundated prior to testing

GeoSoils, Inc.
5741 Palmer Way
Carlsbad, CA 92008
Telephone: (760) 438-3155
Fax: (760) 931-0915

GeoSoils, Inc.

DIRECT SHEAR TEST

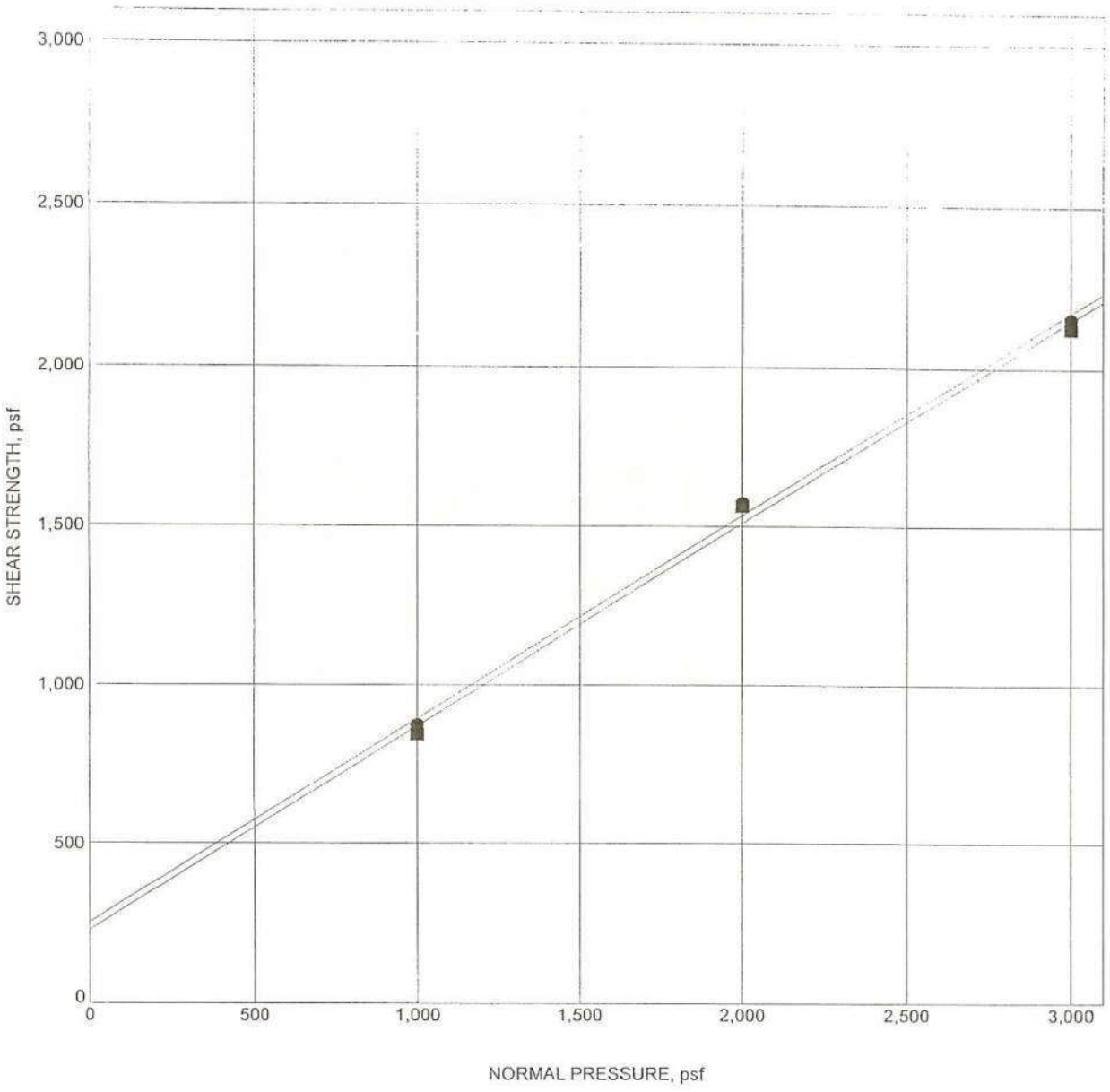
Project: SOUTHERN CALIFORNIA LAND MANAG.

Number: 4787-A-SC

Date: June 2005

Figure D-1

US_DIRECT_SHEAR_4787.GPJ US_LAB.GDT 6/6/05



	Sample	Depth/El.	Primary/Residual Shear	Sample Type	γ_d	MC%	c	ϕ
●	TP-10	3.0	Primary Shear	Remolded	122.4	8.0	254	33
■	TP-10	3.0	Residual Shear	Remolded	122.4	8.0	230	33

Note: Sample Innundated prior to testing

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GeoSoils, Inc.

DIRECT SHEAR TEST

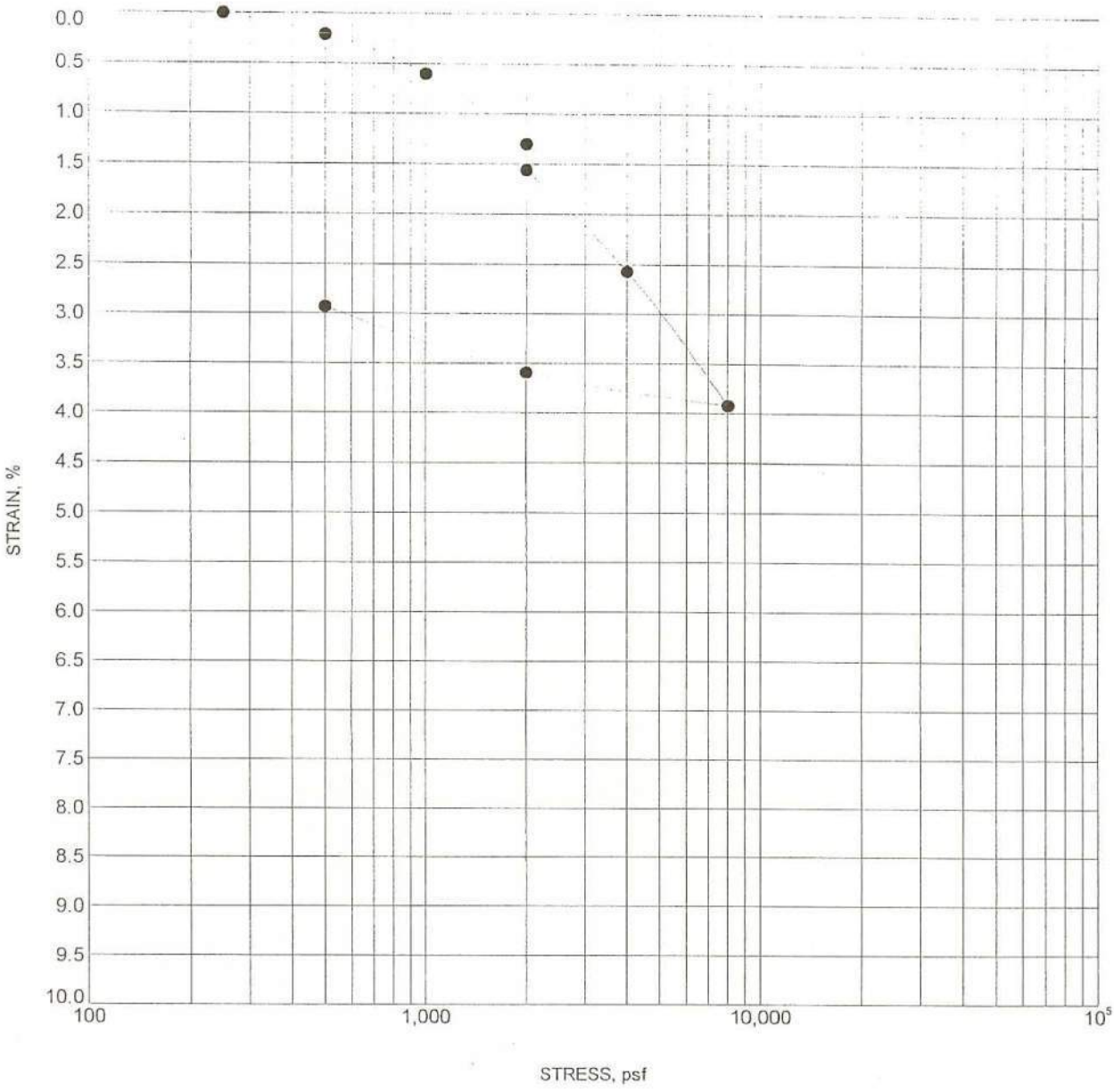
Project: SOUTHERN CALIFORNIA LAND MANAG.

Number: 4787-A-SC

Date: June 2005

Figure D-2

US_DIRECT_SHEAR 4787.GPJ US_LAB.GDT 6/6/05



Sample		Depth/El.	Visual Classification	γ_d Initial	MC Initial	MC Final	H20
●	B-1	15.0	Silty Sand	124.0	8.9	11.2	2000

Stress at which water was added: 2000 psf
Strain Difference: _ _ _ _ _ 0.26%

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CONSOLIDATION TEST

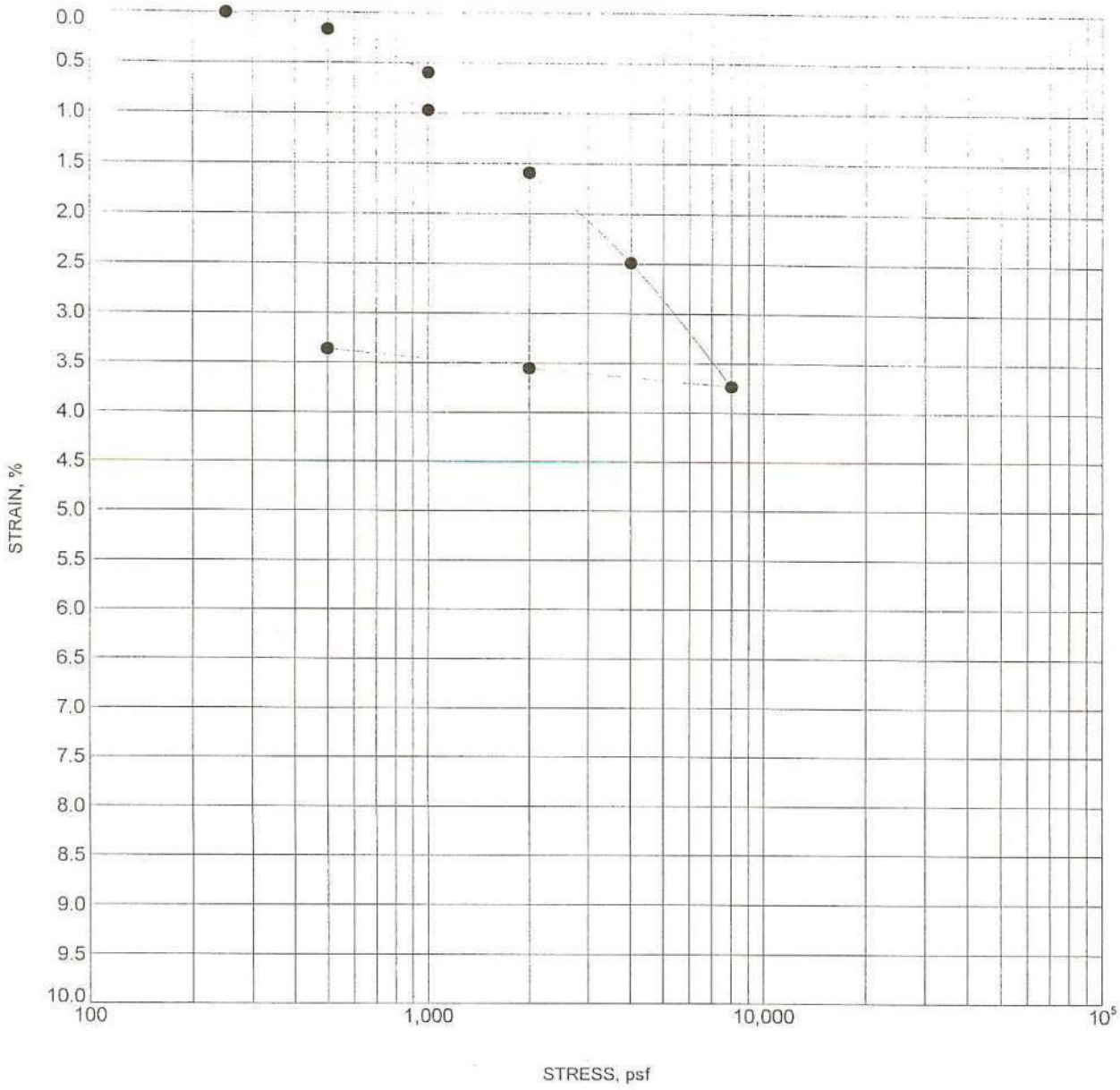
Project: SOUTHERN CALIFORNIA LAND MANAG.

Number: 4787-A-SC

Date: June 2005

Figure D-3

US CONSOL STRAIN 4787.GPJ US_LAB.GDT 6/6/05



Sample		Depth/El.	Visual Classification	γ_d Initial	MC Initial	MC Final	H20
●	B-2	7.0	Silty Sand	108.3	5.6	17.5	1000

Stress at which water was added: 1000 psf
Strain Difference: _ _ _ _ 0.38%

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5741 Palmer Way
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GeoSoils, Inc.

CONSOLIDATION TEST

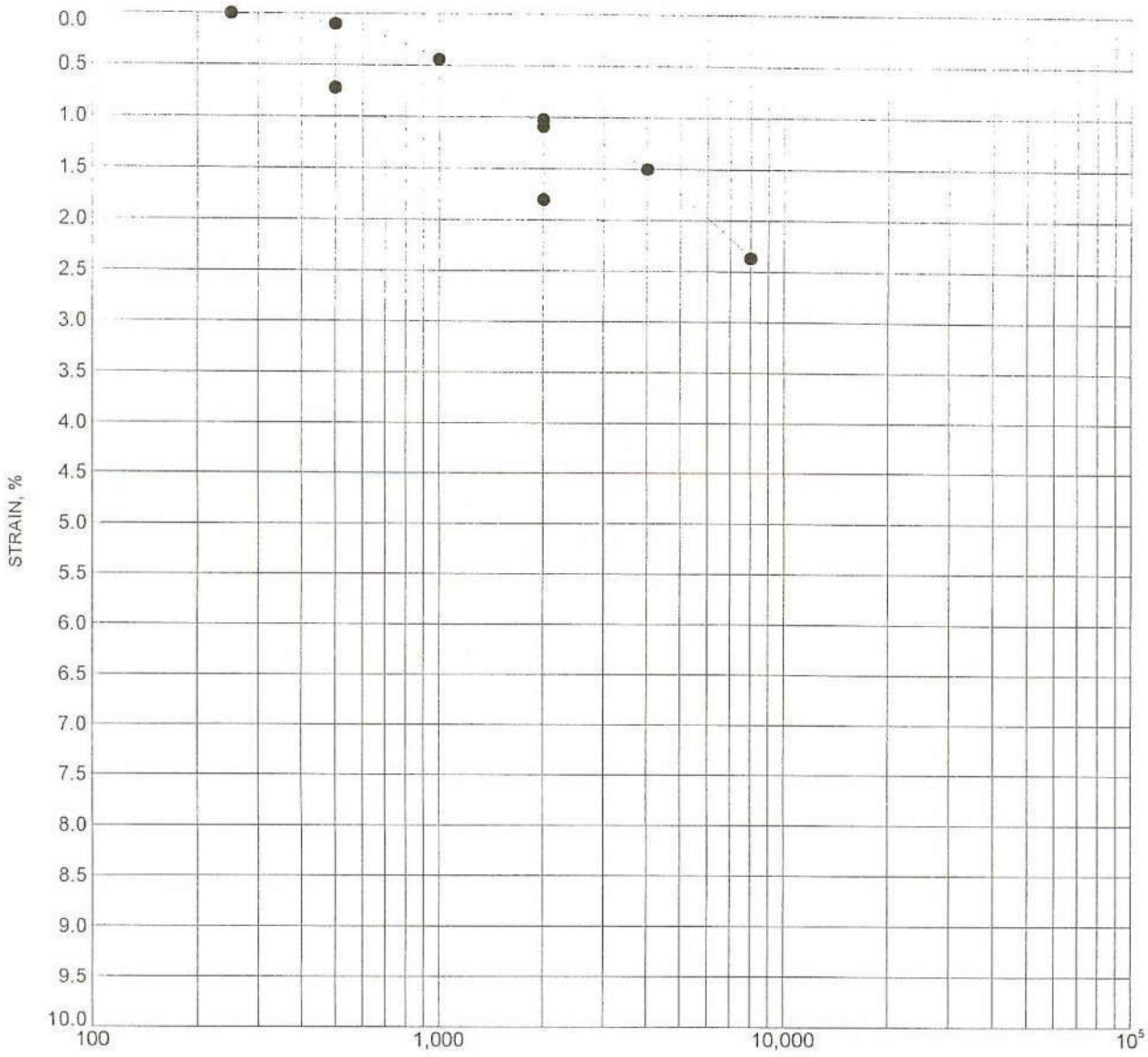
Project: SOUTHERN CALIFORNIA LAND MANAG.

Number: 4787-A-SC

Date: June 2005

Figure D-4

US_CONSOL_STRAIN 4787.GPJ US_LAB.GDT 6/6/05



Sample	Depth/El.	Visual Classification	γ_d Initial	MC Initial	MC Final	H20
● B-3	10.0	Clayey Sand	128.7	9.6	10.4	2000

Stress at which water was added: 2000 psf
Strain Difference: _____ -7.00000000000001E-02%

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Carlsbad, CA 92008
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CONSOLIDATION TEST

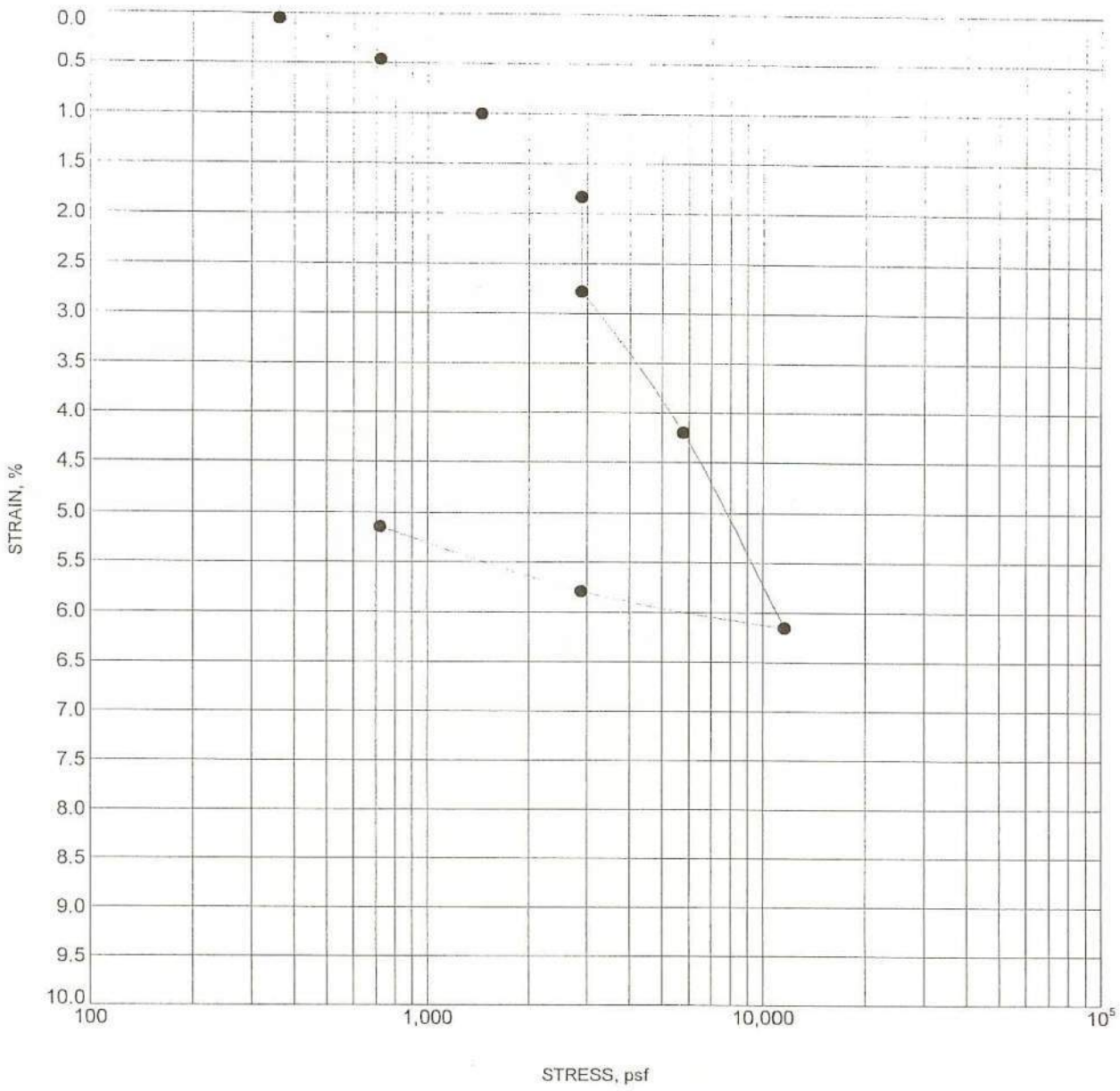
Project: SOUTHERN CALIFORNIA LAND MANAG.

Number: 4787-A-SC

Date: June 2005

Figure D-5

US_CONSOL_STRAIN 4787.GPJ US_LAB.GDT 6/6/05



Sample	Depth/El.	Visual Classification	γ_d Initial	MC Initial	MC Final	H20
● B-3	20.0	Silty Sand	132.4	6.5	5.6	2880

Stress at which water was added: 2880 psf
Strain Difference: _____ 0.95%

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GeoSoils, Inc.

CONSOLIDATION TEST

Project: SOUTHERN CALIFORNIA LAND MANAG.

Number: 4787-A-SC

Date: June 2005

Figure D-6

US_CONSOL_STRAIN 4787.GPJ US_LAB.GDT 6/6/05

TEST SPECIMAN		A	B	C	D
Compactor air pressure	PSI	350	230	110	
Water added	%	0.0	1.1	2.3	
Moisture at compaction	%	10.2	11.4	12.7	
Height of sample	IN	2.31	2.4	2.48	
Dry density	PCF	130.3	124.6	118.7	
R-Value by exudation		28	17	9	
R-Value by exudation, corrected		24	16	9	
Exudation pressure	PSI	649	414	179	
Stability thickness	FT	0.92	1.06	1.16	
Expansion pressure thickness	FT	1.77	0.87	0.00	

DESIGN CALCULATION DATA

Traffic index, assumed	5.0
Gravel equivalent factor, assumed	1.25
Expansion, stability equilibrium	0.95
R-Value by expansion	26
R-Value by exudation	15
R-Value at equilibrium	**15**

SAMPLE INFORMATION

Sample Location: TP-13 @ 2.5-3.5

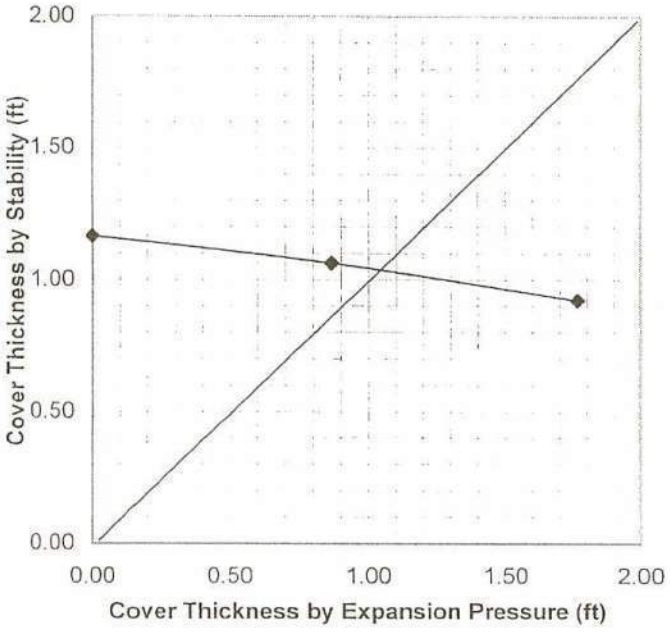
Sample Description: Dark Brown Silty Sand

Notes:

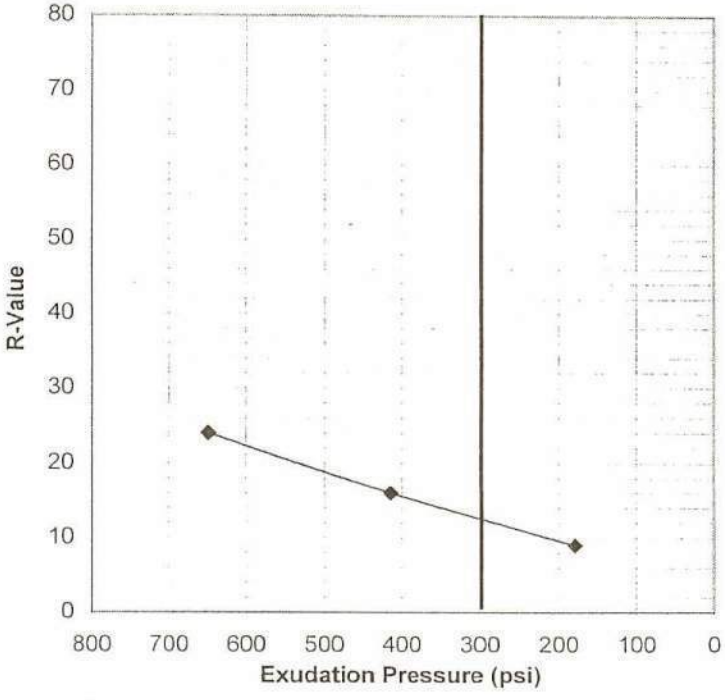
0% Retained on 3/4 inch sieve

Test Method: Cal-Trans Test 301

Expansion, Stability Equilibrium



R-Value By Exudation



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Telephone: (760) 438-3155
Fax: (760) 931-0915

R - VALUE TEST RESULTS

Project: SOUTHERN CALIFORNIA LAND MANAGEMENT

Number: 4787-A-SC

Date: Jun-05

Figure D-7

TEST SPECIMAN		A	B	C	D
Compactor air pressure	PSI	350	350	110	
Water added	%	0.0	0.0	0.0	
Moisture at compaction	%	10.0	10.9	13.6	
Height of sample	IN	2.31	2.38	2.44	
Dry density	PCF	129.5	126.5	119.7	
R-Value by exudation		65	44	14	
R-Value by exudation, corrected		60	42	14	
Exudation pressure	PSI	589	314	139	
Stability thickness	FT	0.45	0.72	1.10	
Expansion pressure thickness	FT	0.80	0.33	0.07	

DESIGN CALCULATION DATA

Traffic index, assumed	5.0
Gravel equivalent factor, assumed	1.25
Expansion, stability equilibrium	0.53
R-Value by expansion	59
R-Value by exudation	41
R-Value at equilibrium	**41**

SAMPLE INFORMATION

Sample Location: TP-2 @ 5-6

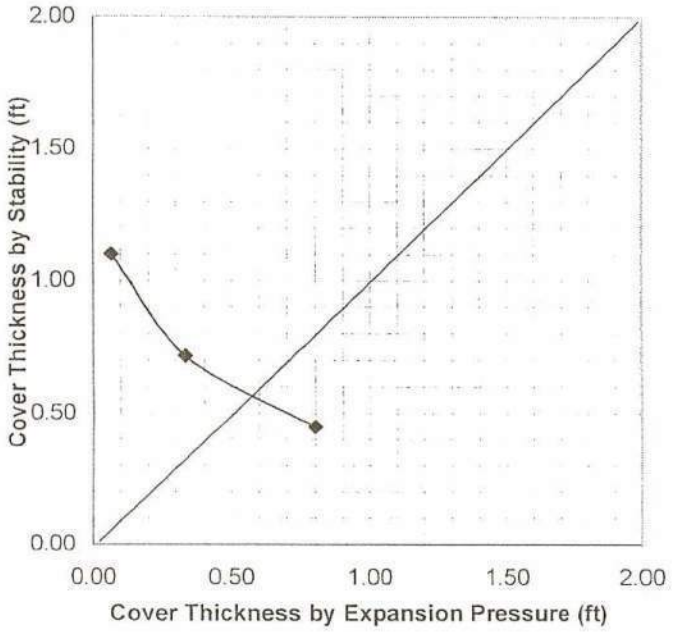
Sample Description: Dark Brown Silty Sand

Notes:

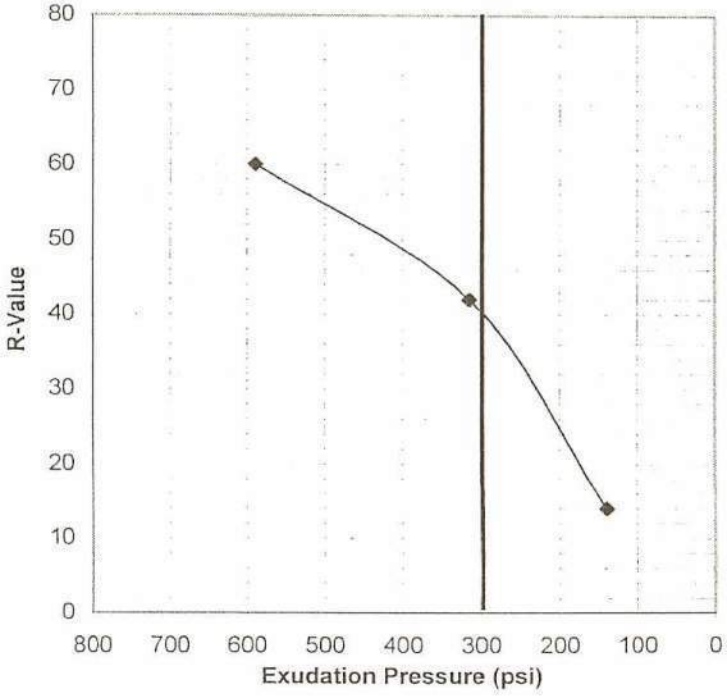
0% Retained on 3/4 inch sieve

Test Method: Cal-Trans Test 301

Expansion, Stability Equilibrium



R-Value By Exudation



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5741 Palmer Way
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Fax: (760) 931-0915

R - VALUE TEST RESULTS

Project: SOUTHERN CALIFORNIA LAND MANAGEMENT

Number: 4787-A-SC

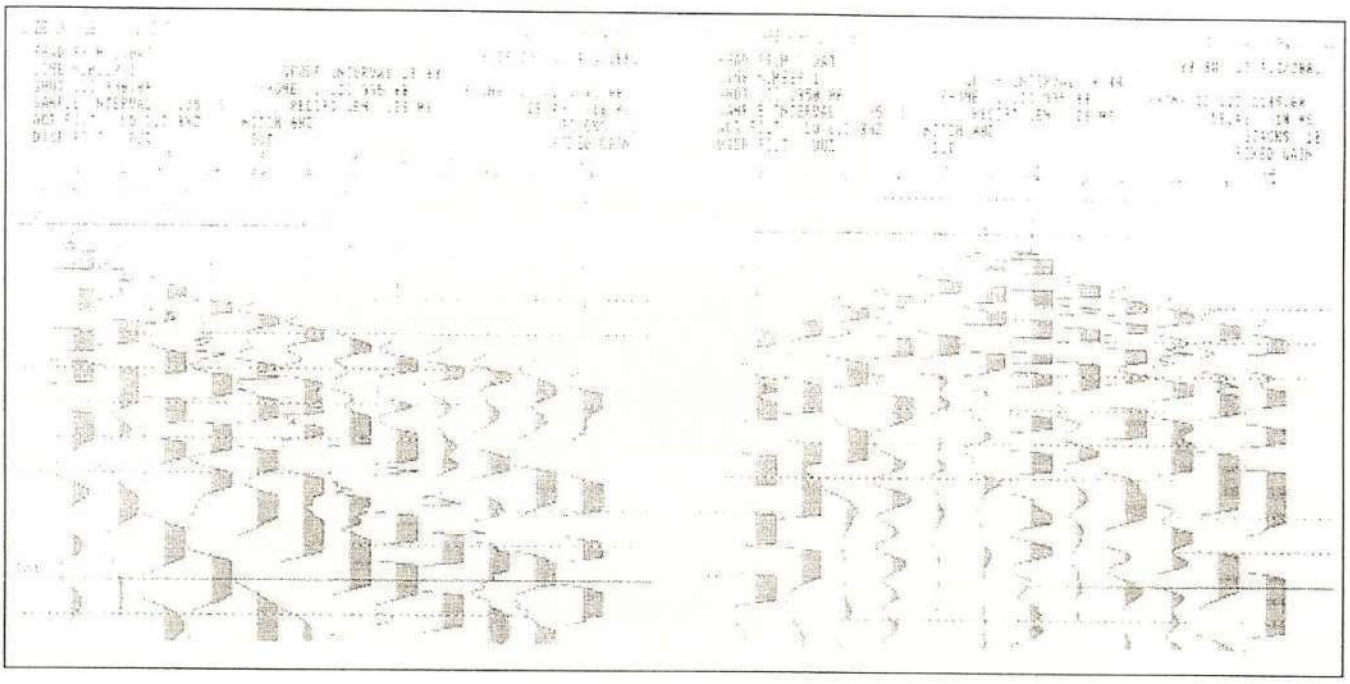
Date: Jun-05

Figure D-8

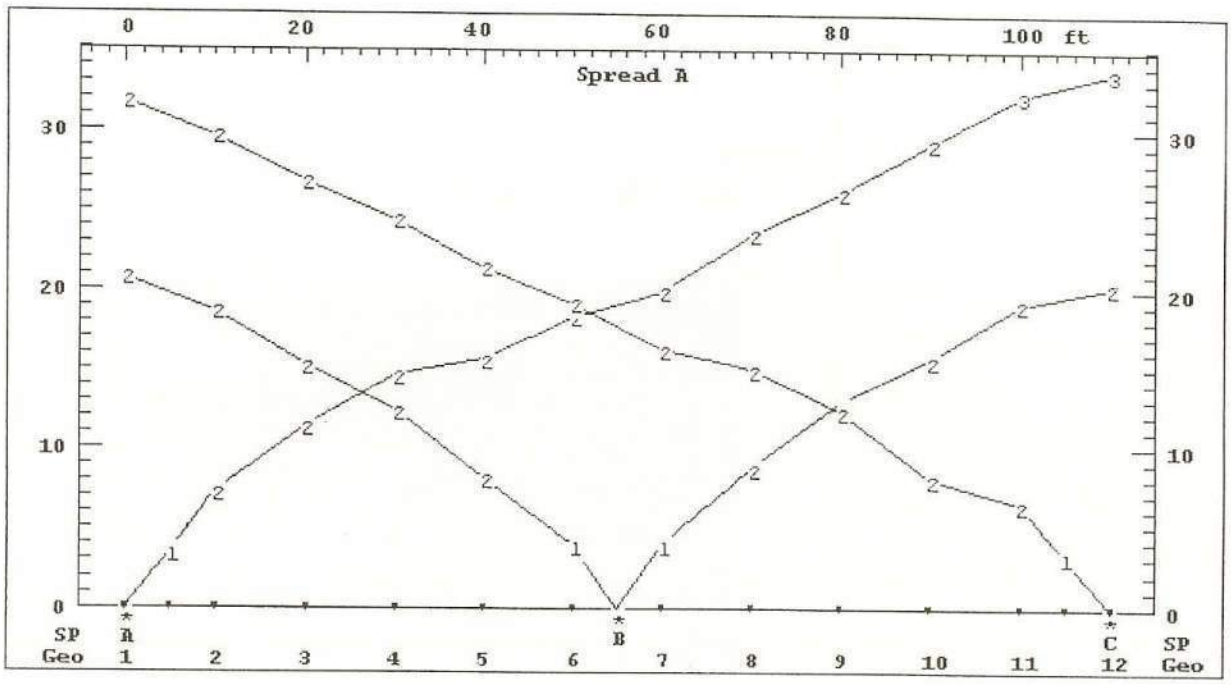
APPENDIX E

SEISMIC REFRACTION DATA

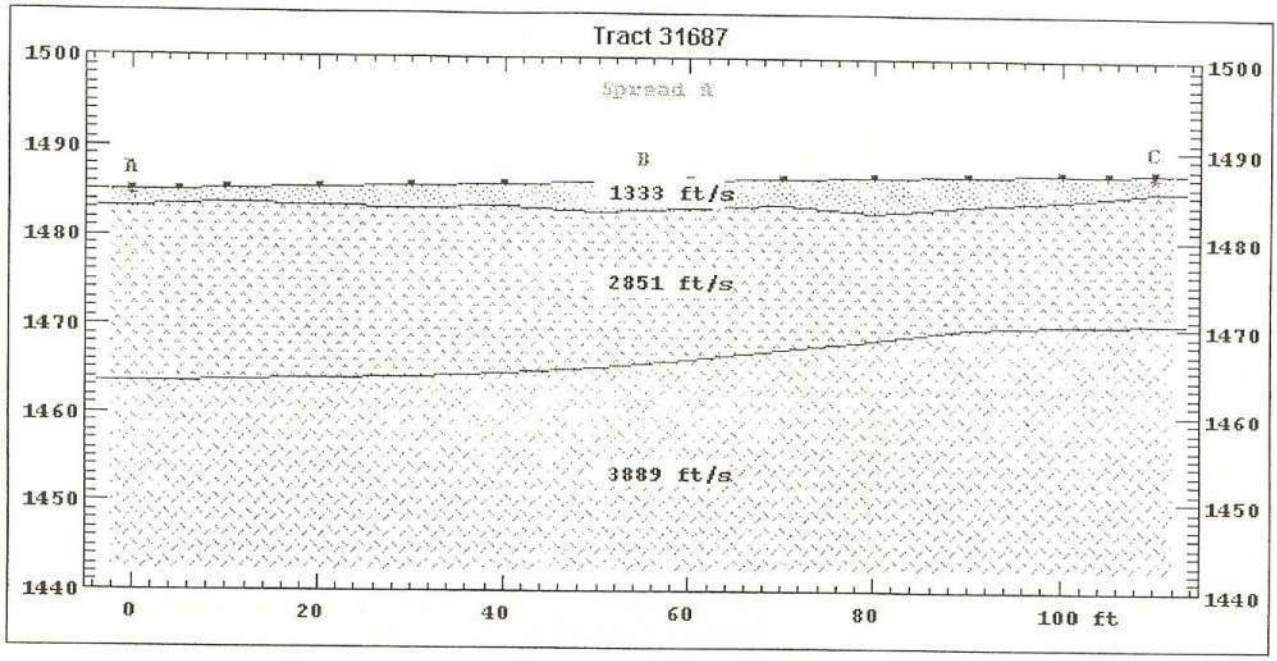
Example
Raw Seismic Data



Example
Seismic Line
Time Distance Curves



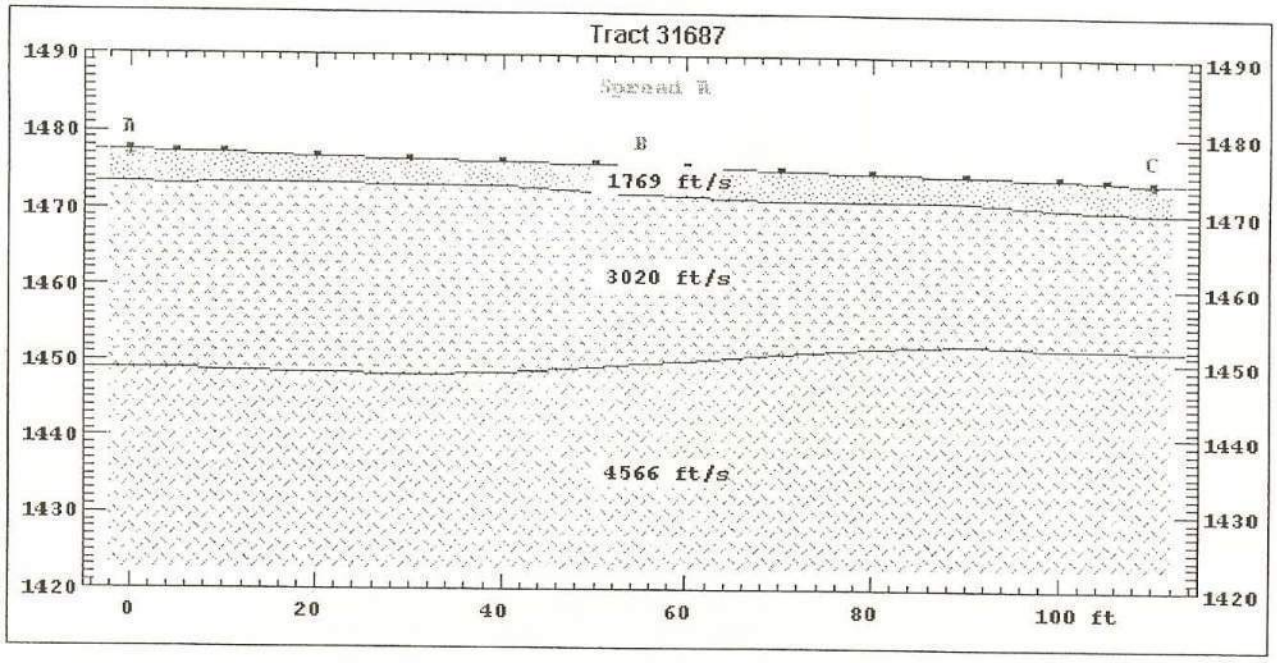
Seismic Line
SL-1



South

North

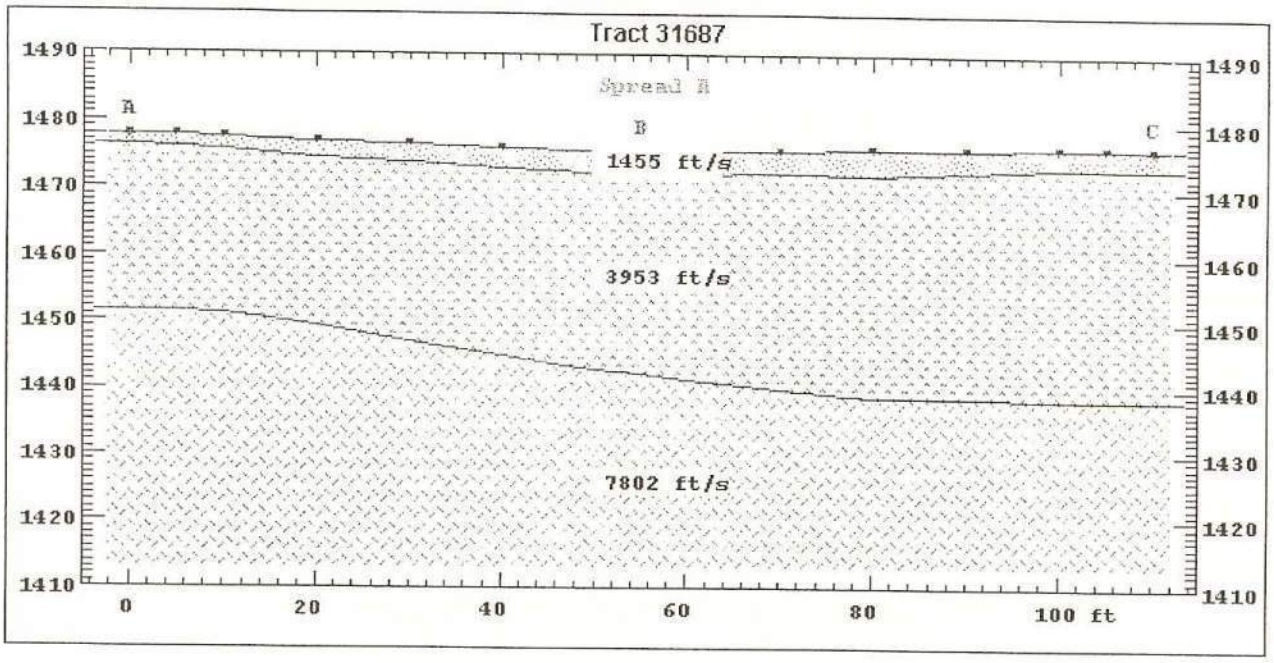
Seismic Line
SL-2



East

West

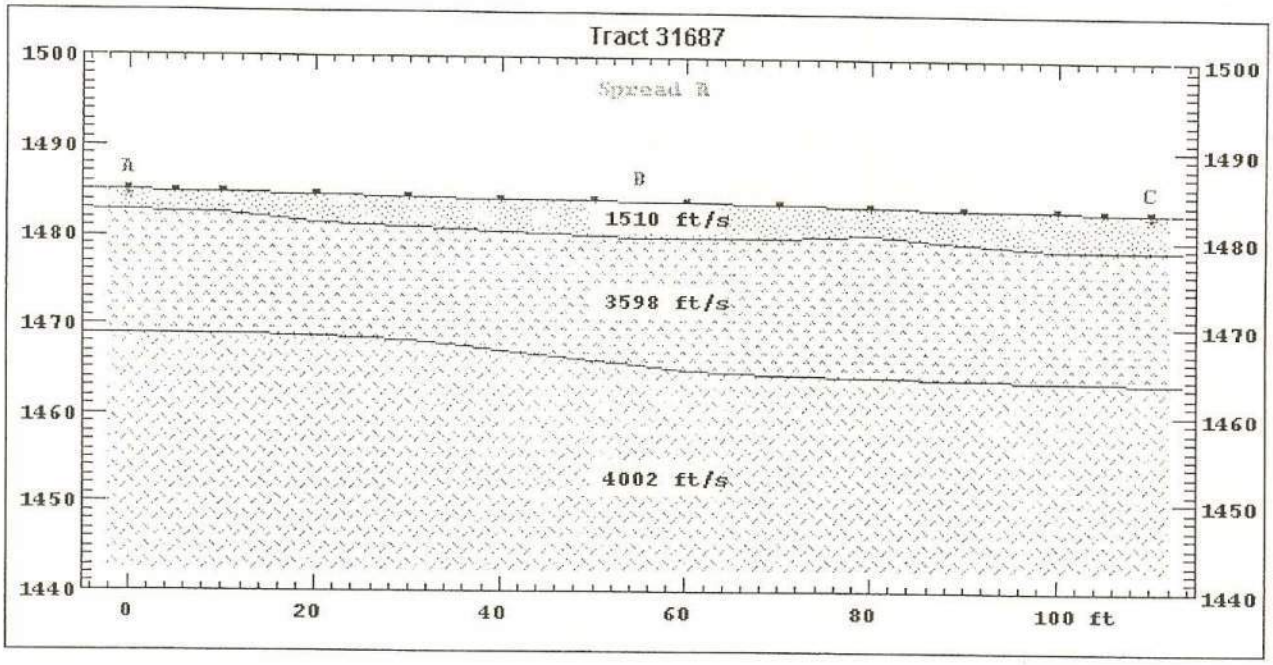
Seismic Line
SL-3



South

North

Seismic Line
SL-4



East

West

APPENDIX F

GENERAL EARTHWORK AND GRADING GUIDELINES

GENERAL EARTHWORK AND GRADING GUIDELINES

General

These guidelines present general procedures and requirements for earthwork and grading as shown on the approved grading plans, including preparation of areas to filled, placement of fill, installation of subdrains and excavations. The recommendations contained in the geotechnical report are part of the earthwork and grading guidelines and would supersede the provisions contained hereafter in the case of conflict. Evaluations performed by the consultant during the course of grading may result in new recommendations which could supersede these guidelines or the recommendations contained in the geotechnical report.

The contractor is responsible for the satisfactory completion of all earthwork in accordance with provisions of the project plans and specifications. The project soil engineer and engineering geologist (geotechnical consultant) or their representatives should provide observation and testing services, and geotechnical consultation during the duration of the project.

EARTHWORK OBSERVATIONS AND TESTING

Geotechnical Consultant

Prior to the commencement of grading, a qualified geotechnical consultant (soil engineer and engineering geologist) should be employed for the purpose of observing earthwork procedures and testing the fills for conformance with the recommendations of the geotechnical report, the approved grading plans, and applicable grading codes and ordinances.

The geotechnical consultant should provide testing and observation so that determination may be made that the work is being accomplished as specified. It is the responsibility of the contractor to assist the consultants and keep them apprised of anticipated work schedules and changes, so that they may schedule their personnel accordingly.

All clean-outs, prepared ground to receive fill, key excavations, and subdrains should be observed and documented by the project engineering geologist and/or soil engineer prior to placing and fill. It is the contractors's responsibility to notify the engineering geologist and soil engineer when such areas are ready for observation.

Laboratory and Field Tests

Maximum dry density tests to determine the degree of compaction should be performed in accordance with American Standard Testing Materials test method ASTM designation D-1557-78. Random field compaction tests should be performed in accordance with test method ASTM designation D-1556-82, D-2937 or D-2922 and D-3017, at intervals of approximately 2 feet of fill height or every 100 cubic yards of fill placed. These criteria

would vary depending on the soil conditions and the size of the project. The location and frequency of testing would be at the discretion of the geotechnical consultant.

Contractor's Responsibility

All clearing, site preparation, and earthwork performed on the project should be conducted by the contractor, with observation by geotechnical consultants and staged approval by the governing agencies, as applicable. It is the contractor's responsibility to prepare the ground surface to receive the fill, to the satisfaction of the soil engineer, and to place, spread, moisture condition, mix and compact the fill in accordance with the recommendations of the soil engineer. The contractor should also remove all major non-earth material considered unsatisfactory by the soil engineer.

It is the sole responsibility of the contractor to provide adequate equipment and methods to accomplish the earthwork in accordance with applicable grading guidelines, codes or agency ordinances, and approved grading plans. Sufficient watering apparatus and compaction equipment should be provided by the contractor with due consideration for the fill material, rate of placement, and climatic conditions. If, in the opinion of the geotechnical consultant, unsatisfactory conditions such as questionable weather, excessive oversized rock, or deleterious material, insufficient support equipment, etc., are resulting in a quality of work that is not acceptable, the consultant will inform the contractor, and the contractor is expected to rectify the conditions, and if necessary, stop work until conditions are satisfactory.

During construction, the contractor shall properly grade all surfaces to maintain good drainage and prevent ponding of water. The contractor shall take remedial measures to control surface water and to prevent erosion of graded areas until such time as permanent drainage and erosion control measures have been installed.

SITE PREPARATION

All major vegetation, including brush, trees, thick grasses, organic debris, and other deleterious material should be removed and disposed of off-site. These removals must be concluded prior to placing fill. Existing fill, soil, alluvium, colluvium, or rock materials determined by the soil engineer or engineering geologist as being unsuitable in-place should be removed prior to fill placement. Depending upon the soil conditions, these materials may be reused as compacted fills. Any materials incorporated as part of the compacted fills should be approved by the soil engineer.

Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipelines, or other structures not located prior to grading are to be removed or treated in a manner recommended by the soil engineer. Soft, dry, spongy, highly fractured, or otherwise unsuitable ground extending to such a depth that surface processing cannot adequately improve the condition should be overexcavated down to

firm ground and approved by the soil engineer before compaction and filling operations continue. Overexcavated and processed soils which have been properly mixed and moisture conditioned should be re-compacted to the minimum relative compaction as specified in these guidelines.

Existing ground which is determined to be satisfactory for support of the fills should be scarified to a minimum depth of 6 inches or as directed by the soil engineer. After the scarified ground is brought to optimum moisture content or greater and mixed, the materials should be compacted as specified herein. If the scarified zone is grater that 6 inches in depth, it may be necessary to remove the excess and place the material in lifts restricted to about 6 inches in compacted thickness.

Existing ground which is not satisfactory to support compacted fill should be overexcavated as required in the geotechnical report or by the on-site soils engineer and/or engineering geologist. Scarification, disc harrowing, or other acceptable form of mixing should continue until the soils are broken down and free of large lumps or clods, until the working surface is reasonably uniform and free from ruts, hollow, hummocks, or other uneven features which would inhibit compaction as described previously.

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical), the ground should be stepped or benched. The lowest bench, which will act as a key, should be a minimum of 15 feet wide and should be at least 2 feet deep into firm material, and approved by the soil engineer and/or engineering geologist. In fill over cut slope conditions, the recommended minimum width of the lowest bench or key is also 15 feet with the key founded on firm material, as designated by the Geotechnical Consultant. As a general rule, unless specifically recommended otherwise by the Soil Engineer, the minimum width of fill keys should be approximately equal to ½ the height of the slope.

Standard benching is generally 4 feet (minimum) vertically, exposing firm, acceptable material. Benching may be used to remove unsuitable materials, although it is understood that the vertical height of the bench may exceed 4 feet. Pre-stripping may be considered for unsuitable materials in excess of 4 feet in thickness.

All areas to receive fill, including processed areas, removal areas, and the toe of fill benches should be observed and approved by the soil engineer and/or engineering geologist prior to placement of fill. Fills may then be properly placed and compacted until design grades (elevations) are attained.

COMPACTED FILLS

Any earth materials imported or excavated on the property may be utilized in the fill provided that each material has been determined to be suitable by the soil engineer. These materials should be free of roots, tree branches, other organic matter or other deleterious materials. All unsuitable materials should be removed from the fill as directed

by the soil engineer. Soils of poor gradation, undesirable expansion potential, or substandard strength characteristics may be designated by the consultant as unsuitable and may require blending with other soils to serve as a satisfactory fill material.

Fill materials derived from benching operations should be dispersed throughout the fill area and blended with other bedrock derived material. Benching operations should not result in the benched material being placed only within a single equipment width away from the fill/bedrock contact.

Oversized materials defined as rock or other irreducible materials with a maximum dimension greater than 12 inches should not be buried or placed in fills unless the location of materials and disposal methods are specifically approved by the soil engineer. Oversized material should be taken off-site or placed in accordance with recommendations of the soil engineer in areas designated as suitable for rock disposal. Oversized material should not be placed within 10 feet vertically of finish grade (elevation) or within 20 feet horizontally of slope faces.

To facilitate future trenching, rock should not be placed within the range of foundation excavations, future utilities, or underground construction unless specifically approved by the soil engineer and/or the developers representative.

If import material is required for grading, representative samples of the materials to be utilized as compacted fill should be analyzed in the laboratory by the soil engineer to determine its physical properties. If any material other than that previously tested is encountered during grading, an appropriate analysis of this material should be conducted by the soil engineer as soon as possible.

Approved fill material should be placed in areas prepared to receive fill in near horizontal layers that when compacted should not exceed 6 inches in thickness. The soil engineer may approve thick lifts if testing indicates the grading procedures are such that adequate compaction is being achieved with lifts of greater thickness. Each layer should be spread evenly and blended to attain uniformity of material and moisture suitable for compaction.

Fill layers at a moisture content less than optimum should be watered and mixed, and wet fill layers should be aerated by scarification or should be blended with drier material. Moisture condition, blending, and mixing of the fill layer should continue until the fill materials have a uniform moisture content at or above optimum moisture.

After each layer has been evenly spread, moisture conditioned and mixed, it should be uniformly compacted to a minimum of 90 percent of maximum density as determined by ASTM test designation, D-1557-78, or as otherwise recommended by the soil engineer. Compaction equipment should be adequately sized and should be specifically designed for soil compaction or of proven reliability to efficiently achieve the specified degree of compaction.

Where tests indicate that the density of any layer of fill, or portion thereof, is below the required relative compaction, or improper moisture is in evidence, the particular layer or portion shall be re-worked until the required density and/or moisture content has been attained. No additional fill shall be placed in an area until the last placed lift of fill has been tested and found to meet the density and moisture requirements, and is approved by the soil engineer.

Compaction of slopes should be accomplished by over-building a minimum of 3 feet horizontally, and subsequently trimming back to the design slope configuration. Testing shall be performed as the fill is elevated to evaluate compaction as the fill core is being developed. Special efforts may be necessary to attain the specified compaction in the fill slope zone. Final slope shaping should be performed by trimming and removing loose materials with appropriate equipment. A final determination of fill slope compaction should be based on observation and/or testing of the finished slope face. Where compacted fill slopes are designed steeper than 2:1 (horizontal to vertical), specific material types, a higher minimum relative compaction, and special grading procedures, may be recommended.

If an alternative to over-building and cutting back the compacted fill slopes is selected, then special effort should be made to achieve the required compaction in the outer 10 feet of each lift of fill by undertaking the following:

1. An extra piece of equipment consisting of a heavy short shanked sheepsfoot should be used to roll (horizontal) parallel to the slopes continuously as fill is placed. The sheepsfoot roller should also be used to roll perpendicular to the slopes, and extend out over the slope to provide adequate compaction to the face of the slope.

2. Loose fill should not be spilled out over the face of the slope as each lift is compacted. Any loose fill spilled over a previously completed slope face should be trimmed off or be subject to re-rolling.

3. Field compaction tests will be made in the outer (horizontal) 2 to 8 feet of the slope at appropriate vertical intervals, subsequent to compaction operations.

4. After completion of the slope, the slope face should be shaped with a small tractor and then re-rolled with a sheepsfoot to achieve compaction to near the slope face. Subsequent to testing to verify compaction, the slopes should be grid-rolled to achieve compaction to the slope face. Final testing should be used to confirm compaction after grid rolling.

5. Where testing indicates less than adequate compaction, the contractor will be responsible to rip, water, mix and re-compact the slope material as necessary to achieve compaction. Additional testing should be performed to verify compaction.

6. Erosion control and drainage devices should be designed by the project civil engineer in compliance with ordinances of the controlling governmental agencies, and/or in accordance with the recommendation of the soil engineer or engineering geologist.

SUBDRAIN INSTALLATION

Subdrains should be installed in approved ground in accordance with the approximate alignment and details indicated by the geotechnical consultant. Subdrain locations or materials should not be changed or modified without approval of the geotechnical consultant. The soil engineer and/or engineering geologist may recommend and direct changes in subdrain line, grade and drain material in the field, pending exposed conditions. The location of constructed subdrains should be recorded by the project civil engineer.

EXCAVATIONS

Excavations and cut slopes should be examined during grading by the engineering geologist. If directed by the engineering geologist, further excavations or overexcavation and re-filling of cut areas should be performed and/or remedial grading of cut slopes should be performed. When fill over cut slopes are to be graded, unless otherwise approved, the cut portion of the slope should be observed by the engineering geologist prior to placement of materials for construction of the fill portion of the slope.

The engineering geologist should observe all cut slopes and should be notified by the contractor when cut slopes are started.

If, during the course of grading, unforeseen adverse or potential adverse geologic conditions are encountered, the engineering geologist and soil engineer should investigate, evaluate and make recommendations to treat these problems. The need for cut slope buttressing or stabilizing should be based on in-grading evaluation by the engineering geologist, whether anticipated or not.

Unless otherwise specified in soil and geological reports, no cut slopes should be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies. Additionally, short-term stability of temporary cut slopes is the contractors responsibility.

Erosion control and drainage devices should be designed by the project civil engineer and should be constructed in compliance with the ordinances of the controlling governmental agencies, and/or in accordance with the recommendations of the soil engineer or engineering geologist.

COMPLETION

Observation, testing and consultation by the geotechnical consultant should be conducted during the grading operations in order to state an opinion that all cut and filled areas are graded in accordance with the approved project specifications.

After completion of grading and after the soil engineer and engineering geologist have finished their observations of the work, final reports should be submitted subject to review by the controlling governmental agencies. No further excavation or filling should be undertaken without prior notification of the soil engineer and/or engineering geologist.

All finished cut and fill slopes should be protected from erosion and/or be planted in accordance with the project specifications and/or as recommended by a landscape architect. Such protection and/or planning should be undertaken as soon as practical after completion of grading.

JOB SAFETY

General

At GeoSoils, Inc. (GSI) getting the job done safely is of primary concern. The following is the company's safety considerations for use by all employees on multi-employer construction sites. On ground personnel are at highest risk of injury and possible fatality on grading and construction projects. GSI recognizes that construction activities will vary on each site and that site safety is the prime responsibility of the contractor; however, everyone must be safety conscious and responsible at all times. To achieve our goal of avoiding accidents, cooperation between the client, the contractor and GSI personnel must be maintained.

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

Safety Meetings: GSI field personnel are directed to attend contractors regularly scheduled and documented safety meetings.

Safety Vests: Safety vests are provided for and are to be worn by GSI personnel at all times when they are working in the field.

Safety Flags: Two safety flags are provided to GSI field technicians; one is to be affixed to the vehicle when on site, the other is to be placed atop the spoil pile on all test pits.

Flashing Lights: All vehicles stationary in the grading area shall use rotating or flashing amber beacon, or strobe lights, on the vehicle during all field testing. While operating a vehicle in the grading area, the emergency flasher on the vehicle shall be activated.

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

Test Pits Location, Orientation and Clearance

The technician is responsible for selecting test pit locations. A primary concern should be the technicians's safety. Efforts will be made to coordinate locations with the grading contractors authorized representative, and to select locations following or behind the established traffic pattern, preferably outside of current traffic. The contractors authorized representative (dump man, operator, supervisor, grade checker, etc.) should direct excavation of the pit and safety during the test period. Of paramount concern should be the soil technicians safety and obtaining enough tests to represent the fill.

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

A zone of non-encroachment should be established for all test pits. No grading equipment should enter this zone during the testing procedure. The zone should extend approximately 50 feet outward from the center of the test pit. This zone is established for safety and to avoid excessive ground vibration which typically decreased test results.

When taking slope tests the technician should park the vehicle directly above or below the test location. If this is not possible, a prominent flag should be placed at the top of the slope. The contractor's representative should effectively keep all equipment at a safe operation distance (e.g. 50 feet) away from the slope during this testing.

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

The contractor should inform our personnel of all changes to haul roads, cut and fill areas or other factors that may affect site access and site safety.

In the event that the technicians safety is jeopardized or compromised as a result of the contractors failure to comply with any of the above, the technician is required, by company policy, to immediately withdraw and notify his/her supervisor. The grading contractors representative will eventually be contacted in an effort to effect a solution. However, in the

interim, no further testing will be performed until the situation is rectified. Any fill place can be considered unacceptable and subject to reprocessing, recompaction or removal.

In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor brings this to his/her attention and notify this office. Effective communication and coordination between the contractors representative and the soils technician is strongly encouraged in order to implement the above safety plan.

Trench and Vertical Excavation

It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed.

Our personnel are directed not to enter any excavation or vertical cut which 1) is 5 feet or deeper unless shored or laid back, 2) displays any evidence of instability, has any loose rock or other debris which could fall into the trench, or 3) displays any other evidence of any unsafe conditions regardless of depth.

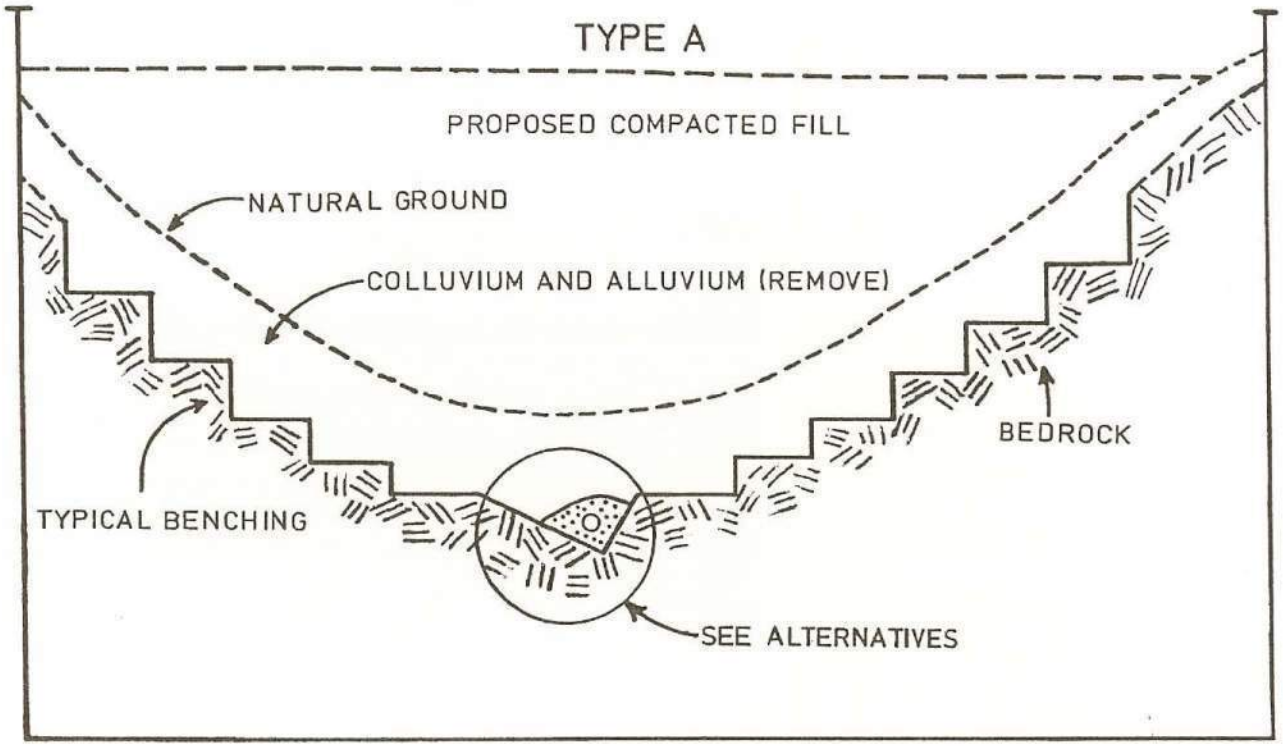
All trench excavations or vertical cuts in excess of 5 feet deep, which any person enters, should be shored or laid back.

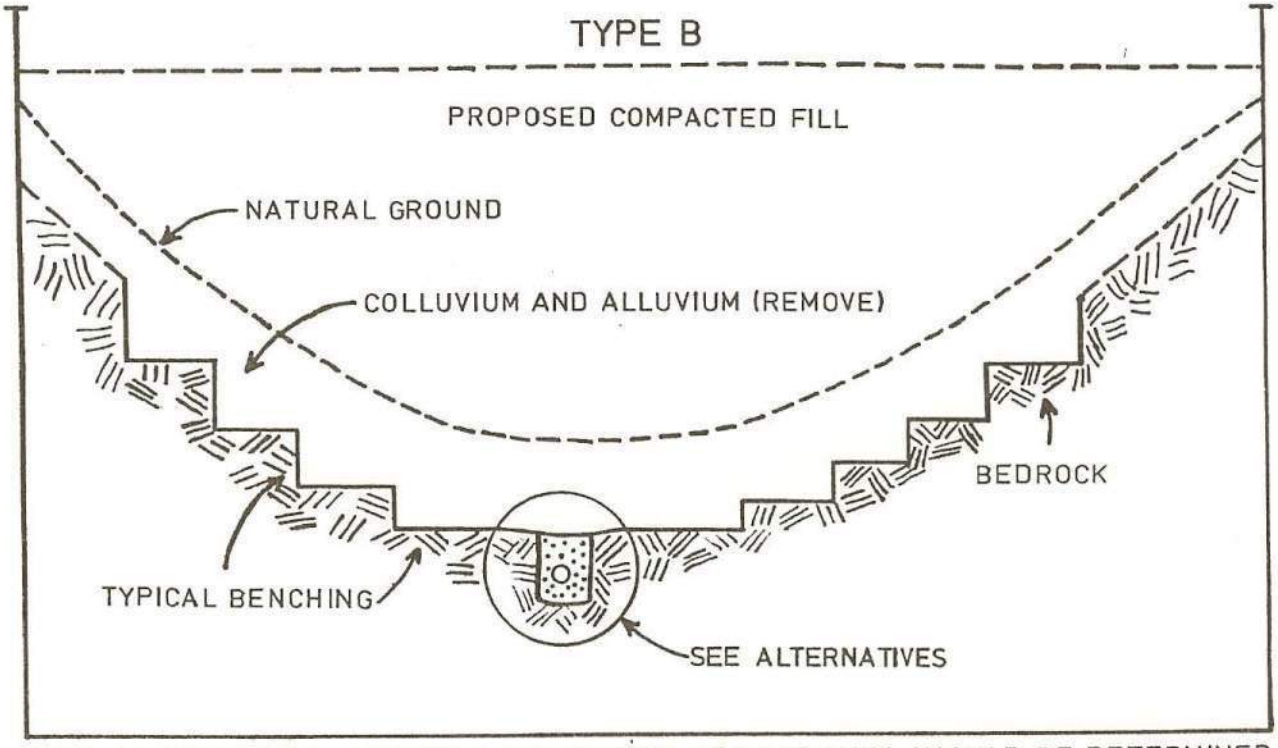
Trench access should be provided in accordance with CAL-OSHA and/or state and local standards. Our personnel are directed not to enter any trench by being lowered or "riding down" on the equipment.

If the contractor fails to provide safe access to trenches for compaction testing, our company policy requires that the soil technician withdraw and notify his/her supervisor. The contractors representative will eventually be contacted in an effort to effect a solution. All backfill not tested due to safety concerns or other reasons could be subject to reprocessing and/or removal.

If GSI personnel become aware of anyone working beneath an unsafe trench wall or vertical excavation, we have a legal obligation to put the contractor and owner/developer on notice to immediately correct the situation. If corrective steps are not taken, GSI then has an obligation to notify CAL-OSHA and/or the proper authorities.

CANYON SUBDRAIN DETAIL



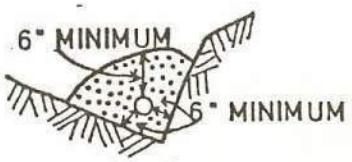


NOTE: ALTERNATIVES, LOCATION AND EXTENT OF SUBDRAINS SHOULD BE DETERMINED BY THE SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST DURING GRADING.

PLATE EG—1

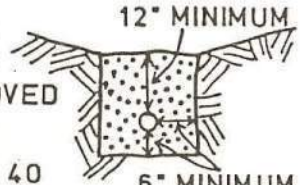
CANYON SUBDRAIN ALTERNATE DETAILS

ALTERNATE 1: PERFORATED PIPE AND FILTER MATERIAL



A–1

FILTER MATERIAL: MINIMUM VOLUME OF 9 FT.³ /LINEAR FT. 6" Ø ABS OR PVC PIPE OR APPROVED SUBSTITUTE WITH MINIMUM 8 (1/4" Ø) PERFS. LINEAR FT. IN BOTTOM HALF OF PIPE.
ASTM D2751, SDR 35 OR ASTM D1527, SCHD. 40
ASTM D3034, SDR 35 OR ASTM D1785, SCHD. 40
FOR CONTINUOUS RUN IN EXCESS OF 500 FT. USE 8" Ø PIPE

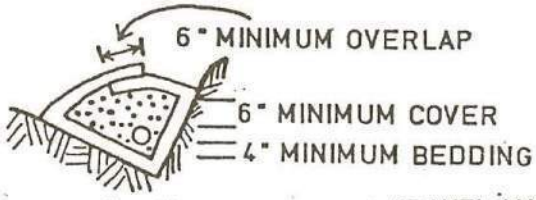


B–1

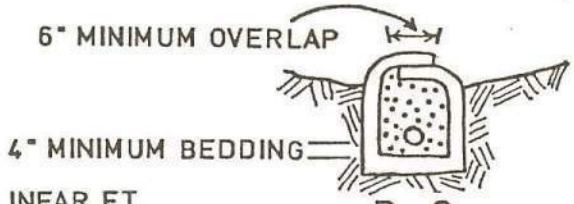
FILTER MATERIAL

SIEVE SIZE	PERCENT PASSING
1 INCH	100
3/4 INCH	90–100
3/8 INCH	40–100
NO. 4	25–40
NO. 8	18–33
NO. 30	5–15
NO. 50	0–7
NO. 200	0–3

ALTERNATE 2: PERFORATED PIPE, GRAVEL AND FILTER FABRIC



A–2

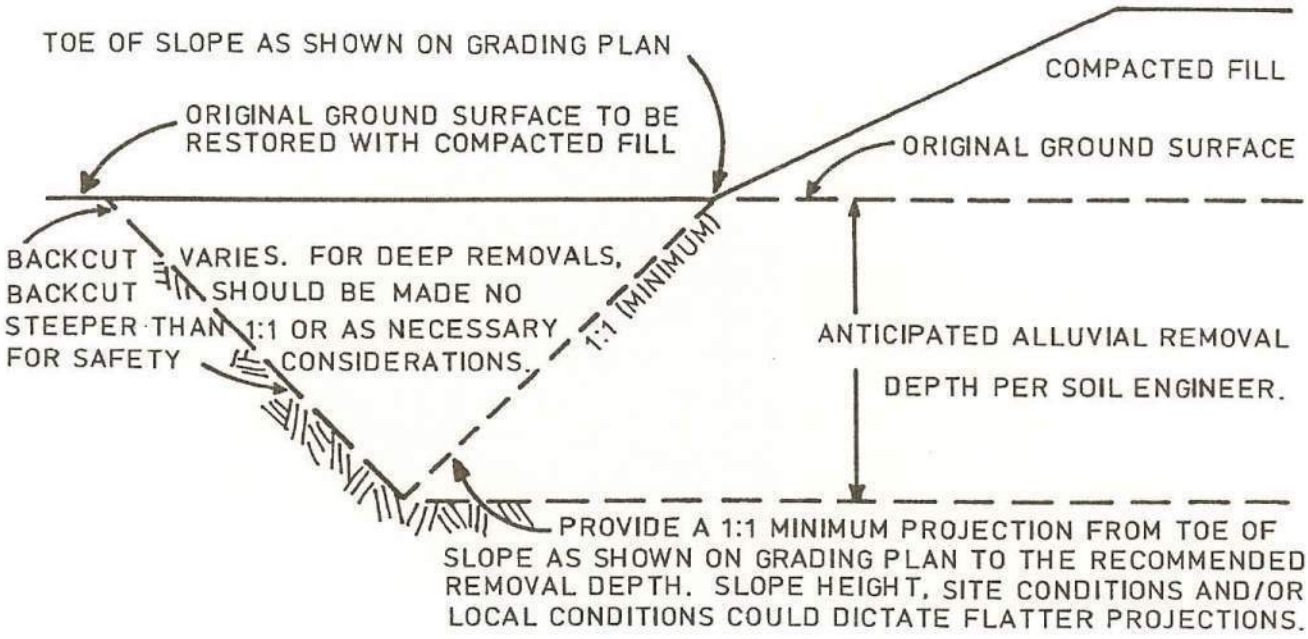


B–2

GRAVEL MATERIAL 9 FT³/LINEAR FT.
PERFORATED PIPE: SEE ALTERNATE 1
GRAVEL: CLEAN 3/4 INCH ROCK OR APPROVED SUBSTITUTE
FILTER FABRIC: MIRAFI 140 OR APPROVED SUBSTITUTE

PLATE EG–2

DETAIL FOR FILL SLOPE TOEING OUT ON FLAT ALLUVIATED CANYON



REMOVAL ADJACENT TO EXISTING FILL

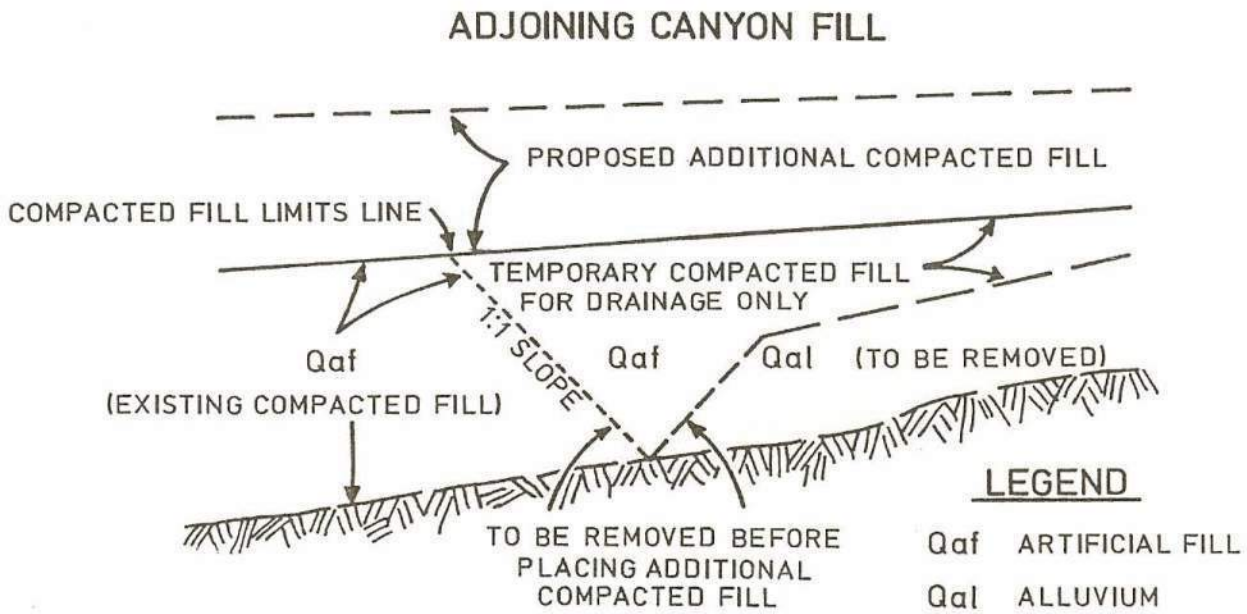


PLATE EG—3

TYPICAL STABILIZATION / BUTTRESS FILL DETAIL

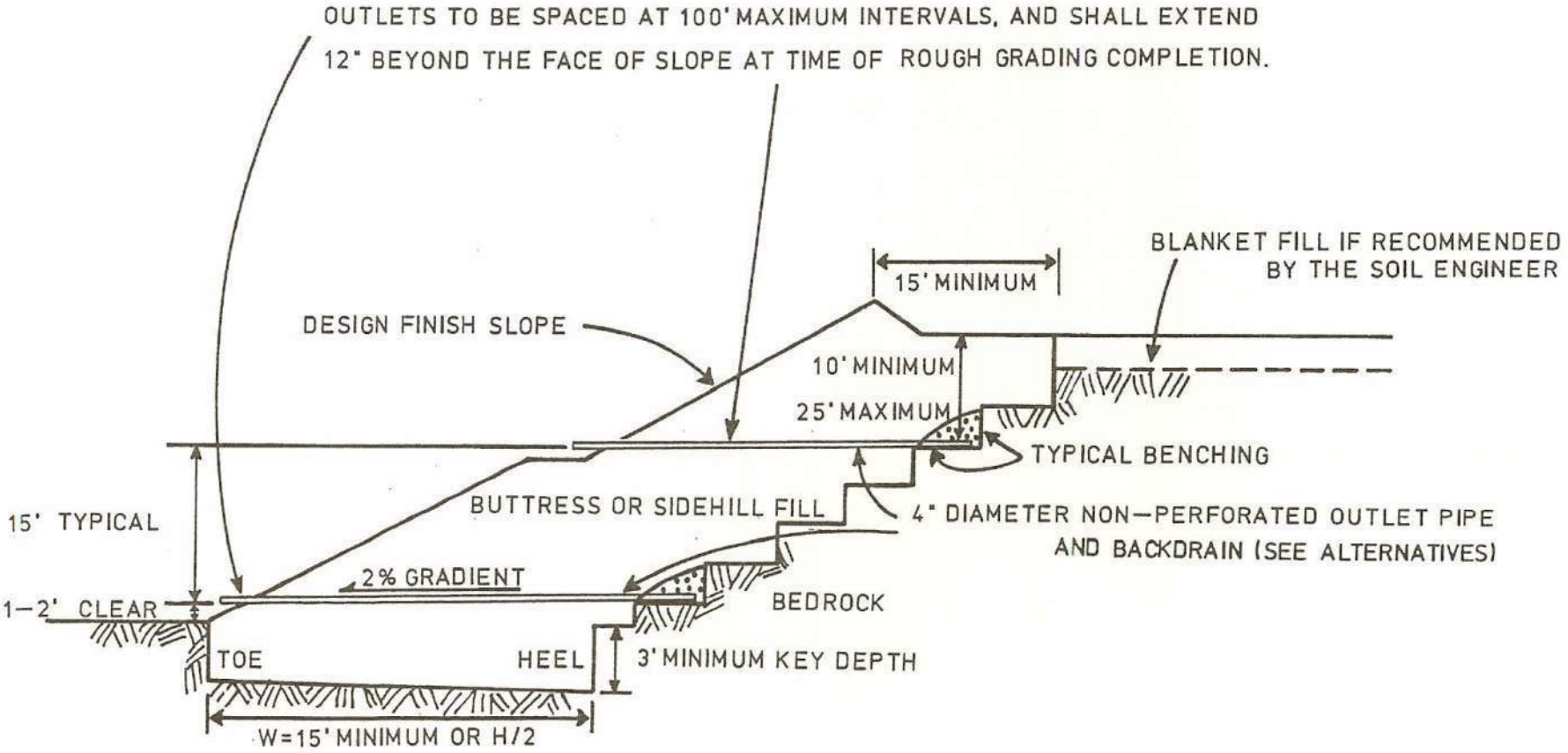
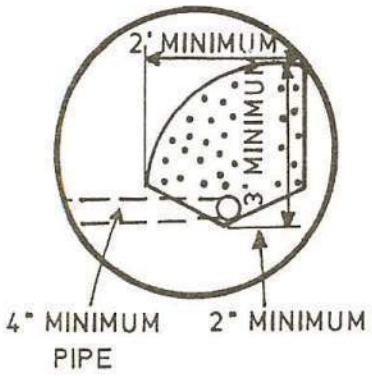
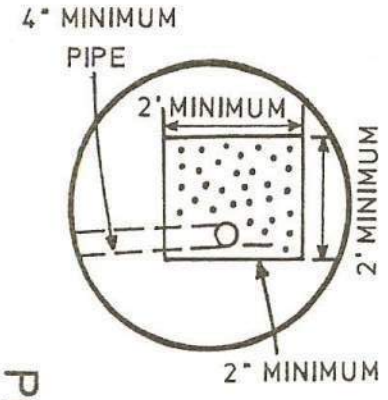


PLATE EG—4

TYPICAL STABILIZATION / BUTTRESS SUBDRAIN DETAIL





FILTER MATERIAL: MINIMUM OF FIVE Ft^3/LINEAR Ft OF PIPE OR FOUR Ft^3/LINEAR Ft OF PIPE WHEN PLACED IN SQUARE CUT TRENCH.

ALTERNATIVE IN LIEU OF FILTER MATERIAL: GRAVEL MAY BE ENCASED IN APPROVED FILTER FABRIC. FILTER FABRIC SHALL BE MIRAFI 140 OR EQUIVALENT. FILTER FABRIC SHALL BE LAPPED A MINIMUM OF 12" ON ALL JOINTS.

MINIMUM 4" DIAMETER PIPE: ABS—ASTM D—2751, SDR 35 OR ASTM D—1527 SCHEDULE 40 PVC—ASTM D—3034, SDR 35 OR ASTM D—1785 SCHEDULE 40 WITH A CRUSHING STRENGTH OF 1,000 POUNDS MINIMUM, AND A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE INSTALLED WITH PERFORATIONS OF BOTTOM OF PIPE. PROVIDE CAP AT UPSTREAM END OF PIPE. SLOPE AT 2% TO OUTLET PIPE. OUTLET PIPE TO BE CONNECTED TO SUBDRAIN PIPE WITH TEE OR ELBOW.

NOTE: 1. TRENCH FOR OUTLET PIPES TO BE BACKFILLED WITH ON—SITE SOIL.

2. BACKDRAINS AND LATERAL DRAINS SHALL BE LOCATED AT ELEVATION OF EVERY BENCH DRAIN. FIRST DRAIN LOCATED AT ELEVATION JUST ABOVE LOWER LOT GRADE. ADDITIONAL DRAINS MAY BE REQUIRED AT THE DISCRETION OF THE SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST.

FILTER MATERIAL SHALL BE OF THE FOLLOWING SPECIFICATION OR AN APPROVED EQUIVALENT:

SIEVE SIZE	PERCENT PASSING
1 INCH	100
3/4 INCH	90—100
3/8 INCH	40—100
NO. 4	25—40
NO. 8	18—33
NO. 30	5—15
NO. 50	0—7
NO. 200	0—3

GRAVEL SHALL BE OF THE FOLLOWING SPECIFICATION OR AN APPROVED EQUIVALENT:

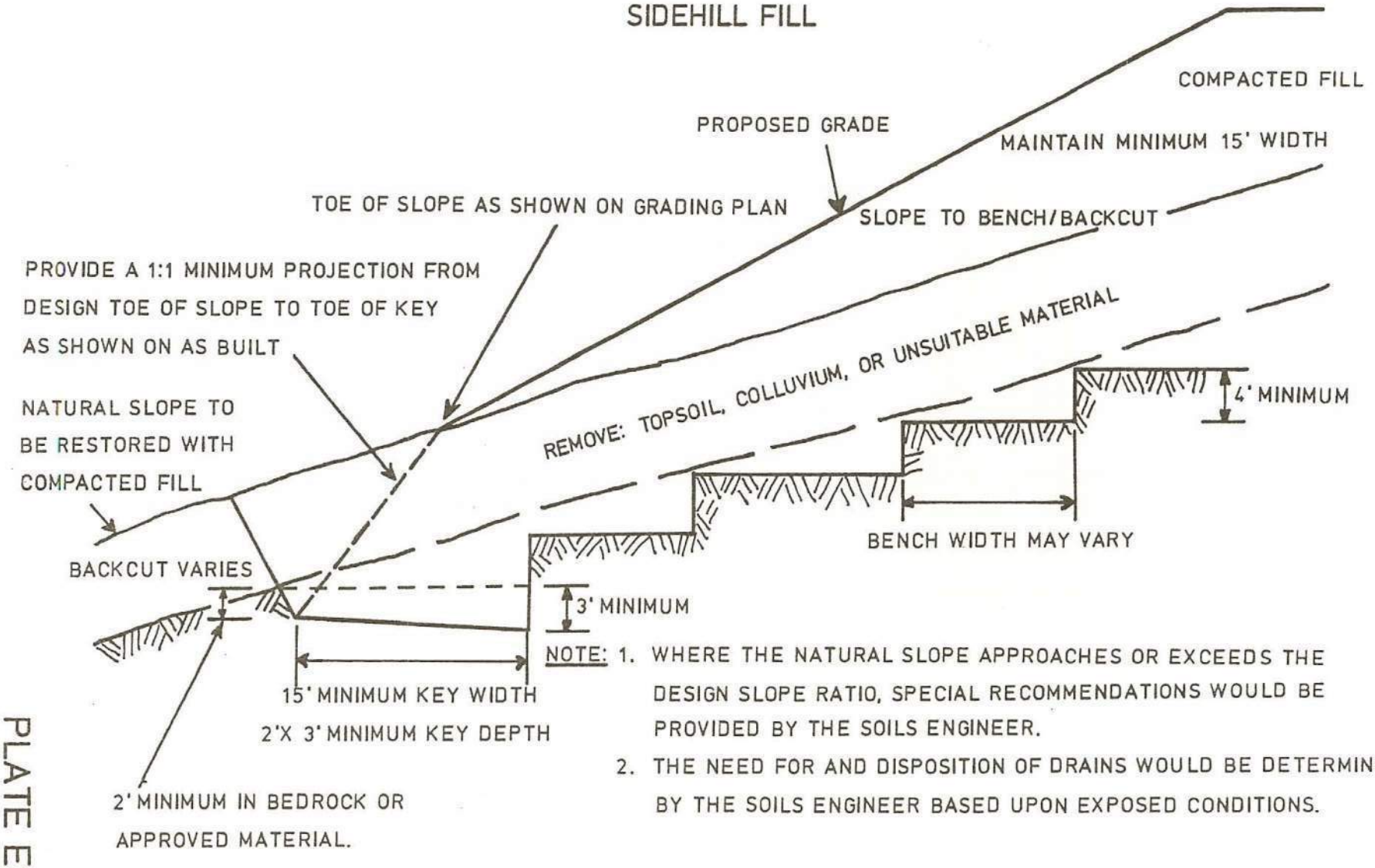
SIEVE SIZE	PERCENT PASSING
1 1/2 INCH	100
NO. 4	50
NO. 200	8

SAND EQUIVALENT: MINIMUM OF 50

PLATE EG—5

FILL OVER NATURAL DETAIL

SIDEHILL FILL

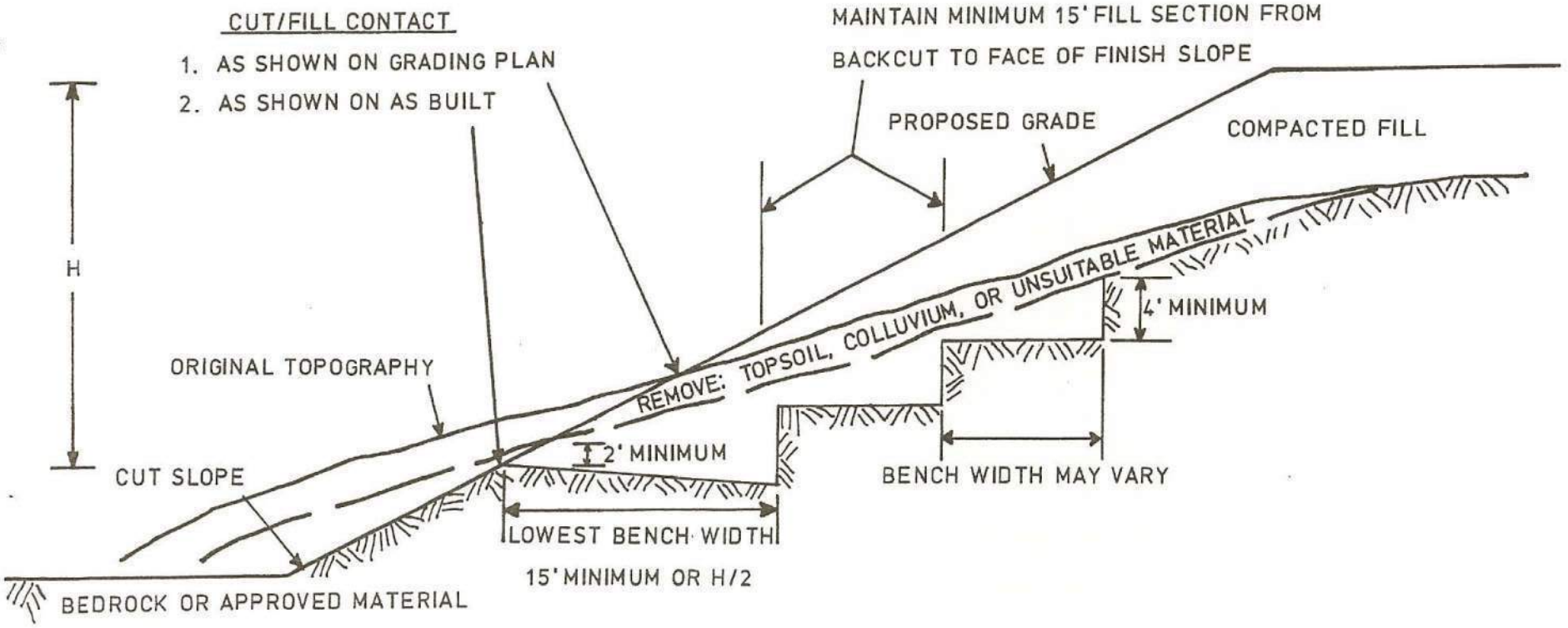


NOTE: 1. WHERE THE NATURAL SLOPE APPROACHES OR EXCEEDS THE DESIGN SLOPE RATIO, SPECIAL RECOMMENDATIONS WOULD BE PROVIDED BY THE SOILS ENGINEER.

2. THE NEED FOR AND DISPOSITION OF DRAINS WOULD BE DETERMINED BY THE SOILS ENGINEER BASED UPON EXPOSED CONDITIONS.

PLATE EG—6

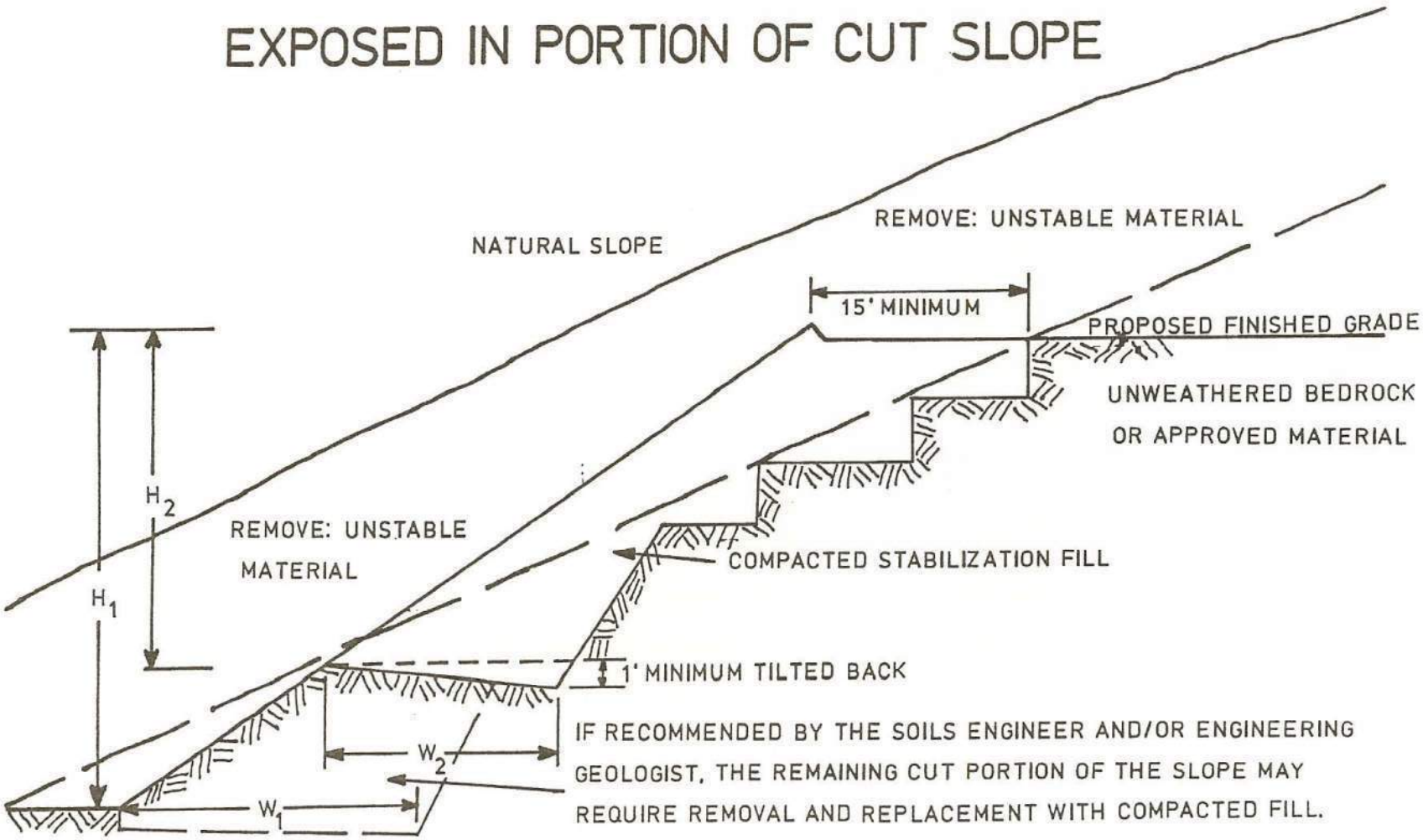
FILL OVER CUT DETAIL



NOTE: THE CUT PORTION OF THE SLOPE SHOULD BE EXCAVATED AND EVALUATED BY THE SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST PRIOR TO CONSTRUCTING THE FILL PORTION.

PLATE EG—7

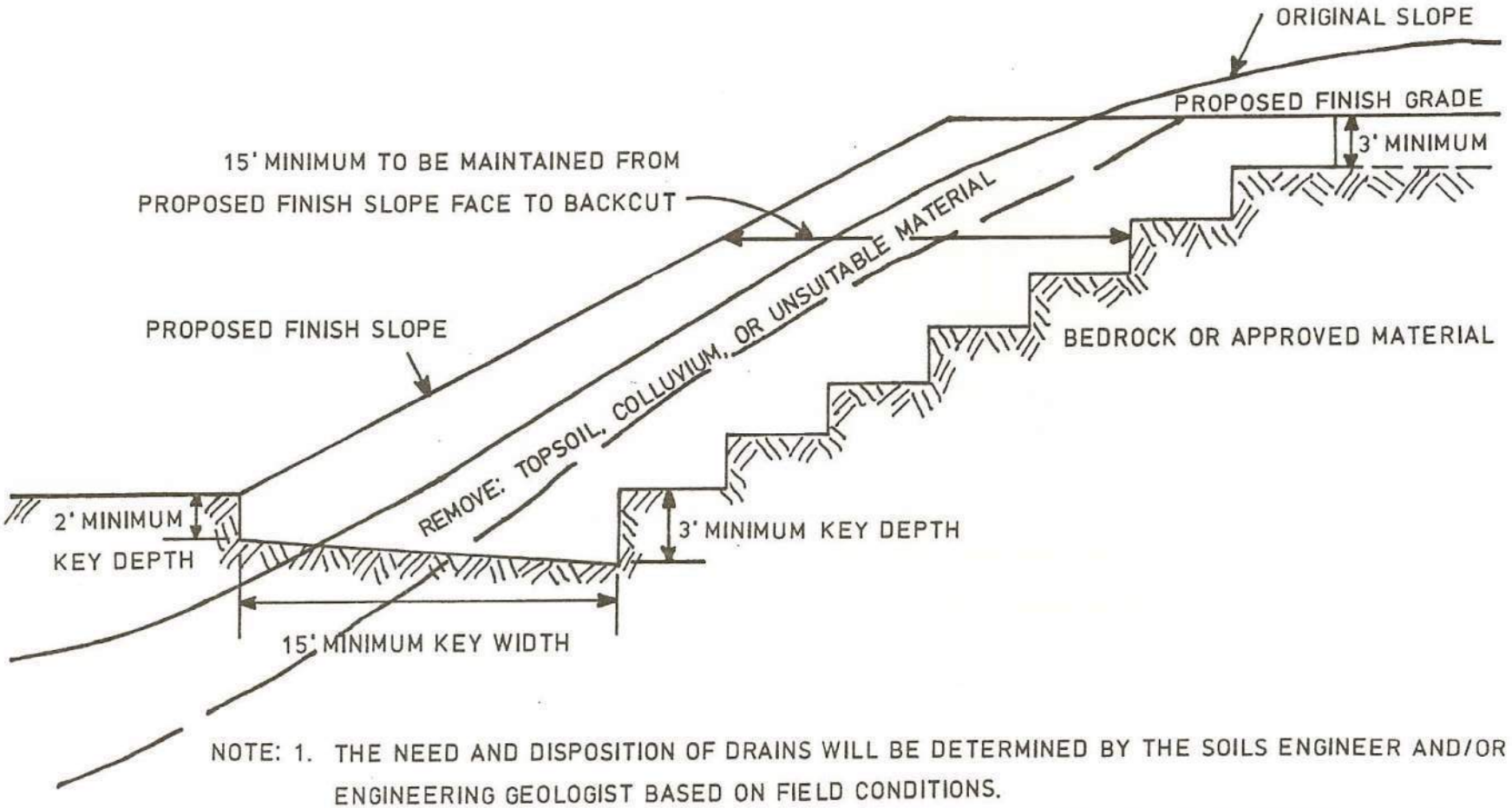
STABILIZATION FILL FOR UNSTABLE MATERIAL EXPOSED IN PORTION OF CUT SLOPE



NOTE: 1. SUBDRAINS ARE NOT REQUIRED UNLESS SPECIFIED BY SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST.

2. "W" SHALL BE EQUIPMENT WIDTH (15') FOR SLOPE HEIGHTS LESS THAN 25 FEET. FOR SLOPES GREATER THAN 25 FEET "W" SHALL BE DETERMINED BY THE PROJECT SOILS ENGINEER AND /OR ENGINEERING GEOLOGIST. AT NO TIME SHALL "W" BE LESS THAN H/2.

SKIN FILL OF NATURAL GROUND

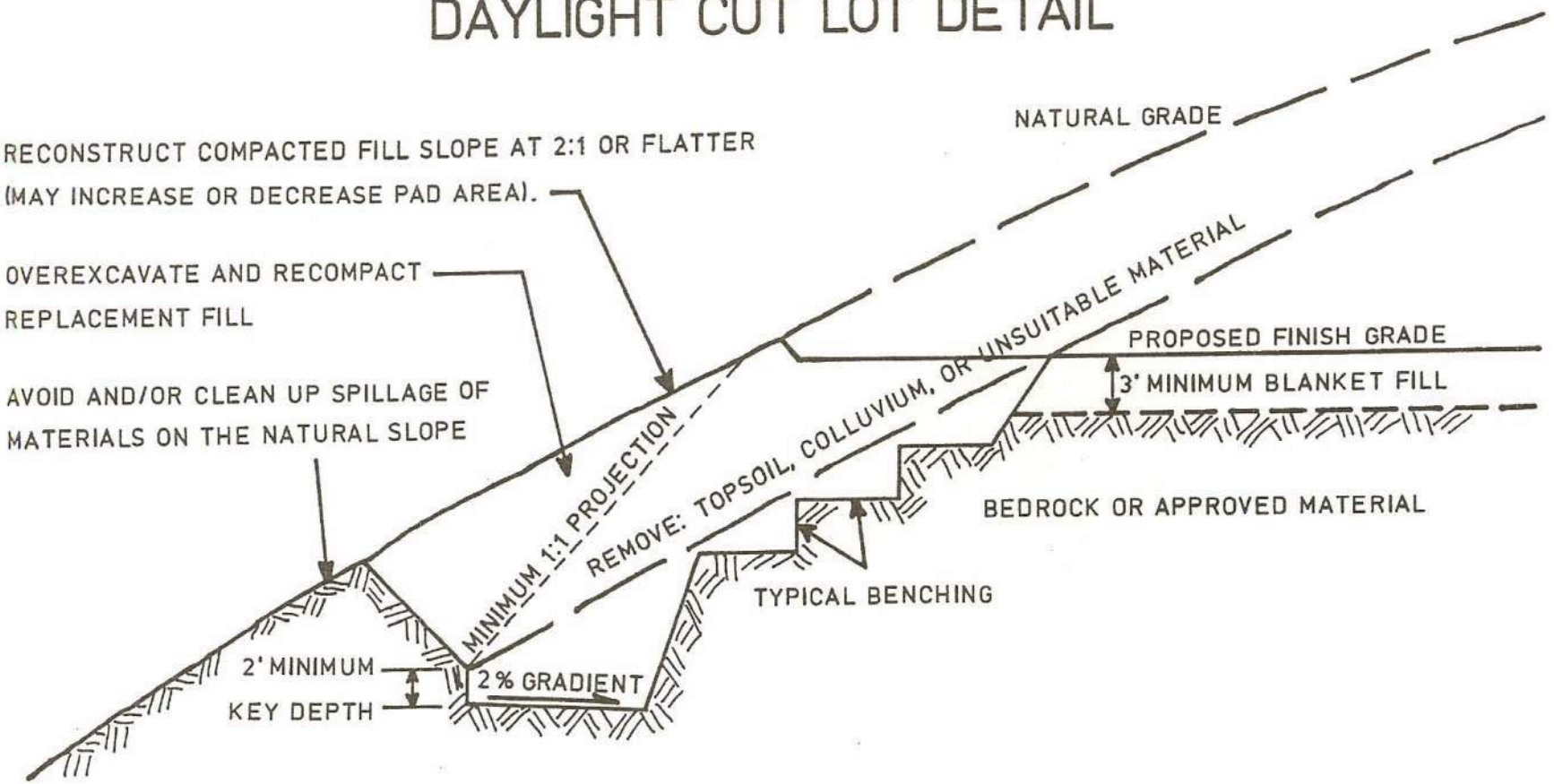


NOTE: 1. THE NEED AND DISPOSITION OF DRAINS WILL BE DETERMINED BY THE SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST BASED ON FIELD CONDITIONS.

2. PAD OVEREXCAVATION AND RECOMPACTION SHOULD BE PERFORMED IF DETERMINED TO BE NECESSARY BY THE SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST.

PLATE EG—9

DAYLIGHT CUT LOT DETAIL



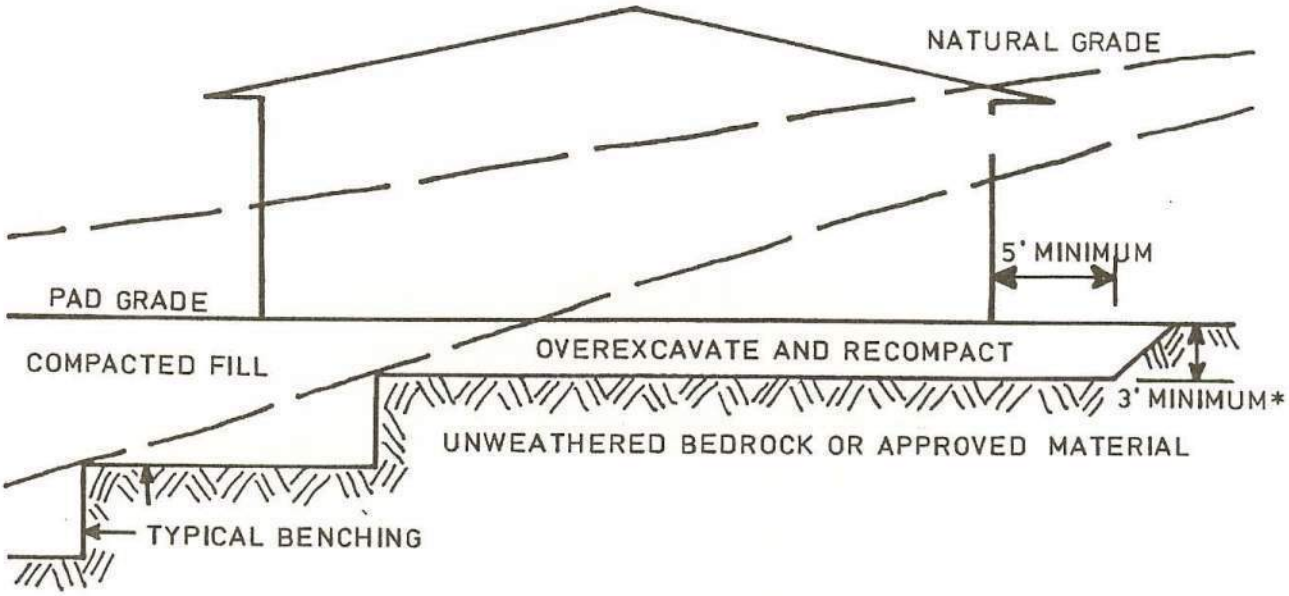
NOTE: 1. SUBDRAIN AND KEY WIDTH REQUIREMENTS WILL BE DETERMINED BASED ON EXPOSED SUBSURFACE CONDITIONS AND THICKNESS OF OVERBURDEN.

2. PAD OVER EXCAVATION AND RECOMPACTION SHOULD BE PERFORMED IF DETERMINED NECESSARY BY THE SOILS ENGINEER AND/OR THE ENGINEERING GEOLOGIST.

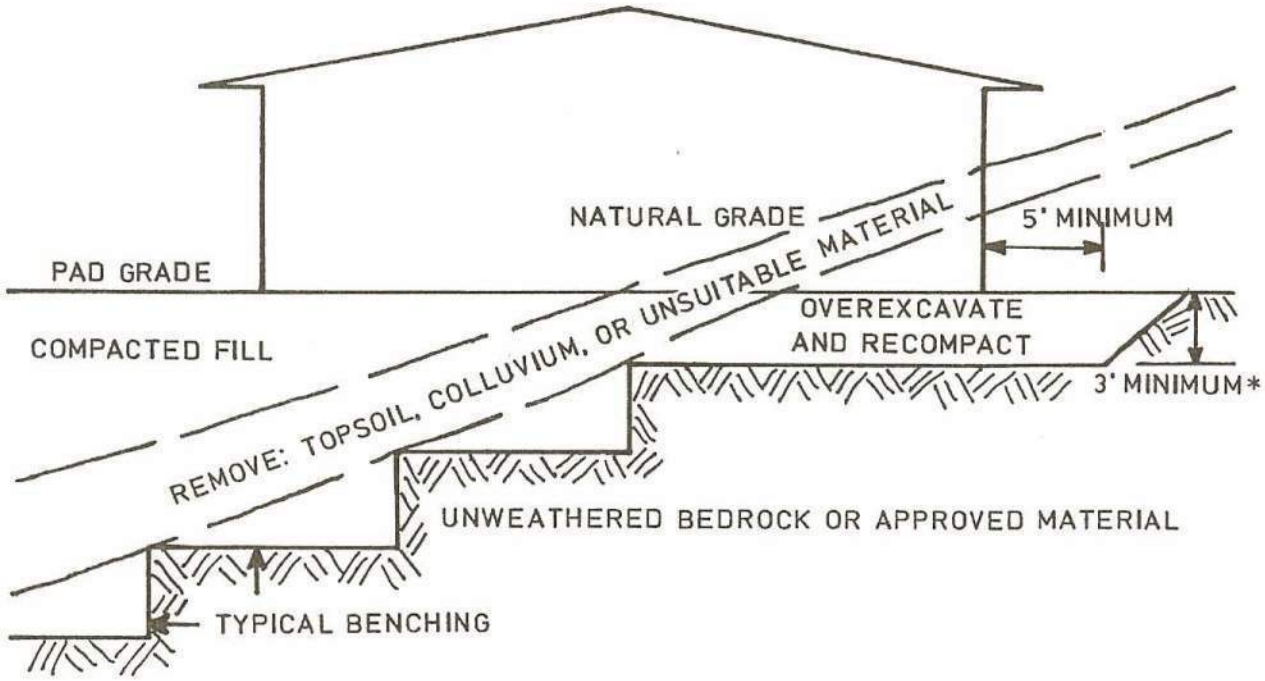
PLATE EG—10

TRANSITION LOT DETAIL

CUT LOT (MATERIAL TYPE TRANSITION)



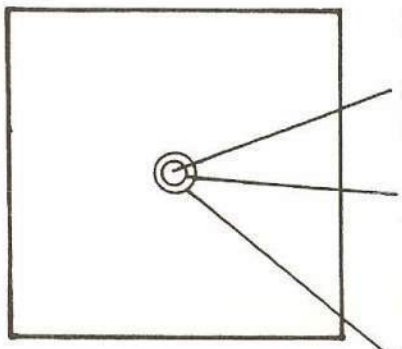
CUT—FILL LOT (DAYLIGHT TRANSITION)



NOTE: * DEEPER OVEREXCAVATION MAY BE RECOMMENDED BY THE SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST IN STEEP CUT—FILL TRANSITION AREAS.

PLATE EG—11

SETTLEMENT PLATE AND RISER DETAIL

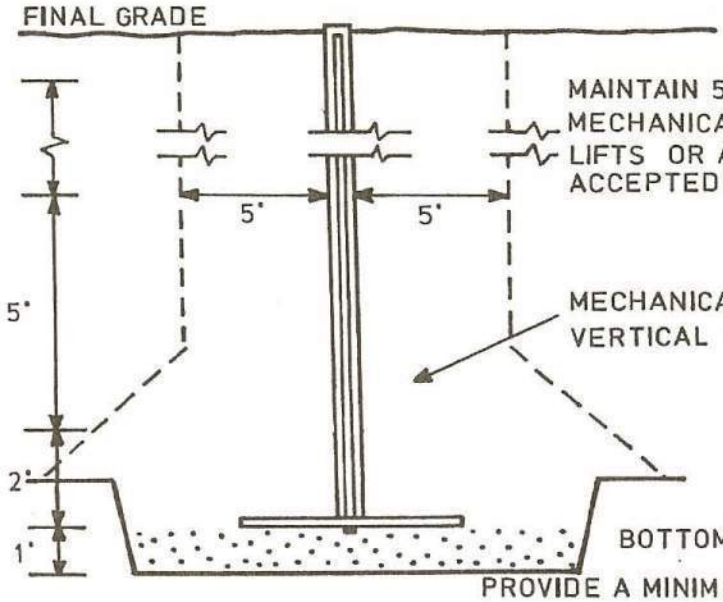


2'X 2'X 1/4" STEEL PLATE

STANDARD 3/4" PIPE NIPPLE WELDED TO TOP OF PLATE.

3/4" X 5' GALVANIZED PIPE, STANDARD PIPE THREADS TOP AND BOTTOM. EXTENSIONS THREADED ON BOTH ENDS AND ADDED IN 5' INCREMENTS.

3 INCH SCHEDULE 40 PVC PIPE SLEEVE, ADD IN 5' INCREMENTS WITH GLUE JOINTS.



MAINTAIN 5' CLEARANCE OF HEAVY EQUIPMENT. MECHANICALLY HAND COMPACT IN 2' VERTICAL LIFTS OR ALTERNATIVE SUITABLE TO AND ACCEPTED BY THE SOILS ENGINEER.

MECHANICALLY HAND COMPACT THE INITIAL 5' VERTICAL WITHIN A 5' RADIUS OF PLATE BASE.

BOTTOM OF CLEANOUT

PROVIDE A MINIMUM 1' BEDDING OF COMPACTED SAND

NOTE:

1. LOCATIONS OF SETTLEMENT PLATES SHOULD BE CLEARLY MARKED AND READILY VISIBLE (RED FLAGGED) TO EQUIPMENT OPERATORS.
2. CONTRACTOR SHOULD MAINTAIN CLEARANCE OF A 5' RADIUS OF PLATE BASE AND WITHIN 5' (VERTICAL) FOR HEAVY EQUIPMENT. FILL WITHIN CLEARANCE AREA SHOULD BE HAND COMPACTED TO PROJECT SPECIFICATIONS OR COMPACTED BY ALTERNATIVE APPROVED BY THE SOILS ENGINEER.
3. AFTER 5' (VERTICAL) OF FILL IS IN PLACE, CONTRACTOR SHOULD MAINTAIN A 5' RADIUS EQUIPMENT CLEARANCE FROM RISER.
4. PLACE AND MECHANICALLY HAND COMPACT INITIAL 2' OF FILL PRIOR TO ESTABLISHING THE INITIAL READING.
5. IN THE EVENT OF DAMAGE TO THE SETTLEMENT PLATE OR EXTENSION RESULTING FROM EQUIPMENT OPERATING WITHIN THE SPECIFIED CLEARANCE AREA, CONTRACTOR SHOULD IMMEDIATELY NOTIFY THE SOILS ENGINEER AND SHOULD BE RESPONSIBLE FOR RESTORING THE SETTLEMENT PLATES TO WORKING ORDER.
6. AN ALTERNATE DESIGN AND METHOD OF INSTALLATION MAY BE PROVIDED AT THE DISCRETION OF THE SOILS ENGINEER.

PLATE EG—14

TYPICAL SURFACE SETTLEMENT MONUMENT

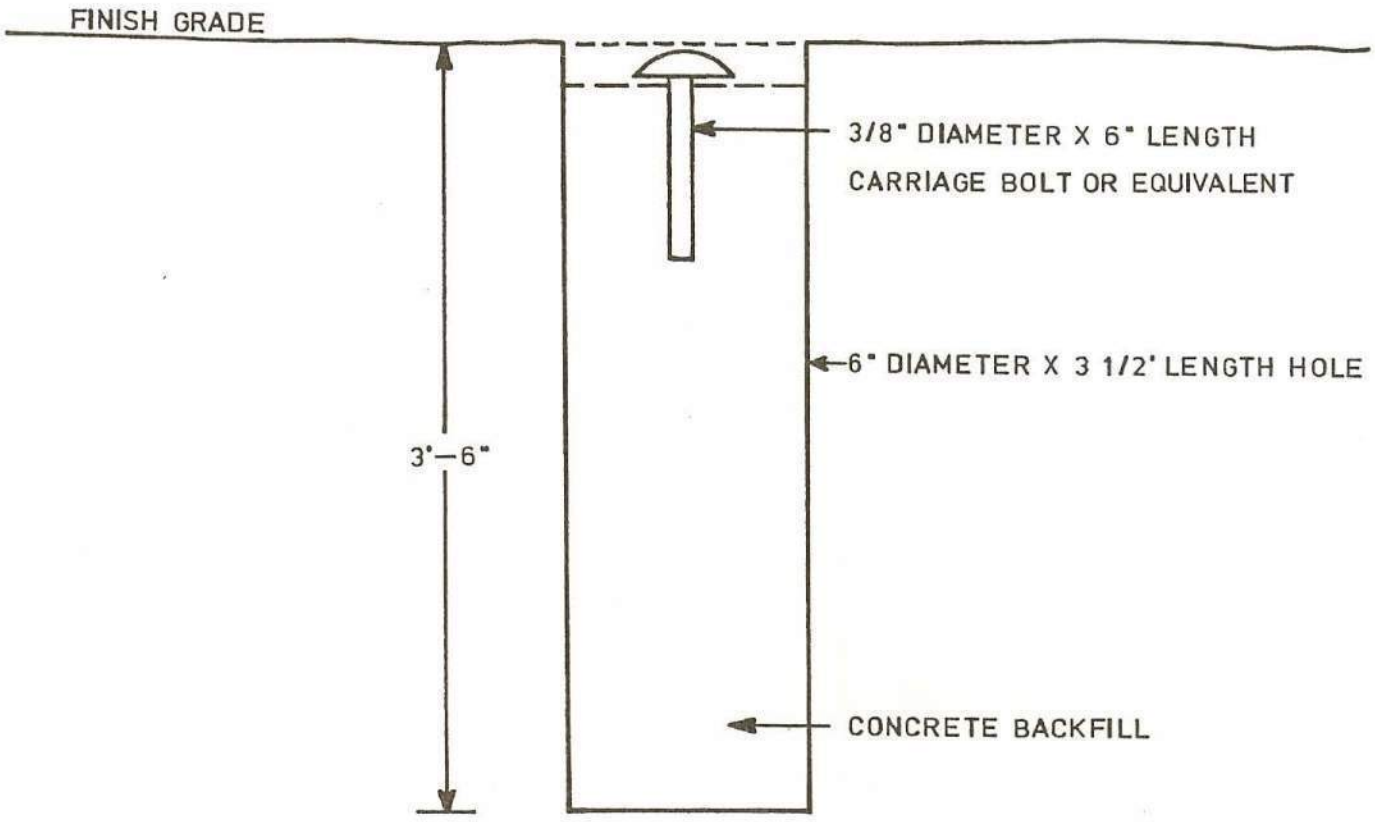
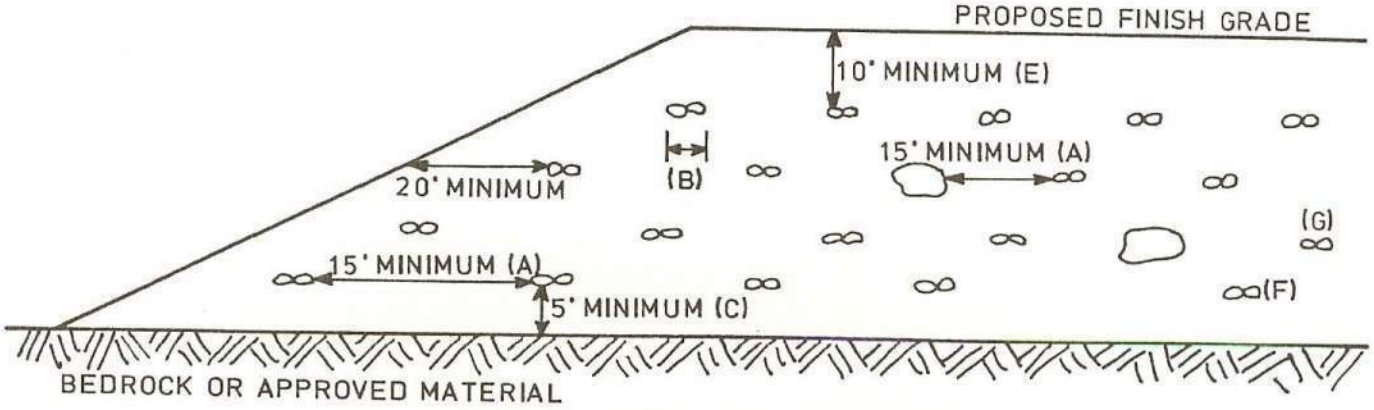


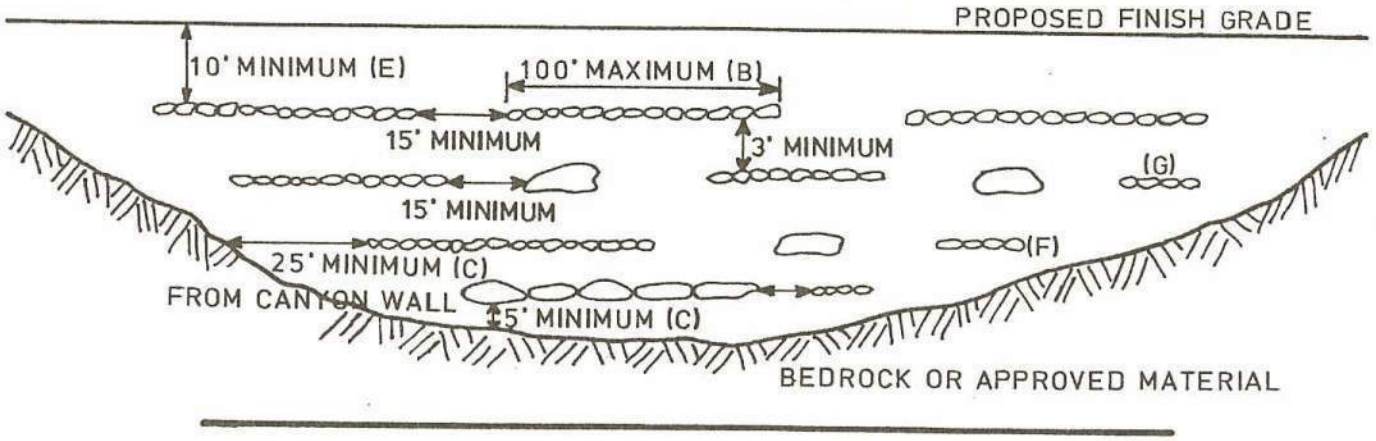
PLATE EG-15

OVERSIZE ROCK DISPOSAL

VIEW NORMAL TO SLOPE FACE



VIEW PARALLEL TO SLOPE FACE

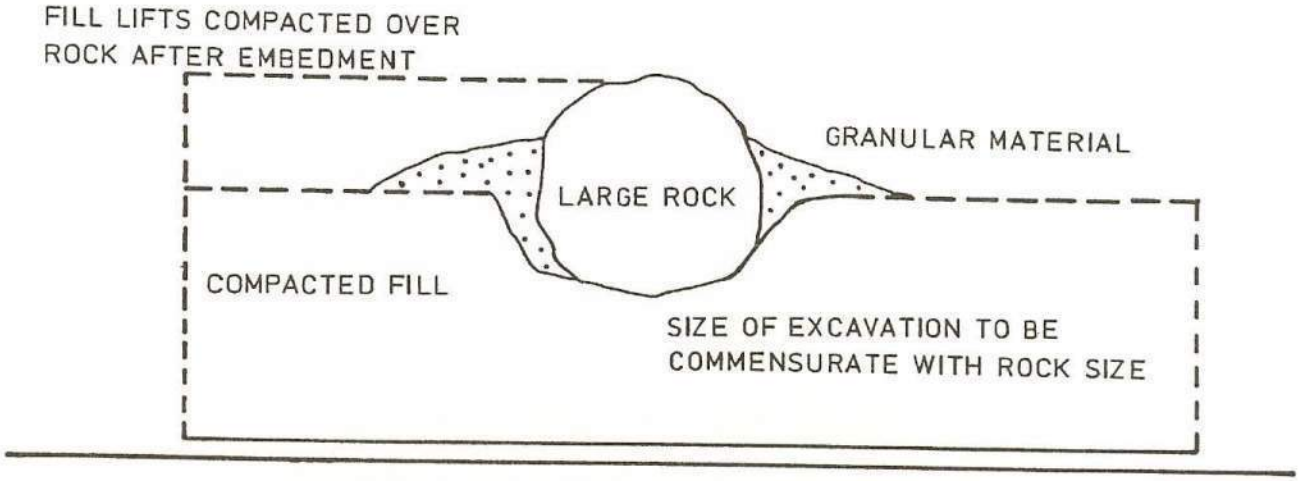


NOTE: (A) ONE EQUIPMENT WIDTH OR A MINIMUM OF 15 FEET.
(B) HEIGHT AND WIDTH MAY VARY DEPENDING ON ROCK SIZE AND TYPE OF EQUIPMENT. LENGTH OF WINDROW SHALL BE NO GREATER THAN 100' MAXIMUM.
(C) IF APPROVED BY THE SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST, WINDROWS MAY BE PLACED DIRECTLY ON COMPETENT MATERIAL OR BEDROCK PROVIDED ADEQUATE SPACE IS AVAILABLE FOR COMPACTION.
(D) ORIENTATION OF WINDROWS MAY VARY BUT SHOULD BE AS RECOMMENDED BY THE SOILS ENGINEER AND/OR ENGINEERING GEOLOGIST. STAGGERING OF WINDROWS IS NOT NECESSARY UNLESS RECOMMENDED.
(E) CLEAR AREA FOR UTILITY TRENCHES, FOUNDATIONS AND SWIMMING POOLS.
(F) ALL FILL OVER AND AROUND ROCK WINDROW SHALL BE COMPACTED TO 90% RELATIVE COMPACTION OR AS RECOMMENDED.
(G) AFTER FILL BETWEEN WINDROWS IS PLACED AND COMPACTED WITH THE LIFT OF FILL COVERING WINDROW, WINDROW SHOULD BE PROOF ROLLED WITH A D-9 DOZER OR EQUIVALENT.
VIEWS ARE DIAGRAMMATIC ONLY. ROCK SHOULD NOT TOUCH AND VOIDS SHOULD BE COMPLETELY FILLED IN.

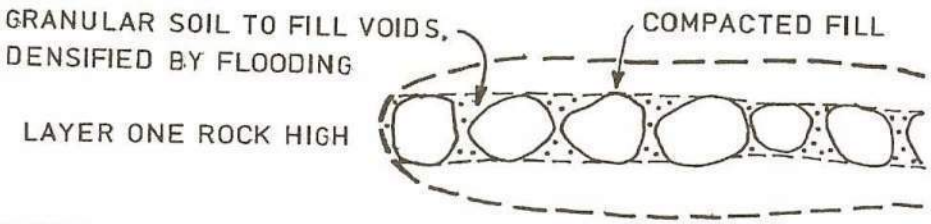
PLATE RD-1

ROCK DISPOSAL PITS

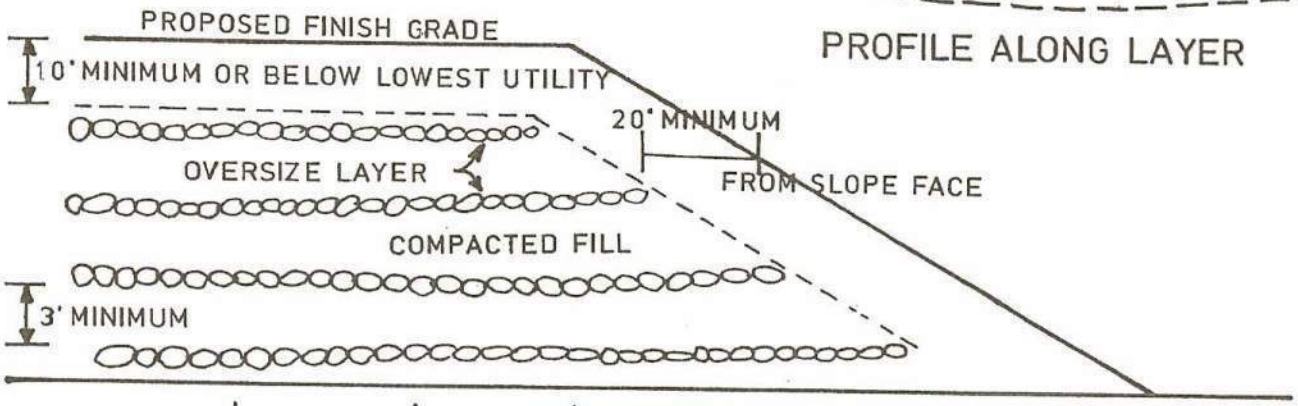
VIEWS ARE DIAGRAMMATIC ONLY. ROCK SHOULD NOT TOUCH AND VOIDS SHOULD BE COMPLETELY FILLED IN.



ROCK DISPOSAL LAYERS



PROFILE ALONG LAYER



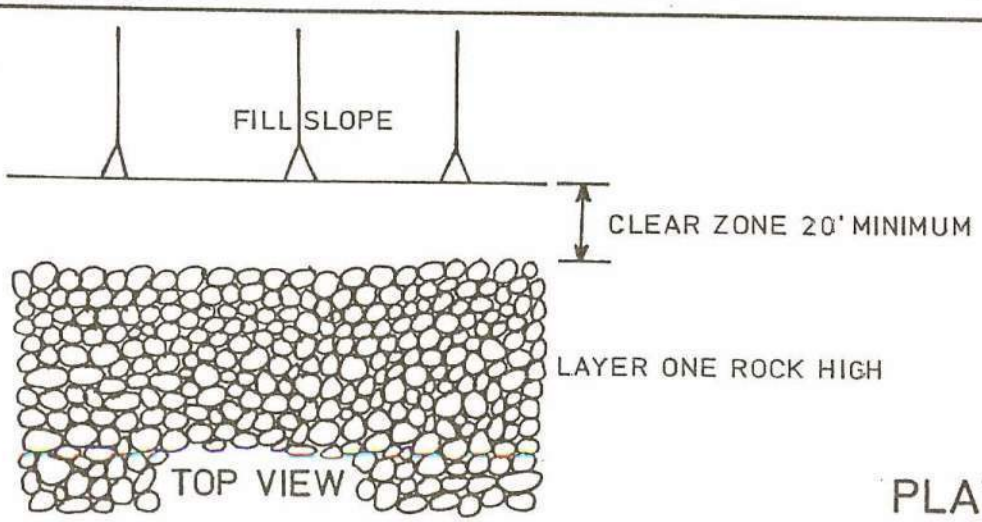
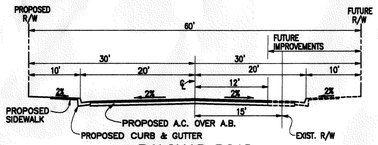
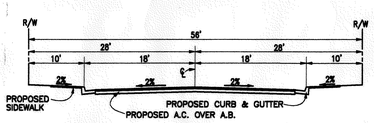


PLATE RD—2

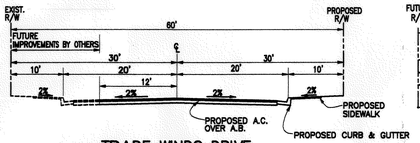
TENTATIVE TRACT MAP NO. 31687
AMENDMENT NO. 4
(SCHEDULE "A")



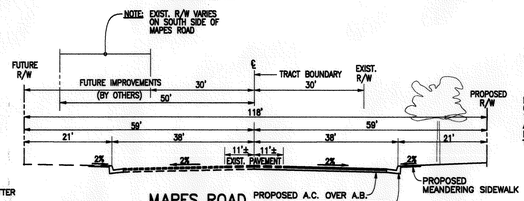
PALOMAR ROAD
(LOOKING NORTH)
PROPOSED STREET SECTION
(PER RIV. CO. STD. NO. 104-A)
NOT TO SCALE



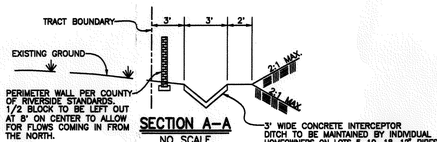
STREETS "A" THROUGH "E" STREETS
PROPOSED STREET SECTION
(PER RIV. CO. STD. NO. 104-A-MODIFIED)
NOT TO SCALE



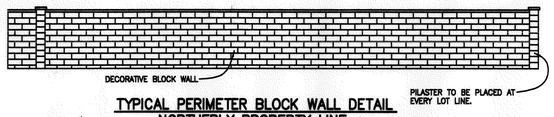
TRADE WINDS DRIVE
(LOOKING NORTH)
PROPOSED STREET SECTION
(PER RIV. CO. STD. NO. 104-A)
NOT TO SCALE



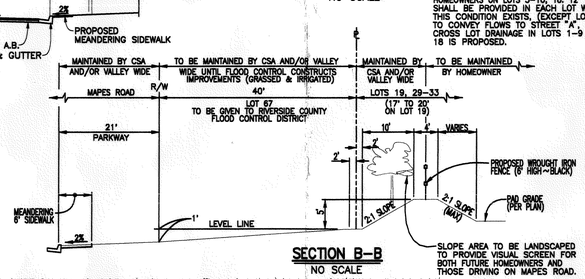
MAPES ROAD
(LOOKING WEST)
PROPOSED STREET SECTION
(PER RIV. CO. STD. NO. 101-MODIFIED)
NOT TO SCALE



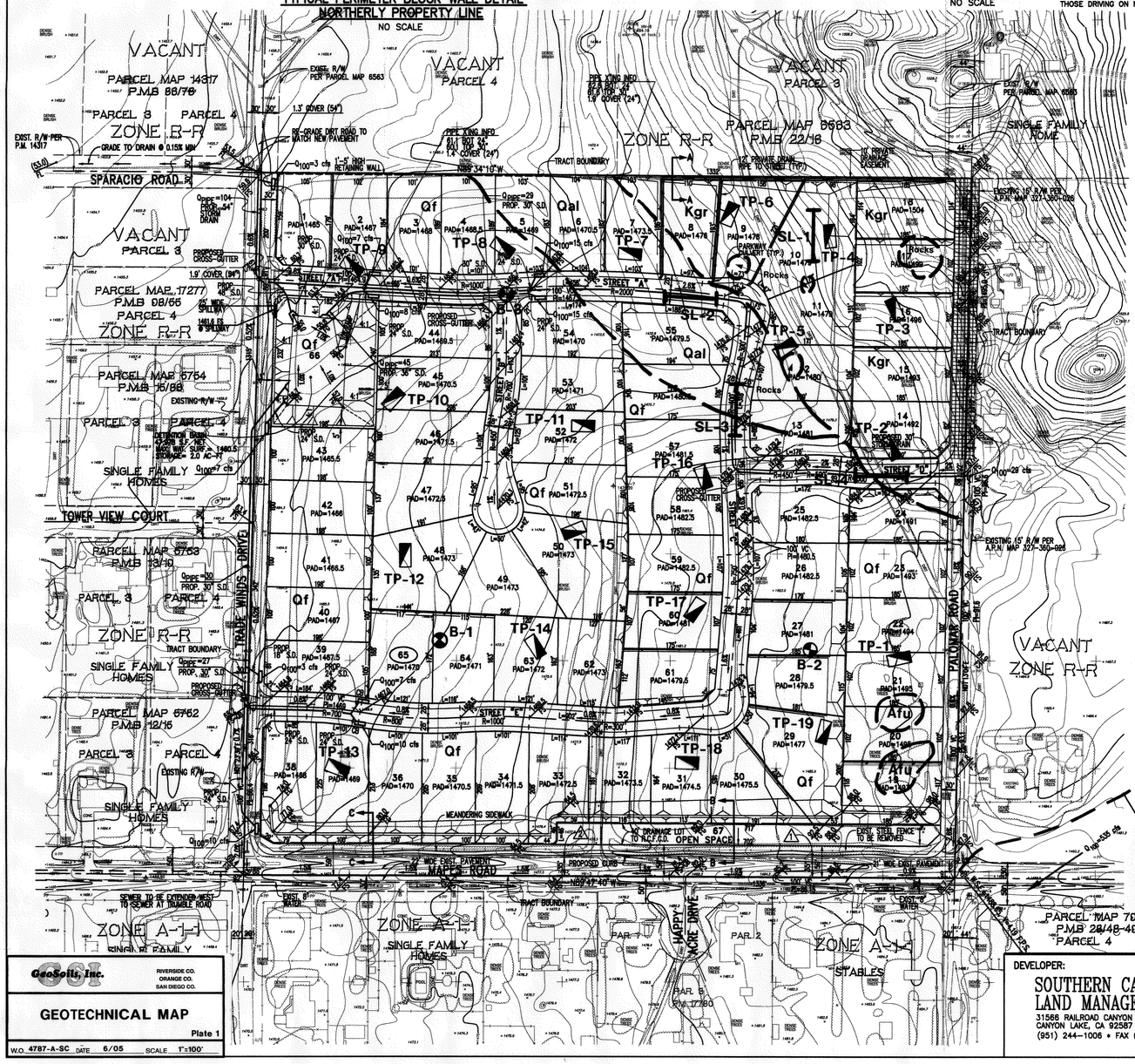
SECTION A-A
NO SCALE



TYPICAL PERIMETER BLOCK WALL DETAIL
NORTHERLY PROPERTY LINE
NO SCALE



SECTION B-B
NO SCALE



APPLICANT / LANDOWNER:

SOUTHERN CALIFORNIA LAND MANAGEMENT
31566 RAILROAD CANYON RD.
CANYON LAKE, CA 92587
(951) 244-1006 * FAX (951) 244-1007
CONTACT: BRIAN MERRITT

PREPARER:

CSL ENGINEERING, INC.
11651 STERLING AVENUE, SUITE E
RIVERSIDE, CALIFORNIA 92503
(951) 785-5122 * FAX (951) 785-5180

LEGAL DESCRIPTION:

THE SOUTHEAST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 2, TOWNSHIP 5 SOUTH, RANGE 3 WEST SAN BERNARDINO BASE AND MERIDIAN.

ASSESSOR'S PARCEL No.:

327-340-017 & 018

ACREAGE:

NET AREA. . . . . 32.16 ACRES
ALL STREET DEDICATIONS. . . . . 8.01 ACRES
GROSS AREA 40.17 ACRES

No. OF PROPOSED LOTS:

65 LOTS RESIDENTIAL (1/2 ACRE GROSS)
1 LOT DEDICATED TO R.C.F.C.D. (LOT 67)
1 LOT FOR DETENTION BASIN PURPOSES (LOT 66)
67 TOTAL LOTS

PROPOSED MINIMUM LOT SIZE:

HALF-ACRE - 65 RESIDENTIAL LOTS

UTILITIES:

ELECTRIC : SOUTHERN CALIFORNIA EDISON
26100 MENIFEE ROAD
ROMOLAND, CALIFORNIA 92380

GAS : SOUTHERN CALIFORNIA GAS COMPANY
1981 WEST LUGONIA AVENUE
REDLANDS, CALIFORNIA 92373

WATER & SEWER : EASTERN MUNICIPAL WATER DISTRICT
2270 TRUMBLE ROAD
PERRIS, CALIFORNIA 92572-8300

TELEPHONE : VERIZON
150 JUANITA
HEMET, CA 92543

TELEVISION : COMCAST CABLE
1581 COMMERCE STREET
CORONA, CA 92880

SCHOOL DISTRICTS:

ELEMENTARY
ROMOLAND SCHOOL DISTRICT
25900 LEON ROAD
HOMELAND, CALIFORNIA 92548

SECONDARY
PERRIS UNION HIGH SCHOOL DISTRICT
155 E. 4TH STREET
PERRIS, CALIFORNIA 92570

EASEMENTS:

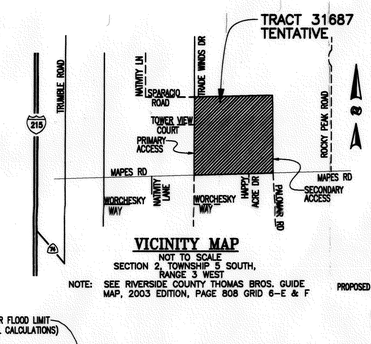
1. AN EASEMENT IN FAVOR OF CALIFORNIA ELECTRIC POWER COMPANY FOR POLELINES, CONDUITS & INCIDENTAL PURPOSES REC. IN BOOK 1139, PAGE 491 ON 1/16/50, O.R.
2. AN EASEMENT IN FAVOR OF CALIFORNIA ELECTRIC POWER COMPANY FOR POLELINES, CONDUITS & INCIDENTAL PURPOSES REC. IN BOOK 1139, PAGE 501 ON 1/16/50, O.R.

LEGEND

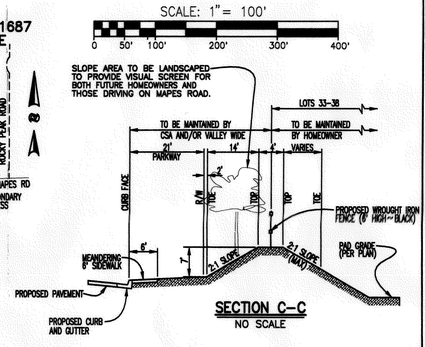
Afu	Artificial fill - undocumented
Qal	Quaternary alluvium
Qf	Quaternary fan deposits (Pleistocene-age fans)
Kgr	Cretaceous granitics
B-3	Approximate location of exploratory boring
TP-19	Approximate location of exploratory test pit
SL-4	Approximate location of seismic refraction survey line
	Area of potential street overexcavation for utilities due to hard rock

All locations are approximate





VICINITY MAP
NOT TO SCALE
SECTION 2, TOWNSHIP 5 SOUTH, RANGE 3 WEST
NOTE: SEE RIVERSIDE COUNTY THOMAS BROS. GUIDE MAP, 2003 EDITION, PAGE 808 GRID 6-E & F



SECTION C-C
NO SCALE

AMENDMENTS:

DATE	No.	DESCRIPTION
4/15/04	1	INCREASE PARK SIZE AND PROVIDE FOR FUTURE TENTATIVE TRACT 32179, REVISE LOT AND STREET CONFIGURATION TO PROVIDE AVERAGE 70' WIDTH, ADD LOT 138 (40' WIDE) FOR FUTURE FLOOD CHANNEL.
8/10/04	2	ADDED INFILTRATION SWALES ADJACENT TO LOTS 82-88, RECONFIGURED LOTS AND STREETS TO ACCOMMODATE INFILTRATION SWALES, MOVED PARK, REMOVED PROJECT REFERENCES TO NORTH WHICH IS TEMPORARILY ON HOLD, ETC.
10/12/04	3	CORRECT LOT AREAS, ADD SECTION E-E, ADD SEPERATE LOT FOR BASIN AND SLOPE.
2/14/05	4	REVISED MAP TO REFLECT 1/2 ACRE LOTS, INCLUDES REVISING LOT & STREET CONFIGURING, STORM DRAIN DESIGN, ETC.

ZONING & LAND USE:

SUBJECT PROPERTY
EXISTING ZONING . . . . . R-R
PROPOSED ZONING . . . . . R-R
EXISTING LAND USE . . . . . VACANT
PROPOSED LAND USE . . . . . SINGLE FAMILY RESIDENTIAL
EXISTING R.C.I.P. . . . . LOW DENSITY RESIDENTIAL (1/2 ACRE MIN.)

TOPOGRAPHY:

THE TOPOGRAPHY SHOWN HEREON IS BASED ON AERIAL TOPOGRAPHY PREPARED BY PSA TECHNOLOGIES FOR CSL ENGINEERING IN AUGUST 2003.

REFERENCE INFORMATION:

1. THIS TENTATIVE MAP INCLUDES ALL THE CONTIGUOUS OWNERSHIP OF THE LAND DIVIDER.
2. PRELIMINARY EARTHWORK CALCULATIONS INDICATE TRACT 31687 WILL BALANCE ON SITE. TRACT 31687 WILL GENERATE APPROXIMATELY 115,000 C.Y. RAW CUT AND 85,000 C.Y. RAW FILL AND IS ANTICIPATED TO BALANCE ON SITE WITH ANTICIPATED SHRINKAGES.
3. THIS SITE IS NOT WITHIN A SPECIFIC PLAN.
4. PERMISSION TO BE OBTAINED PRIOR TO GRADING OFFSITE IF NECESSARY.
5. TENTATIVE TRACT 31687 IS NOT LOCATED IN EITHER A GEOLOGICAL HAZARD AREA, LIQUEFACTION HAZARD AREA, OR A SPECIAL STUDIES ZONE.
6. TENTATIVE TRACT 31687 IS LOCATED IN ZONE C, PER FEMA PANEL 060245-1450D.
7. NO EXISTING STRUCTURES EXIST ON SITE.
8. NO FLAMMABLE/COMBUSTIBLE LIQUID STORAGE ARE PLANNED FOR THIS SITE.
9. IRRIGATION AND LANDSCAPE PLANS WILL BE DEFERRED TO A LATER TIME.
10. ALL SLOPES ARE 2:1 UNLESS OTHERWISE SHOWN.
11. NO CONCRETE CHANNELS ARE PROPOSED.
12. THIS SITE IS NOT SUBJECT TO OVERFLOW, INUNDATION OR FLOOD HAZARD.
13. THIS SITE IS IN CSA 146 & 152. THE DETENTION BASIN, (LOT 66), AS WELL AS OPEN SPACE LOT 67, SHALL BE MAINTAINED BY CSA OR VALLEY WIDE PARK AND RECREATION.
14. NO KNOWN EXISTING WELLS ON OR WITHIN 200 FEET OF SITE.
15. ALL STREETS ARE TO BE PUBLIC STREETS AND DEDICATED TO THE COUNTY.
16. DETENTION BASIN PROVIDES FOR APPROXIMATELY 2.0 ACRE-FT OF STORAGE.
17. LOWEST ELEVATION ONSITE IS 1459, HIGHEST ELEVATION ONSITE IS 1507.
18. A PERIMETER WALL WITH PILASTERS IS PROPOSED ALONG NORTHERLY PROJECT PERIMETER, (SEE TYPICAL PERIMETER BLOCK WALL DETAIL).

GeoSoils, Inc. — RIVERSIDE CO. ORANGE CO. SAN DIEGO CO.
GEOTECHNICAL MAP
Plate 1
W.O. 4787-A-SC DATE 6/05 SCALE 1"=100'

DEVELOPER:
SOUTHERN CALIFORNIA LAND MANAGEMENT
31566 RAILROAD CANYON RD. #643
CANYON LAKE, CA 92587
(951) 244-1006 * FAX (951) 244-1007

CSL ENGINEERING, INC.
11651 STERLING AVENUE, SUITE E
RIVERSIDE, CALIFORNIA 92503
(951) 785-5122 * FAX (951) 785-5180
PREPARED BY: R.C.E. NO. 25917 (EXP. 12/31/05)
RICHARD A. SCIANNI DATE:

TENTATIVE TRACT No. 31687
COUNTY OF RIVERSIDE
AMENDMENT NO. 4
SCHEDULE "A"

1 OF 1 SHTS

PREPARED FOR: SO. CAL. LAND MANAGEMENT | W.O. | DATE: APRIL, 2004. REV. AUG. 2004, FEB. 2005

JN620/620Tentative-Amd4.dwg/3-9-05/S-100

Appendix 4: Historical Site Conditions

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

N/A

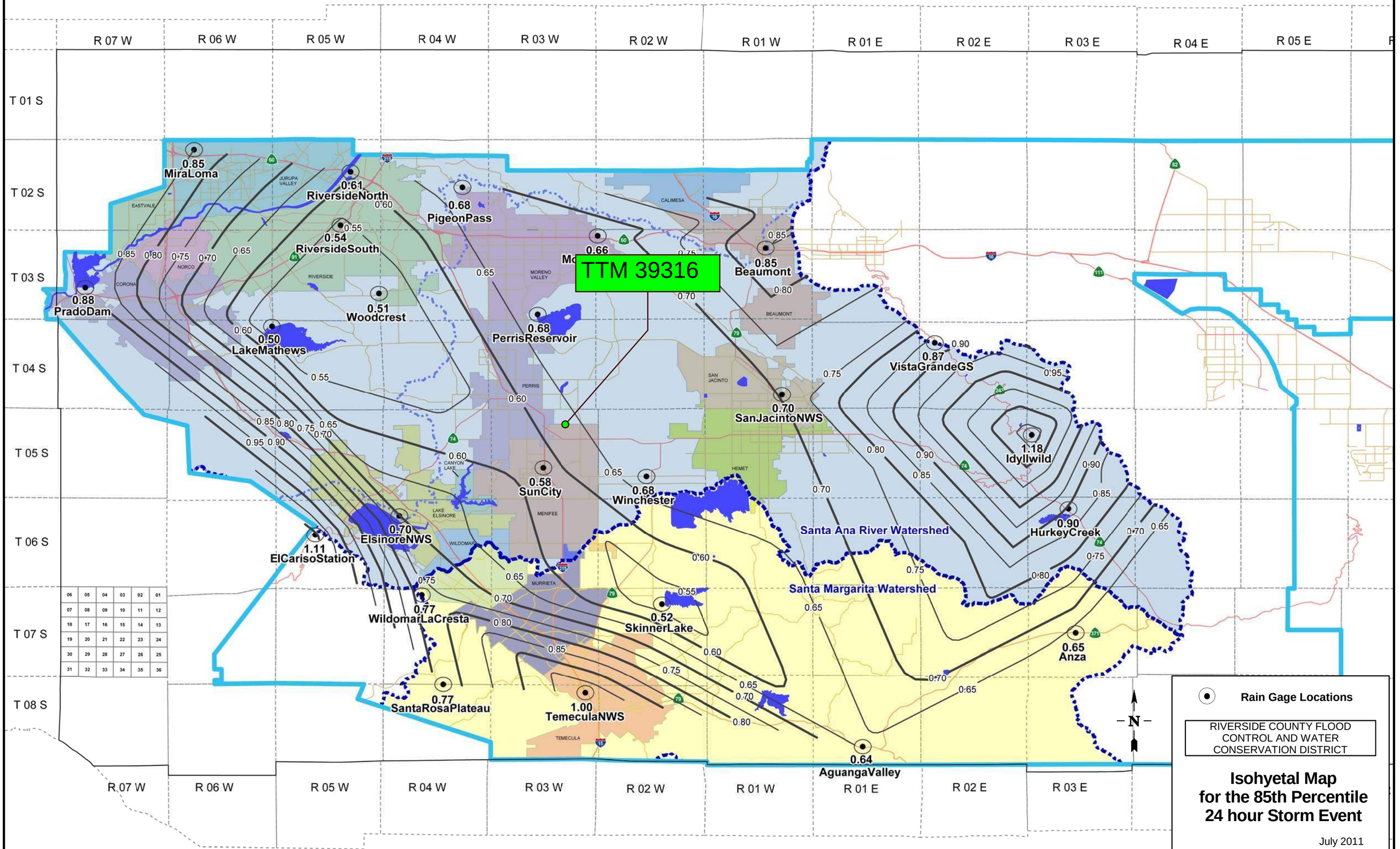
Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

N/A

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation


R 07 W
R 06 W
R 05 W
R 04 W
R 03 W
R 02 W
R 01 W
R 01 E
R 02 E
R 03 E
R 04 E
R 05 E
T 01 S
T 02 S
T 03 S
T 04 S
T 05 S
T 06 S
T 07 S
T 08 S
TTM 39316
0.85 MiraLoma
0.61 RiversideNorth
0.54 RiversideSouth
0.68 PigeonPass
0.66
0.85 Beaumont
0.88 PradoDam
0.51 Woodcrest
0.50 LakeMathews
0.68 PerrisReservoir
0.87 VistaGrandeGS
0.70 SanJacintoNWS
1.18 Idyllwild
0.58 SunCity
0.68 Winchester
0.70 ElsinoreNWS
1.11 ElCarisoStation
0.90 HurkeyCreek
0.77 WildomarLaCresta
0.52 SkinnerLake
0.65 Anza
0.77 SantaRosaPlateau
1.00 TemeculaNWS
0.64 AguangaValley
Santa Ana River Watershed
Santa Margarita Watershed
JURUPA VALLEY
EASTVALE
CORONA
NORCO
RIVERSIDE
MORENO VALLEY
CALIMESA
BEAUMONT
PERRIS
SAN JACINTO
HEMET
CANYON LAKE
LAKE ELSINORE
MENIFEE
WILDOMAR
MURRIETA
TEMECULA
Rain Gage Locations
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
Isohyetal Map for the 85th Percentile 24 hour Storm Event
July 2011

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: KWC Engineers
Date: 7/16/2026
Designed by: GGONZALEZ
Case No:
Company Project Number/Name: TTM 39316

BMP Identification

BMP NAME / ID: WQ Basin 1/ DMA-A

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

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

D_{85}= 0.63 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
Roof	*367690*	*Roofs*	*1*	*0.89*	*327979.5*			
Pavement	*503174*	*Concrete or Asphalt*	*1*	*0.89*	*448831.2*			
Landscape	*789288.6*	*Ornamental Landscaping*	*0.1*	*0.11*	*87183.2*			
Basin	*84861*	*Ornamental Landscaping*	*0.1*	*0.11*	*9373.6*			
	1745013.6		*Total*		*873367.5*	*0.63*	*45851.8*	*50680*

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: KWC Engineers
Date: 7/16/2026
Designed by: GGONZALEZ
Case No:
Company Project Number/Name: TTM 39316

BMP Identification

BMP NAME / ID: DMA B

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

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

D_{85}= 0.63 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
Pavement	*23086.8*	*Concrete or Asphalt*	*1*	*0.89*	*20593.4*			

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: KWC Engineers — Date: 7/16/2026

Designed by: GGONZALEZ — Case No:

Company Project Number/Name: TTM 39316

BMP Identification

BMP NAME / ID: DMA C

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

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

D_{85}= 0.63 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
Pavement	*13,419*	*Concrete or Asphalt*	*1*	*0.89*	*11969.7*			
Landscape	*27,092*	*Ornamental Landscaping*	*0.1*	*0.11*	*2992.5*			

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: KWC Engineers — Date: 7/16/2026

Designed by: GGONZALEZ — Case No:

Company Project Number/Name: TTM 39316

BMP Identification

BMP NAME / ID: DMA D

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

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

D_{85}= 0.63 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
Pavement	*10,454*	*Concrete or Asphalt*	*1*	*0.89*	*9325.3*			

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: KWC Engineers — Date: 7/16/2026

Designed by: Jferre — Case No:

Company Project Number/Name: TTM 39316

BMP Identification

BMP NAME / ID: DMA A, DMA B, DMA C & DMA D

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

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

D_{85}= 0.63 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
Roof/ DMA A	*367690*	*Roofs*	*1*	*0.89*	*327979.5*			
Pavement/ DMA A	*503174*	*Concrete or Asphalt*	*1*	*0.89*	*448831.2*			
Landscape /DMA A	*789288.6*	*Ornamental Landscaping*	*0.1*	*0.11*	*87183.2*			
Basin/ DMA A	*84861*	*Ornamental Landscaping*	*0.1*	*0.11*	*9373.6*			
Pavement/ DMA B	*23086.8*	*Concrete or Asphalt*	*1*	*0.89*	*20593.4*			
Pavement/ DMA C	*13419*	*Concrete or Asphalt*	*1*	*0.89*	*11969.7*			
Landscape /DMAC	*27092*	*Ornamental Landscaping*	*0.1*	*0.11*	*2992.5*			
Pavement/ DMA D	*10454*	*Concrete or Asphalt*	*1*	*0.89*	*9325*			

Bioretention Facility - Design Procedure (Rev. 06-2014)	BMP ID: BASIN 1	Legend:	Required Entries / Calculated Cells

Company Name: KWC Engineers — Date: 7/16/2026

Designed by: L.Johnson — County/City Case No.:

Design Volume

Enter the area tributary to this feature	A_{TRIB} =	41.76	acres
Enter V_{BMP} determined from Section 4.3 of this Handbook	V_{BMP} =	48,208	ft^3

Type of Bioretention Facility Design

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

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

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer	d_S =	3.0	ft
Top Width of Bioretention Facility, excluding curb	w_T =	1100.0	ft
Total Effective Depth, d_E $d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$	d_E =	1.80	ft
Minimum Surface Area, A_m $A_M\ (ft^2) = \frac{V_{BMP}\ (ft^3)}{d_E\ (ft)}$	A_M =	26,792	ft^2
Proposed Surface Area	A=	36,200	ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility	z =	4	:1
Diameter of Underdrain		6	inches
Longitudinal Slope of Site (3% maximum)		0.05	%
6" Check Dam Spacing		0	feet
Describe Landscaping:			

Notes: Per meeting with Riverside County Transportation on 12/22/2025, it was confirmed that 50% of the proposed basin is to have a 2:1 slope on the west & east side and the other 50% of the basin is to have a 4:1 slope on the north & south side.

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern

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 08/06/25 File: E2507A242R242.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6653

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

English Units used in output format

ROMOLAND
EXISTING CONDITION 2-YEAR 24-HOUR STORM
PROJECT SITE DRAINAGE AREA A UNIT HYDROGRAPH ANALYSIS
BY KWC ENGINEERS

Drainage Area = 60.00(Ac.) = 0.094 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 60.00(Ac.) = 0.094 Sq. Mi.
Length along longest watercourse = 2904.00(Ft.)
Length along longest watercourse measured to centroid = 1268.00(Ft.)
Length along longest watercourse = 0.550 Mi.
Length along longest watercourse measured to centroid = 0.240 Mi.
Difference in elevation = 162.70(Ft.)
Slope along watercourse = 295.8182 Ft./Mi.
Average Manning's 'N' = 0.025
Lag time = 0.094 Hr.
Lag time = 5.66 Min.
25% of lag time = 1.41 Min.
40% of lag time = 2.26 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]
60.00	1.60	96.00

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
60.00	4.00	240.00

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 1.600(In)
Area Averaged 100-Year Rainfall = 4.000(In)

Point rain (area averaged) = 1.600(In)
Areal adjustment factor = 99.99 %
Adjusted average point rain = 1.600(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
60.000	79.00	0.000

Total Area Entered = 60.00(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
79.0	61.8	0.451	0.000	0.451	1.000	0.451
					Sum (F) =	0.451

Area averaged mean soil loss (F) (In/Hr) = 0.451
Minimum soil loss rate ((In/Hr)) = 0.225
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.518

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

Unit Hydrograph Data

Unit time period (hrs)	Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	88.357	10.865	6.570
2	0.167	176.714	52.819	31.939
3	0.250	265.070	21.353	12.912
4	0.333	353.427	8.762	5.298
5	0.417	441.784	3.844	2.325
6	0.500	530.141	1.195	0.723
7	0.583	618.498	0.653	0.395
8	0.667	706.854	0.509	0.308
			Sum = 100.000	Sum= 60.469

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

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.07	0.013	(0.799)	0.007	0.006
2	0.17	0.07	0.013	(0.796)	0.007	0.006
3	0.25	0.07	0.013	(0.793)	0.007	0.006
4	0.33	0.10	0.019	(0.789)	0.010	0.009
5	0.42	0.10	0.019	(0.786)	0.010	0.009
6	0.50	0.10	0.019	(0.783)	0.010	0.009
7	0.58	0.10	0.019	(0.780)	0.010	0.009
8	0.67	0.10	0.019	(0.777)	0.010	0.009
9	0.75	0.10	0.019	(0.774)	0.010	0.009
10	0.83	0.13	0.026	(0.771)	0.013	0.012
11	0.92	0.13	0.026	(0.768)	0.013	0.012
12	1.00	0.13	0.026	(0.765)	0.013	0.012
13	1.08	0.10	0.019	(0.762)	0.010	0.009
14	1.17	0.10	0.019	(0.759)	0.010	0.009
15	1.25	0.10	0.019	(0.756)	0.010	0.009
16	1.33	0.10	0.019	(0.753)	0.010	0.009
17	1.42	0.10	0.019	(0.750)	0.010	0.009
18	1.50	0.10	0.019	(0.747)	0.010	0.009
19	1.58	0.10	0.019	(0.744)	0.010	0.009
20	1.67	0.10	0.019	(0.741)	0.010	0.009
21	1.75	0.10	0.019	(0.738)	0.010	0.009
22	1.83	0.13	0.026	(0.735)	0.013	0.012
23	1.92	0.13	0.026	(0.732)	0.013	0.012
24	2.00	0.13	0.026	(0.729)	0.013	0.012
25	2.08	0.13	0.026	(0.726)	0.013	0.012
26	2.17	0.13	0.026	(0.723)	0.013	0.012
27	2.25	0.13	0.026	(0.720)	0.013	0.012
28	2.33	0.13	0.026	(0.717)	0.013	0.012
29	2.42	0.13	0.026	(0.715)	0.013	0.012
30	2.50	0.13	0.026	(0.712)	0.013	0.012
31	2.58	0.17	0.032	(0.709)	0.017	0.015
32	2.67	0.17	0.032	(0.706)	0.017	0.015
33	2.75	0.17	0.032	(0.703)	0.017	0.015
34	2.83	0.17	0.032	(0.700)	0.017	0.015
35	2.92	0.17	0.032	(0.697)	0.017	0.015
36	3.00	0.17	0.032	(0.694)	0.017	0.015
37	3.08	0.17	0.032	(0.691)	0.017	0.015
38	3.17	0.17	0.032	(0.688)	0.017	0.015

39	3.25	0.17	0.032	(0.686)	0.017	0.015
40	3.33	0.17	0.032	(0.683)	0.017	0.015
41	3.42	0.17	0.032	(0.680)	0.017	0.015
42	3.50	0.17	0.032	(0.677)	0.017	0.015
43	3.58	0.17	0.032	(0.674)	0.017	0.015
44	3.67	0.17	0.032	(0.671)	0.017	0.015
45	3.75	0.17	0.032	(0.669)	0.017	0.015
46	3.83	0.20	0.038	(0.666)	0.020	0.019
47	3.92	0.20	0.038	(0.663)	0.020	0.019
48	4.00	0.20	0.038	(0.660)	0.020	0.019
49	4.08	0.20	0.038	(0.657)	0.020	0.019
50	4.17	0.20	0.038	(0.655)	0.020	0.019
51	4.25	0.20	0.038	(0.652)	0.020	0.019
52	4.33	0.23	0.045	(0.649)	0.023	0.022
53	4.42	0.23	0.045	(0.646)	0.023	0.022
54	4.50	0.23	0.045	(0.643)	0.023	0.022
55	4.58	0.23	0.045	(0.641)	0.023	0.022
56	4.67	0.23	0.045	(0.638)	0.023	0.022
57	4.75	0.23	0.045	(0.635)	0.023	0.022
58	4.83	0.27	0.051	(0.632)	0.027	0.025
59	4.92	0.27	0.051	(0.630)	0.027	0.025
60	5.00	0.27	0.051	(0.627)	0.027	0.025
61	5.08	0.20	0.038	(0.624)	0.020	0.019
62	5.17	0.20	0.038	(0.622)	0.020	0.019
63	5.25	0.20	0.038	(0.619)	0.020	0.019
64	5.33	0.23	0.045	(0.616)	0.023	0.022
65	5.42	0.23	0.045	(0.613)	0.023	0.022
66	5.50	0.23	0.045	(0.611)	0.023	0.022
67	5.58	0.27	0.051	(0.608)	0.027	0.025
68	5.67	0.27	0.051	(0.605)	0.027	0.025
69	5.75	0.27	0.051	(0.603)	0.027	0.025
70	5.83	0.27	0.051	(0.600)	0.027	0.025
71	5.92	0.27	0.051	(0.597)	0.027	0.025
72	6.00	0.27	0.051	(0.595)	0.027	0.025
73	6.08	0.30	0.058	(0.592)	0.030	0.028
74	6.17	0.30	0.058	(0.589)	0.030	0.028
75	6.25	0.30	0.058	(0.587)	0.030	0.028
76	6.33	0.30	0.058	(0.584)	0.030	0.028
77	6.42	0.30	0.058	(0.582)	0.030	0.028
78	6.50	0.30	0.058	(0.579)	0.030	0.028
79	6.58	0.33	0.064	(0.576)	0.033	0.031
80	6.67	0.33	0.064	(0.574)	0.033	0.031
81	6.75	0.33	0.064	(0.571)	0.033	0.031
82	6.83	0.33	0.064	(0.569)	0.033	0.031
83	6.92	0.33	0.064	(0.566)	0.033	0.031
84	7.00	0.33	0.064	(0.563)	0.033	0.031
85	7.08	0.33	0.064	(0.561)	0.033	0.031
86	7.17	0.33	0.064	(0.558)	0.033	0.031
87	7.25	0.33	0.064	(0.556)	0.033	0.031
88	7.33	0.37	0.070	(0.553)	0.036	0.034
89	7.42	0.37	0.070	(0.551)	0.036	0.034
90	7.50	0.37	0.070	(0.548)	0.036	0.034
91	7.58	0.40	0.077	(0.546)	0.040	0.037
92	7.67	0.40	0.077	(0.543)	0.040	0.037
93	7.75	0.40	0.077	(0.541)	0.040	0.037
94	7.83	0.43	0.083	(0.538)	0.043	0.040
95	7.92	0.43	0.083	(0.536)	0.043	0.040
96	8.00	0.43	0.083	(0.533)	0.043	0.040
97	8.08	0.50	0.096	(0.531)	0.050	0.046
98	8.17	0.50	0.096	(0.528)	0.050	0.046
99	8.25	0.50	0.096	(0.526)	0.050	0.046
100	8.33	0.50	0.096	(0.523)	0.050	0.046
101	8.42	0.50	0.096	(0.521)	0.050	0.046
102	8.50	0.50	0.096	(0.518)	0.050	0.046
103	8.58	0.53	0.102	(0.516)	0.053	0.049
104	8.67	0.53	0.102	(0.514)	0.053	0.049
105	8.75	0.53	0.102	(0.511)	0.053	0.049
106	8.83	0.57	0.109	(0.509)	0.056	0.052
107	8.92	0.57	0.109	(0.506)	0.056	0.052
108	9.00	0.57	0.109	(0.504)	0.056	0.052
109	9.08	0.63	0.122	(0.502)	0.063	0.059
110	9.17	0.63	0.122	(0.499)	0.063	0.059
111	9.25	0.63	0.122	(0.497)	0.063	0.059

112	9.33	0.67	0.128	(0.494)	0.066	0.062
113	9.42	0.67	0.128	(0.492)	0.066	0.062
114	9.50	0.67	0.128	(0.490)	0.066	0.062
115	9.58	0.70	0.134	(0.487)	0.070	0.065
116	9.67	0.70	0.134	(0.485)	0.070	0.065
117	9.75	0.70	0.134	(0.483)	0.070	0.065
118	9.83	0.73	0.141	(0.480)	0.073	0.068
119	9.92	0.73	0.141	(0.478)	0.073	0.068
120	10.00	0.73	0.141	(0.476)	0.073	0.068
121	10.08	0.50	0.096	(0.473)	0.050	0.046
122	10.17	0.50	0.096	(0.471)	0.050	0.046
123	10.25	0.50	0.096	(0.469)	0.050	0.046
124	10.33	0.50	0.096	(0.467)	0.050	0.046
125	10.42	0.50	0.096	(0.464)	0.050	0.046
126	10.50	0.50	0.096	(0.462)	0.050	0.046
127	10.58	0.67	0.128	(0.460)	0.066	0.062
128	10.67	0.67	0.128	(0.458)	0.066	0.062
129	10.75	0.67	0.128	(0.455)	0.066	0.062
130	10.83	0.67	0.128	(0.453)	0.066	0.062
131	10.92	0.67	0.128	(0.451)	0.066	0.062
132	11.00	0.67	0.128	(0.449)	0.066	0.062
133	11.08	0.63	0.122	(0.446)	0.063	0.059
134	11.17	0.63	0.122	(0.444)	0.063	0.059
135	11.25	0.63	0.122	(0.442)	0.063	0.059
136	11.33	0.63	0.122	(0.440)	0.063	0.059
137	11.42	0.63	0.122	(0.438)	0.063	0.059
138	11.50	0.63	0.122	(0.436)	0.063	0.059
139	11.58	0.57	0.109	(0.433)	0.056	0.052
140	11.67	0.57	0.109	(0.431)	0.056	0.052
141	11.75	0.57	0.109	(0.429)	0.056	0.052
142	11.83	0.60	0.115	(0.427)	0.060	0.056
143	11.92	0.60	0.115	(0.425)	0.060	0.056
144	12.00	0.60	0.115	(0.423)	0.060	0.056
145	12.08	0.83	0.160	(0.421)	0.083	0.077
146	12.17	0.83	0.160	(0.418)	0.083	0.077
147	12.25	0.83	0.160	(0.416)	0.083	0.077
148	12.33	0.87	0.166	(0.414)	0.086	0.080
149	12.42	0.87	0.166	(0.412)	0.086	0.080
150	12.50	0.87	0.166	(0.410)	0.086	0.080
151	12.58	0.93	0.179	(0.408)	0.093	0.086
152	12.67	0.93	0.179	(0.406)	0.093	0.086
153	12.75	0.93	0.179	(0.404)	0.093	0.086
154	12.83	0.97	0.186	(0.402)	0.096	0.089
155	12.92	0.97	0.186	(0.400)	0.096	0.089
156	13.00	0.97	0.186	(0.398)	0.096	0.089
157	13.08	1.13	0.218	(0.396)	0.113	0.105
158	13.17	1.13	0.218	(0.394)	0.113	0.105
159	13.25	1.13	0.218	(0.392)	0.113	0.105
160	13.33	1.13	0.218	(0.390)	0.113	0.105
161	13.42	1.13	0.218	(0.388)	0.113	0.105
162	13.50	1.13	0.218	(0.386)	0.113	0.105
163	13.58	0.77	0.147	(0.384)	0.076	0.071
164	13.67	0.77	0.147	(0.382)	0.076	0.071
165	13.75	0.77	0.147	(0.380)	0.076	0.071
166	13.83	0.77	0.147	(0.378)	0.076	0.071
167	13.92	0.77	0.147	(0.376)	0.076	0.071
168	14.00	0.77	0.147	(0.374)	0.076	0.071
169	14.08	0.90	0.173	(0.372)	0.089	0.083
170	14.17	0.90	0.173	(0.370)	0.089	0.083
171	14.25	0.90	0.173	(0.369)	0.089	0.083
172	14.33	0.87	0.166	(0.367)	0.086	0.080
173	14.42	0.87	0.166	(0.365)	0.086	0.080
174	14.50	0.87	0.166	(0.363)	0.086	0.080
175	14.58	0.87	0.166	(0.361)	0.086	0.080
176	14.67	0.87	0.166	(0.359)	0.086	0.080
177	14.75	0.87	0.166	(0.357)	0.086	0.080
178	14.83	0.83	0.160	(0.356)	0.083	0.077
179	14.92	0.83	0.160	(0.354)	0.083	0.077
180	15.00	0.83	0.160	(0.352)	0.083	0.077
181	15.08	0.80	0.154	(0.350)	0.080	0.074
182	15.17	0.80	0.154	(0.348)	0.080	0.074
183	15.25	0.80	0.154	(0.347)	0.080	0.074
184	15.33	0.77	0.147	(0.345)	0.076	0.071

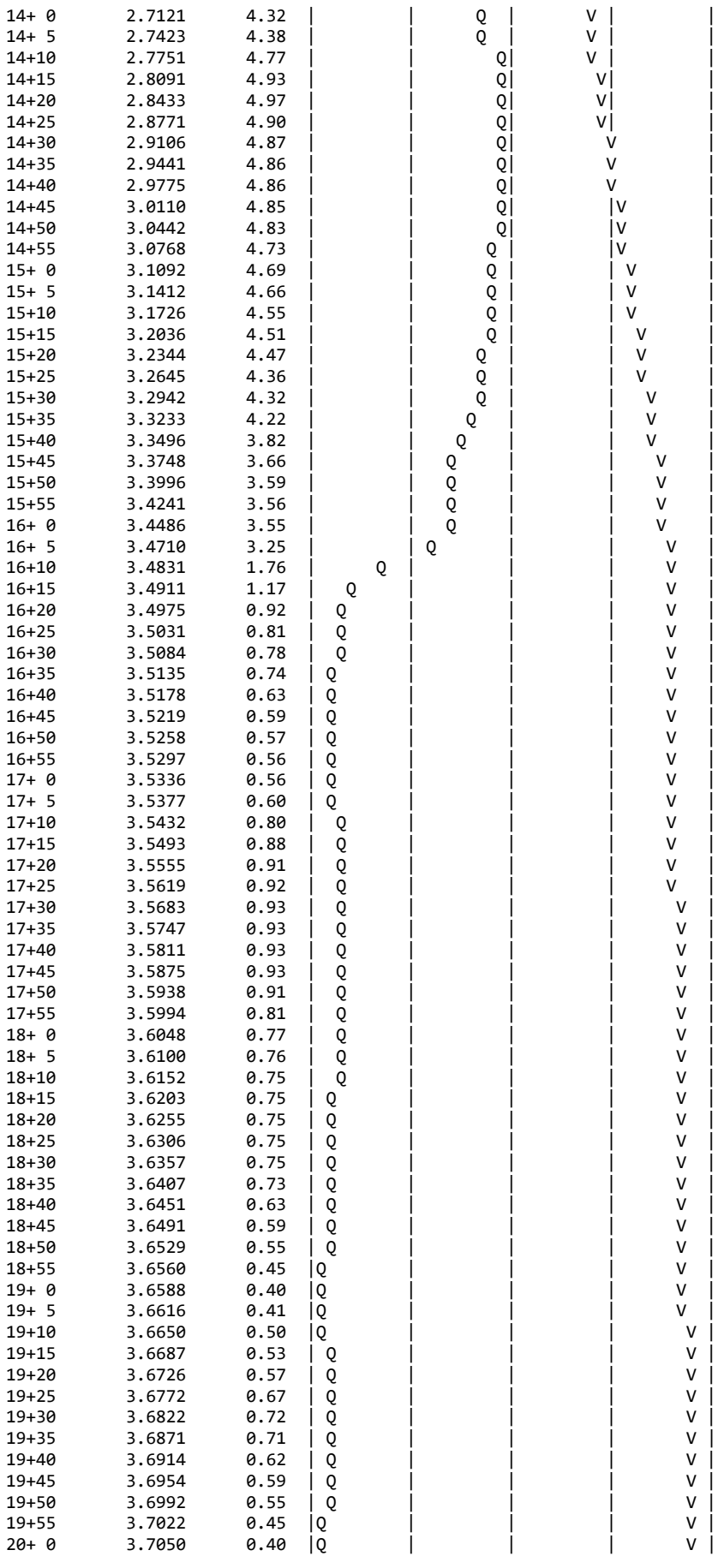
185	15.42	0.77	0.147	(0.343)	0.076	0.071
186	15.50	0.77	0.147	(0.341)	0.076	0.071
187	15.58	0.63	0.122	(0.339)	0.063	0.059
188	15.67	0.63	0.122	(0.338)	0.063	0.059
189	15.75	0.63	0.122	(0.336)	0.063	0.059
190	15.83	0.63	0.122	(0.334)	0.063	0.059
191	15.92	0.63	0.122	(0.333)	0.063	0.059
192	16.00	0.63	0.122	(0.331)	0.063	0.059
193	16.08	0.13	0.026	(0.329)	0.013	0.012
194	16.17	0.13	0.026	(0.327)	0.013	0.012
195	16.25	0.13	0.026	(0.326)	0.013	0.012
196	16.33	0.13	0.026	(0.324)	0.013	0.012
197	16.42	0.13	0.026	(0.323)	0.013	0.012
198	16.50	0.13	0.026	(0.321)	0.013	0.012
199	16.58	0.10	0.019	(0.319)	0.010	0.009
200	16.67	0.10	0.019	(0.318)	0.010	0.009
201	16.75	0.10	0.019	(0.316)	0.010	0.009
202	16.83	0.10	0.019	(0.314)	0.010	0.009
203	16.92	0.10	0.019	(0.313)	0.010	0.009
204	17.00	0.10	0.019	(0.311)	0.010	0.009
205	17.08	0.17	0.032	(0.310)	0.017	0.015
206	17.17	0.17	0.032	(0.308)	0.017	0.015
207	17.25	0.17	0.032	(0.307)	0.017	0.015
208	17.33	0.17	0.032	(0.305)	0.017	0.015
209	17.42	0.17	0.032	(0.303)	0.017	0.015
210	17.50	0.17	0.032	(0.302)	0.017	0.015
211	17.58	0.17	0.032	(0.300)	0.017	0.015
212	17.67	0.17	0.032	(0.299)	0.017	0.015
213	17.75	0.17	0.032	(0.297)	0.017	0.015
214	17.83	0.13	0.026	(0.296)	0.013	0.012
215	17.92	0.13	0.026	(0.295)	0.013	0.012
216	18.00	0.13	0.026	(0.293)	0.013	0.012
217	18.08	0.13	0.026	(0.292)	0.013	0.012
218	18.17	0.13	0.026	(0.290)	0.013	0.012
219	18.25	0.13	0.026	(0.289)	0.013	0.012
220	18.33	0.13	0.026	(0.287)	0.013	0.012
221	18.42	0.13	0.026	(0.286)	0.013	0.012
222	18.50	0.13	0.026	(0.285)	0.013	0.012
223	18.58	0.10	0.019	(0.283)	0.010	0.009
224	18.67	0.10	0.019	(0.282)	0.010	0.009
225	18.75	0.10	0.019	(0.280)	0.010	0.009
226	18.83	0.07	0.013	(0.279)	0.007	0.006
227	18.92	0.07	0.013	(0.278)	0.007	0.006
228	19.00	0.07	0.013	(0.276)	0.007	0.006
229	19.08	0.10	0.019	(0.275)	0.010	0.009
230	19.17	0.10	0.019	(0.274)	0.010	0.009
231	19.25	0.10	0.019	(0.273)	0.010	0.009
232	19.33	0.13	0.026	(0.271)	0.013	0.012
233	19.42	0.13	0.026	(0.270)	0.013	0.012
234	19.50	0.13	0.026	(0.269)	0.013	0.012
235	19.58	0.10	0.019	(0.268)	0.010	0.009
236	19.67	0.10	0.019	(0.266)	0.010	0.009
237	19.75	0.10	0.019	(0.265)	0.010	0.009
238	19.83	0.07	0.013	(0.264)	0.007	0.006
239	19.92	0.07	0.013	(0.263)	0.007	0.006
240	20.00	0.07	0.013	(0.262)	0.007	0.006
241	20.08	0.10	0.019	(0.260)	0.010	0.009
242	20.17	0.10	0.019	(0.259)	0.010	0.009
243	20.25	0.10	0.019	(0.258)	0.010	0.009
244	20.33	0.10	0.019	(0.257)	0.010	0.009
245	20.42	0.10	0.019	(0.256)	0.010	0.009
246	20.50	0.10	0.019	(0.255)	0.010	0.009
247	20.58	0.10	0.019	(0.254)	0.010	0.009
248	20.67	0.10	0.019	(0.253)	0.010	0.009
249	20.75	0.10	0.019	(0.252)	0.010	0.009
250	20.83	0.07	0.013	(0.251)	0.007	0.006
251	20.92	0.07	0.013	(0.250)	0.007	0.006
252	21.00	0.07	0.013	(0.249)	0.007	0.006
253	21.08	0.10	0.019	(0.248)	0.010	0.009
254	21.17	0.10	0.019	(0.247)	0.010	0.009
255	21.25	0.10	0.019	(0.246)	0.010	0.009
256	21.33	0.07	0.013	(0.245)	0.007	0.006
257	21.42	0.07	0.013	(0.244)	0.007	0.006

```
258  21.50     0.07      0.013       (  0.243)       0.007        0.006
259  21.58     0.10      0.019       (  0.242)       0.010        0.009
260  21.67     0.10      0.019       (  0.241)       0.010        0.009
261  21.75     0.10      0.019       (  0.240)       0.010        0.009
262  21.83     0.07      0.013       (  0.240)       0.007        0.006
263  21.92     0.07      0.013       (  0.239)       0.007        0.006
264  22.00     0.07      0.013       (  0.238)       0.007        0.006
265  22.08     0.10      0.019       (  0.237)       0.010        0.009
266  22.17     0.10      0.019       (  0.236)       0.010        0.009
267  22.25     0.10      0.019       (  0.236)       0.010        0.009
268  22.33     0.07      0.013       (  0.235)       0.007        0.006
269  22.42     0.07      0.013       (  0.234)       0.007        0.006
270  22.50     0.07      0.013       (  0.233)       0.007        0.006
271  22.58     0.07      0.013       (  0.233)       0.007        0.006
272  22.67     0.07      0.013       (  0.232)       0.007        0.006
273  22.75     0.07      0.013       (  0.231)       0.007        0.006
274  22.83     0.07      0.013       (  0.231)       0.007        0.006
275  22.92     0.07      0.013       (  0.230)       0.007        0.006
276  23.00     0.07      0.013       (  0.230)       0.007        0.006
277  23.08     0.07      0.013       (  0.229)       0.007        0.006
278  23.17     0.07      0.013       (  0.229)       0.007        0.006
279  23.25     0.07      0.013       (  0.228)       0.007        0.006
280  23.33     0.07      0.013       (  0.228)       0.007        0.006
281  23.42     0.07      0.013       (  0.227)       0.007        0.006
282  23.50     0.07      0.013       (  0.227)       0.007        0.006
283  23.58     0.07      0.013       (  0.227)       0.007        0.006
284  23.67     0.07      0.013       (  0.226)       0.007        0.006
285  23.75     0.07      0.013       (  0.226)       0.007        0.006
286  23.83     0.07      0.013       (  0.226)       0.007        0.006
287  23.92     0.07      0.013       (  0.225)       0.007        0.006
288  24.00     0.07      0.013       (  0.225)       0.007        0.006
              (Loss Rate Not Used)
    Sum =     100.0                                  Sum =     9.3
       Flood volume = Effective rainfall      0.77(In)
        times area      60.0(Ac.)/[(In)/(Ft.)] =       3.9(Ac.Ft)
       Total soil loss =      0.83(In)
       Total soil loss =     4.144(Ac.Ft)
       Total rainfall =      1.60(In)
       Flood volume =      167947.7 Cubic Feet
       Total soil loss =      180491.5 Cubic Feet
       ---------------------------------------------------------------------
        Peak flow rate of this hydrograph =      6.334(CFS)
       ---------------------------------------------------------------------
       +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - H O U R    S T O R M
                     R u n o f f      H y d r o g r a p h
       ---------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals ((CFS))

       ---------------------------------------------------------------------
 Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
 ---------------------------------------------------------------------------
   0+ 5       0.0003      0.04  Q         |         |         |         |
   0+10       0.0019      0.24  Q         |         |         |         |
   0+15       0.0041      0.32  VQ        |         |         |         |
   0+20       0.0067      0.37  VQ        |         |         |         |
   0+25       0.0100      0.48  VQ        |         |         |         |
   0+30       0.0136      0.53  V Q       |         |         |         |
   0+35       0.0174      0.55  V Q       |         |         |         |
   0+40       0.0212      0.56  V Q       |         |         |         |
   0+45       0.0250      0.56  V Q       |         |         |         |
   0+50       0.0290      0.58  V Q       |         |         |         |
   0+55       0.0337      0.68  V Q       |         |         |         |
   1+ 0       0.0387      0.72  V Q       |         |         |         |
   1+ 5       0.0436      0.71  V Q       |         |         |         |
   1+10       0.0479      0.62  V Q       |         |         |         |
   1+15       0.0519      0.59  V Q       |         |         |         |
   1+20       0.0558      0.57  V Q       |         |         |         |
   1+25       0.0597      0.56  V Q       |         |         |         |
   1+30       0.0636      0.56  V Q       |         |         |         |
   1+35       0.0674      0.56  V Q       |         |         |         |
   1+40       0.0713      0.56  V Q       |         |         |         |
   1+45       0.0752      0.56  V Q       |         |         |         |
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1+50	0.0792	0.58	V Q	|	|	|	|
1+55	0.0838	0.68	V Q	|	|	|	|
2+ 0	0.0888	0.72	V Q	|	|	|	|
2+ 5	0.0938	0.73	V Q	|	|	|	|
2+10	0.0989	0.74	|VQ	|	|	|	|
2+15	0.1041	0.74	|VQ	|	|	|	|
2+20	0.1092	0.75	|VQ	|	|	|	|
2+25	0.1143	0.75	|VQ	|	|	|	|
2+30	0.1195	0.75	|VQ	|	|	|	|
2+35	0.1248	0.77	|V Q	|	|	|	|
2+40	0.1307	0.87	|V Q	|	|	|	|
2+45	0.1370	0.91	|V Q	|	|	|	|
2+50	0.1433	0.92	|V Q	|	|	|	|
2+55	0.1497	0.93	|V Q	|	|	|	|
3+ 0	0.1561	0.93	|V Q	|	|	|	|
3+ 5	0.1625	0.93	|V Q	|	|	|	|
3+10	0.1690	0.93	|V Q	|	|	|	|
3+15	0.1754	0.93	|V Q	|	|	|	|
3+20	0.1818	0.93	|V Q	|	|	|	|
3+25	0.1882	0.93	|V Q	|	|	|	|
3+30	0.1947	0.93	| VQ	|	|	|	|
3+35	0.2011	0.93	| VQ	|	|	|	|
3+40	0.2075	0.93	| VQ	|	|	|	|
3+45	0.2139	0.93	| VQ	|	|	|	|
3+50	0.2205	0.95	| VQ	|	|	|	|
3+55	0.2278	1.05	| V Q	|	|	|	|
4+ 0	0.2353	1.09	| V Q	|	|	|	|
4+ 5	0.2429	1.11	| V Q	|	|	|	|
4+10	0.2506	1.12	| V Q	|	|	|	|
4+15	0.2583	1.12	| V Q	|	|	|	|
4+20	0.2661	1.14	| V Q	|	|	|	|
4+25	0.2747	1.24	| V Q	|	|	|	|
4+30	0.2835	1.28	| V Q	|	|	|	|
4+35	0.2924	1.29	| V Q	|	|	|	|
4+40	0.3013	1.30	| V Q	|	|	|	|
4+45	0.3103	1.30	| V Q	|	|	|	|
4+50	0.3194	1.33	| V Q	|	|	|	|
4+55	0.3293	1.43	| V Q	|	|	|	|
5+ 0	0.3394	1.46	| V Q	|	|	|	|
5+ 5	0.3493	1.44	| V Q	|	|	|	|
5+10	0.3579	1.25	| V Q	|	|	|	|
5+15	0.3660	1.17	| VQ	|	|	|	|
5+20	0.3740	1.16	| VQ	|	|	|	|
5+25	0.3826	1.25	| VQ	|	|	|	|
5+30	0.3914	1.28	| VQ	|	|	|	|
5+35	0.4005	1.32	| VQ	|	|	|	|
5+40	0.4103	1.42	| VQ	|	|	|	|
5+45	0.4203	1.46	| VQ	|	|	|	|
5+50	0.4305	1.48	| VQ	|	|	|	|
5+55	0.4408	1.49	| VQ	|	|	|	|
6+ 0	0.4510	1.49	| VQ	|	|	|	|
6+ 5	0.4615	1.51	| V Q	|	|	|	|
6+10	0.4726	1.61	| V Q	|	|	|	|
6+15	0.4839	1.65	| VQ	|	|	|	|
6+20	0.4954	1.67	| VQ	|	|	|	|
6+25	0.5070	1.68	| VQ	|	|	|	|
6+30	0.5185	1.68	| VQ	|	|	|	|
6+35	0.5302	1.70	| VQ	|	|	|	|
6+40	0.5426	1.80	| V Q	|	|	|	|
6+45	0.5552	1.84	| V Q	|	|	|	|
6+50	0.5680	1.85	| V Q	|	|	|	|
6+55	0.5808	1.86	| VQ	|	|	|	|
7+ 0	0.5937	1.86	| VQ	|	|	|	|
7+ 5	0.6065	1.87	| VQ	|	|	|	|
7+10	0.6194	1.87	| VQ	|	|	|	|
7+15	0.6322	1.87	| VQ	|	|	|	|
7+20	0.6452	1.89	| VQ	|	|	|	|
7+25	0.6589	1.98	| VQ	|	|	|	|
7+30	0.6728	2.02	| V Q	|	|	|	|
7+35	0.6870	2.06	| VQ	|	|	|	|
7+40	0.7020	2.17	| VQ	|	|	|	|
7+45	0.7172	2.21	| VQ	|	|	|	|
7+50	0.7326	2.25	| VQ	|	|	|	|

7+55	0.7489	2.35	V Q|	|	|	|
8+ 0	0.7654	2.40	V Q|	|	|	|
8+ 5	0.7823	2.45	VQ|	|	|	|
8+10	0.8006	2.66	V Q	|	|	|
8+15	0.8194	2.74	V Q	|	|	|
8+20	0.8386	2.78	V |Q	|	|	|
8+25	0.8578	2.79	V |Q	|	|	|
8+30	0.8770	2.79	V|Q	|	|	|
8+35	0.8964	2.82	V|Q	|	|	|
8+40	0.9165	2.92	V|Q	|	|	|
8+45	0.9369	2.96	V|Q	|	|	|
8+50	0.9575	2.99	V|Q	|	|	|
8+55	0.9789	3.10	V Q	|	|	|
9+ 0	1.0005	3.14	V Q	|	|	|
9+ 5	1.0226	3.20	V Q	|	|	|
9+10	1.0460	3.41	V Q	|	|	|
9+15	1.0700	3.49	|V Q	|	|	|
9+20	1.0944	3.54	|V Q	|	|	|
9+25	1.1196	3.66	|V Q	|	|	|
9+30	1.1451	3.70	|V Q	|	|	|
9+35	1.1708	3.74	| V Q	|	|	|
9+40	1.1973	3.85	| V Q	|	|	|
9+45	1.2241	3.89	| V Q	|	|	|
9+50	1.2511	3.93	| V Q	|	|	|
9+55	1.2789	4.03	| V Q	|	|	|
10+ 0	1.3070	4.08	| V Q	|	|	|
10+ 5	1.3342	3.95	| V Q	|	|	|
10+10	1.3567	3.27	| QV	|	|	|
10+15	1.3773	2.99	|Q V	|	|	|
10+20	1.3971	2.88	|Q V	|	|	|
10+25	1.4166	2.83	|Q V	|	|	|
10+30	1.4360	2.81	|Q V	|	|	|
10+35	1.4560	2.91	|Q V	|	|	|
10+40	1.4794	3.39	| Q V	|	|	|
10+45	1.5042	3.59	| QV	|	|	|
10+50	1.5295	3.67	| QV	|	|	|
10+55	1.5550	3.71	| Q V	|	|	|
11+ 0	1.5806	3.72	| Q V	|	|	|
11+ 5	1.6062	3.71	| Q V	|	|	|
11+10	1.6311	3.61	| Q V	|	|	|
11+15	1.6557	3.57	| Q V	|	|	|
11+20	1.6802	3.56	| Q V	|	|	|
11+25	1.7046	3.55	| Q V	|	|	|
11+30	1.7290	3.55	| Q V	|	|	|
11+35	1.7532	3.51	| Q V	|	|	|
11+40	1.7760	3.31	| Q V	|	|	|
11+45	1.7982	3.23	| Q V	|	|	|
11+50	1.8204	3.22	| Q V	|	|	|
11+55	1.8431	3.30	| Q V|	|	|	|
12+ 0	1.8661	3.34	| Q V|	|	|	|
12+ 5	1.8901	3.49	| Q V|	|	|	|
12+10	1.9189	4.19	| Q V|	|	|	|
12+15	1.9497	4.47	| Q V	|	|	|
12+20	1.9814	4.60	| Q V	|	|	|
12+25	2.0141	4.75	| QV	|	|	|
12+30	2.0473	4.81	| Q|V	|	|	|
12+35	2.0808	4.87	| Q|V	|	|	|
12+40	2.1158	5.09	| QV	|	|	|
12+45	2.1514	5.17	| Q V	|	|	|
12+50	2.1874	5.22	| Q V	|	|	|
12+55	2.2241	5.34	| |Q V	|	|	|
13+ 0	2.2612	5.38	| |Q V	|	|	|
13+ 5	2.2991	5.50	| |Q V	|	|	|
13+10	2.3404	6.00	| | Q	|	|	|
13+15	2.3831	6.20	| | Q	|	|	|
13+20	2.4264	6.29	| | Q	|	|	|
13+25	2.4699	6.32	| | Q	|	|	|
13+30	2.5136	6.33	| | QV	|	|	|
13+35	2.5557	6.12	| | Q V	|	|	|
13+40	2.5904	5.04	| Q V	|	|	|
13+45	2.6221	4.60	| Q | V	|	|	|
13+50	2.6525	4.42	| Q | V	|	|	|
13+55	2.6824	4.34	| Q | V	|	|	|



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  20+ 5       3.7078      0.41  |Q        |         |         |       V |
  20+10       3.7112      0.50  |Q        |         |         |       V |
  20+15       3.7149      0.53  | Q       |         |         |       V |
  20+20       3.7187      0.55  | Q       |         |         |       V |
  20+25       3.7225      0.56  | Q       |         |         |       V |
  20+30       3.7264      0.56  | Q       |         |         |       V |
  20+35       3.7302      0.56  | Q       |         |         |       V |
  20+40       3.7341      0.56  | Q       |         |         |       V |
  20+45       3.7379      0.56  | Q       |         |         |       V |
  20+50       3.7416      0.54  | Q       |         |         |       V |
  20+55       3.7447      0.44  |Q        |         |         |       V |
  21+ 0       3.7474      0.40  |Q        |         |         |       V |
  21+ 5       3.7502      0.41  |Q        |         |         |       V |
  21+10       3.7537      0.50  |Q        |         |         |       V |
  21+15       3.7573      0.53  | Q       |         |         |       V |
  21+20       3.7610      0.53  | Q       |         |         |        V|
  21+25       3.7640      0.44  |Q        |         |         |        V|
  21+30       3.7667      0.40  |Q        |         |         |        V|
  21+35       3.7695      0.40  |Q        |         |         |        V|
  21+40       3.7729      0.50  |Q        |         |         |        V|
  21+45       3.7766      0.53  | Q       |         |         |        V|
  21+50       3.7803      0.53  | Q       |         |         |        V|
  21+55       3.7833      0.44  |Q        |         |         |        V|
  22+ 0       3.7860      0.40  |Q        |         |         |        V|
  22+ 5       3.7888      0.40  |Q        |         |         |        V|
  22+10       3.7922      0.50  |Q        |         |         |        V|
  22+15       3.7959      0.53  | Q       |         |         |        V|
  22+20       3.7995      0.53  | Q       |         |         |        V|
  22+25       3.8025      0.44  |Q        |         |         |        V|
  22+30       3.8053      0.40  |Q        |         |         |        V|
  22+35       3.8079      0.38  |Q        |         |         |        V|
  22+40       3.8105      0.38  |Q        |         |         |        V|
  22+45       3.8131      0.38  |Q        |         |         |        V|
  22+50       3.8157      0.37  |Q        |         |         |        V|
  22+55       3.8183      0.37  |Q        |         |         |        V|
  23+ 0       3.8208      0.37  |Q        |         |         |        V|
  23+ 5       3.8234      0.37  |Q        |         |         |        V|
  23+10       3.8260      0.37  |Q        |         |         |        V|
  23+15       3.8285      0.37  |Q        |         |         |        V|
  23+20       3.8311      0.37  |Q        |         |         |        V|
  23+25       3.8337      0.37  |Q        |         |         |        V|
  23+30       3.8363      0.37  |Q        |         |         |        V|
  23+35       3.8388      0.37  |Q        |         |         |        V|
  23+40       3.8414      0.37  |Q        |         |         |        V|
  23+45       3.8440      0.37  |Q        |         |         |        V|
  23+50       3.8465      0.37  |Q        |         |         |        V|
  23+55       3.8491      0.37  |Q        |         |         |        V|
  24+ 0       3.8517      0.37  |Q        |         |         |        V|
  24+ 5       3.8540      0.33  |Q        |         |         |        V|
  24+10       3.8549      0.14  Q         |         |         |        V|
  24+15       3.8553      0.06  Q         |         |         |        V|
  24+20       3.8554      0.02  Q         |         |         |        V|
  24+25       3.8555      0.01  Q         |         |         |        V|
  24+30       3.8555      0.00  Q         |         |         |        V|
  24+35       3.8555      0.00  Q         |         |         |         V
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U n i t H y d r o g r a p h A n a l y s i s

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Study date 08/06/25 File: P2507A242R242.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 6653

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

 English Units used in output format

ROMOLAND
PROPOSED CONDITION 2-YEAR 24-HOUR STORM
PROJECT SITE DRAINAGE AREA A UNIT HYDROGRAPH ANALYSIS
BY KWC ENGINEERS

Drainage Area = 56.88(Ac.) = 0.089 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 56.88(Ac.) = 0.089 Sq. Mi.
Length along longest watercourse = 2904.00(Ft.)
Length along longest watercourse measured to centroid = 1268.00(Ft.)
Length along longest watercourse = 0.550 Mi.
Length along longest watercourse measured to centroid = 0.240 Mi.
Difference in elevation = 162.70(Ft.)
Slope along watercourse = 295.8182 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time = 0.075 Hr.
Lag time = 4.53 Min.
25% of lag time = 1.13 Min.
40% of lag time = 1.81 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]
56.88	1.60	91.01

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
56.88	4.00	227.52

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 1.600(In)
Area Averaged 100-Year Rainfall = 4.000(In)

Point rain (area averaged) = 1.600(In)
Areal adjustment factor = 99.99 %
Adjusted average point rain = 1.600(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
56.880	68.90	0.480

Total Area Entered = 56.88(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
68.9	49.7	0.575	0.480	0.327	1.000	0.327
					Sum (F) =	0.327

Area averaged mean soil loss (F) (In/Hr) = 0.327
Minimum soil loss rate ((In/Hr)) = 0.163
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.500

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

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	110.446	18.124	10.389
2	0.167	220.892	56.184	32.207
3	0.250	331.338	16.801	9.631
4	0.333	441.784	6.172	3.538
5	0.417	552.230	1.639	0.940
6	0.500	662.676	0.767	0.440
7	0.583	773.122	0.313	0.179
			Sum = 100.000	Sum= 57.324

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

Unit Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.07	0.013	(0.579)	0.006	0.006
2	0.17	0.07	0.013	(0.577)	0.006	0.006
3	0.25	0.07	0.013	(0.575)	0.006	0.006
4	0.33	0.10	0.019	(0.572)	0.010	0.010
5	0.42	0.10	0.019	(0.570)	0.010	0.010
6	0.50	0.10	0.019	(0.568)	0.010	0.010
7	0.58	0.10	0.019	(0.566)	0.010	0.010
8	0.67	0.10	0.019	(0.564)	0.010	0.010
9	0.75	0.10	0.019	(0.561)	0.010	0.010
10	0.83	0.13	0.026	(0.559)	0.013	0.013
11	0.92	0.13	0.026	(0.557)	0.013	0.013
12	1.00	0.13	0.026	(0.555)	0.013	0.013
13	1.08	0.10	0.019	(0.553)	0.010	0.010
14	1.17	0.10	0.019	(0.550)	0.010	0.010
15	1.25	0.10	0.019	(0.548)	0.010	0.010
16	1.33	0.10	0.019	(0.546)	0.010	0.010
17	1.42	0.10	0.019	(0.544)	0.010	0.010
18	1.50	0.10	0.019	(0.542)	0.010	0.010
19	1.58	0.10	0.019	(0.539)	0.010	0.010
20	1.67	0.10	0.019	(0.537)	0.010	0.010
21	1.75	0.10	0.019	(0.535)	0.010	0.010
22	1.83	0.13	0.026	(0.533)	0.013	0.013
23	1.92	0.13	0.026	(0.531)	0.013	0.013
24	2.00	0.13	0.026	(0.529)	0.013	0.013
25	2.08	0.13	0.026	(0.527)	0.013	0.013
26	2.17	0.13	0.026	(0.524)	0.013	0.013
27	2.25	0.13	0.026	(0.522)	0.013	0.013
28	2.33	0.13	0.026	(0.520)	0.013	0.013
29	2.42	0.13	0.026	(0.518)	0.013	0.013
30	2.50	0.13	0.026	(0.516)	0.013	0.013
31	2.58	0.17	0.032	(0.514)	0.016	0.016
32	2.67	0.17	0.032	(0.512)	0.016	0.016
33	2.75	0.17	0.032	(0.510)	0.016	0.016
34	2.83	0.17	0.032	(0.508)	0.016	0.016
35	2.92	0.17	0.032	(0.505)	0.016	0.016
36	3.00	0.17	0.032	(0.503)	0.016	0.016
37	3.08	0.17	0.032	(0.501)	0.016	0.016
38	3.17	0.17	0.032	(0.499)	0.016	0.016
39	3.25	0.17	0.032	(0.497)	0.016	0.016

40	3.33	0.17	0.032	(0.495)	0.016	0.016
41	3.42	0.17	0.032	(0.493)	0.016	0.016
42	3.50	0.17	0.032	(0.491)	0.016	0.016
43	3.58	0.17	0.032	(0.489)	0.016	0.016
44	3.67	0.17	0.032	(0.487)	0.016	0.016
45	3.75	0.17	0.032	(0.485)	0.016	0.016
46	3.83	0.20	0.038	(0.483)	0.019	0.019
47	3.92	0.20	0.038	(0.481)	0.019	0.019
48	4.00	0.20	0.038	(0.479)	0.019	0.019
49	4.08	0.20	0.038	(0.477)	0.019	0.019
50	4.17	0.20	0.038	(0.475)	0.019	0.019
51	4.25	0.20	0.038	(0.473)	0.019	0.019
52	4.33	0.23	0.045	(0.471)	0.022	0.022
53	4.42	0.23	0.045	(0.469)	0.022	0.022
54	4.50	0.23	0.045	(0.467)	0.022	0.022
55	4.58	0.23	0.045	(0.465)	0.022	0.022
56	4.67	0.23	0.045	(0.463)	0.022	0.022
57	4.75	0.23	0.045	(0.461)	0.022	0.022
58	4.83	0.27	0.051	(0.459)	0.026	0.026
59	4.92	0.27	0.051	(0.457)	0.026	0.026
60	5.00	0.27	0.051	(0.455)	0.026	0.026
61	5.08	0.20	0.038	(0.453)	0.019	0.019
62	5.17	0.20	0.038	(0.451)	0.019	0.019
63	5.25	0.20	0.038	(0.449)	0.019	0.019
64	5.33	0.23	0.045	(0.447)	0.022	0.022
65	5.42	0.23	0.045	(0.445)	0.022	0.022
66	5.50	0.23	0.045	(0.443)	0.022	0.022
67	5.58	0.27	0.051	(0.441)	0.026	0.026
68	5.67	0.27	0.051	(0.439)	0.026	0.026
69	5.75	0.27	0.051	(0.437)	0.026	0.026
70	5.83	0.27	0.051	(0.435)	0.026	0.026
71	5.92	0.27	0.051	(0.433)	0.026	0.026
72	6.00	0.27	0.051	(0.431)	0.026	0.026
73	6.08	0.30	0.058	(0.429)	0.029	0.029
74	6.17	0.30	0.058	(0.427)	0.029	0.029
75	6.25	0.30	0.058	(0.425)	0.029	0.029
76	6.33	0.30	0.058	(0.424)	0.029	0.029
77	6.42	0.30	0.058	(0.422)	0.029	0.029
78	6.50	0.30	0.058	(0.420)	0.029	0.029
79	6.58	0.33	0.064	(0.418)	0.032	0.032
80	6.67	0.33	0.064	(0.416)	0.032	0.032
81	6.75	0.33	0.064	(0.414)	0.032	0.032
82	6.83	0.33	0.064	(0.412)	0.032	0.032
83	6.92	0.33	0.064	(0.410)	0.032	0.032
84	7.00	0.33	0.064	(0.409)	0.032	0.032
85	7.08	0.33	0.064	(0.407)	0.032	0.032
86	7.17	0.33	0.064	(0.405)	0.032	0.032
87	7.25	0.33	0.064	(0.403)	0.032	0.032
88	7.33	0.37	0.070	(0.401)	0.035	0.035
89	7.42	0.37	0.070	(0.399)	0.035	0.035
90	7.50	0.37	0.070	(0.397)	0.035	0.035
91	7.58	0.40	0.077	(0.396)	0.038	0.038
92	7.67	0.40	0.077	(0.394)	0.038	0.038
93	7.75	0.40	0.077	(0.392)	0.038	0.038
94	7.83	0.43	0.083	(0.390)	0.042	0.042
95	7.92	0.43	0.083	(0.388)	0.042	0.042
96	8.00	0.43	0.083	(0.387)	0.042	0.042
97	8.08	0.50	0.096	(0.385)	0.048	0.048
98	8.17	0.50	0.096	(0.383)	0.048	0.048
99	8.25	0.50	0.096	(0.381)	0.048	0.048
100	8.33	0.50	0.096	(0.379)	0.048	0.048
101	8.42	0.50	0.096	(0.378)	0.048	0.048
102	8.50	0.50	0.096	(0.376)	0.048	0.048
103	8.58	0.53	0.102	(0.374)	0.051	0.051
104	8.67	0.53	0.102	(0.372)	0.051	0.051
105	8.75	0.53	0.102	(0.371)	0.051	0.051
106	8.83	0.57	0.109	(0.369)	0.054	0.054
107	8.92	0.57	0.109	(0.367)	0.054	0.054
108	9.00	0.57	0.109	(0.365)	0.054	0.054
109	9.08	0.63	0.122	(0.364)	0.061	0.061
110	9.17	0.63	0.122	(0.362)	0.061	0.061
111	9.25	0.63	0.122	(0.360)	0.061	0.061
112	9.33	0.67	0.128	(0.359)	0.064	0.064

113	9.42	0.67	0.128	(0.357)	0.064	0.064
114	9.50	0.67	0.128	(0.355)	0.064	0.064
115	9.58	0.70	0.134	(0.353)	0.067	0.067
116	9.67	0.70	0.134	(0.352)	0.067	0.067
117	9.75	0.70	0.134	(0.350)	0.067	0.067
118	9.83	0.73	0.141	(0.348)	0.070	0.070
119	9.92	0.73	0.141	(0.347)	0.070	0.070
120	10.00	0.73	0.141	(0.345)	0.070	0.070
121	10.08	0.50	0.096	(0.343)	0.048	0.048
122	10.17	0.50	0.096	(0.342)	0.048	0.048
123	10.25	0.50	0.096	(0.340)	0.048	0.048
124	10.33	0.50	0.096	(0.338)	0.048	0.048
125	10.42	0.50	0.096	(0.337)	0.048	0.048
126	10.50	0.50	0.096	(0.335)	0.048	0.048
127	10.58	0.67	0.128	(0.333)	0.064	0.064
128	10.67	0.67	0.128	(0.332)	0.064	0.064
129	10.75	0.67	0.128	(0.330)	0.064	0.064
130	10.83	0.67	0.128	(0.329)	0.064	0.064
131	10.92	0.67	0.128	(0.327)	0.064	0.064
132	11.00	0.67	0.128	(0.325)	0.064	0.064
133	11.08	0.63	0.122	(0.324)	0.061	0.061
134	11.17	0.63	0.122	(0.322)	0.061	0.061
135	11.25	0.63	0.122	(0.321)	0.061	0.061
136	11.33	0.63	0.122	(0.319)	0.061	0.061
137	11.42	0.63	0.122	(0.317)	0.061	0.061
138	11.50	0.63	0.122	(0.316)	0.061	0.061
139	11.58	0.57	0.109	(0.314)	0.054	0.054
140	11.67	0.57	0.109	(0.313)	0.054	0.054
141	11.75	0.57	0.109	(0.311)	0.054	0.054
142	11.83	0.60	0.115	(0.310)	0.058	0.058
143	11.92	0.60	0.115	(0.308)	0.058	0.058
144	12.00	0.60	0.115	(0.306)	0.058	0.058
145	12.08	0.83	0.160	(0.305)	0.080	0.080
146	12.17	0.83	0.160	(0.303)	0.080	0.080
147	12.25	0.83	0.160	(0.302)	0.080	0.080
148	12.33	0.87	0.166	(0.300)	0.083	0.083
149	12.42	0.87	0.166	(0.299)	0.083	0.083
150	12.50	0.87	0.166	(0.297)	0.083	0.083
151	12.58	0.93	0.179	(0.296)	0.090	0.090
152	12.67	0.93	0.179	(0.294)	0.090	0.090
153	12.75	0.93	0.179	(0.293)	0.090	0.090
154	12.83	0.97	0.186	(0.291)	0.093	0.093
155	12.92	0.97	0.186	(0.290)	0.093	0.093
156	13.00	0.97	0.186	(0.288)	0.093	0.093
157	13.08	1.13	0.218	(0.287)	0.109	0.109
158	13.17	1.13	0.218	(0.286)	0.109	0.109
159	13.25	1.13	0.218	(0.284)	0.109	0.109
160	13.33	1.13	0.218	(0.283)	0.109	0.109
161	13.42	1.13	0.218	(0.281)	0.109	0.109
162	13.50	1.13	0.218	(0.280)	0.109	0.109
163	13.58	0.77	0.147	(0.278)	0.074	0.074
164	13.67	0.77	0.147	(0.277)	0.074	0.074
165	13.75	0.77	0.147	(0.276)	0.074	0.074
166	13.83	0.77	0.147	(0.274)	0.074	0.074
167	13.92	0.77	0.147	(0.273)	0.074	0.074
168	14.00	0.77	0.147	(0.271)	0.074	0.074
169	14.08	0.90	0.173	(0.270)	0.086	0.086
170	14.17	0.90	0.173	(0.269)	0.086	0.086
171	14.25	0.90	0.173	(0.267)	0.086	0.086
172	14.33	0.87	0.166	(0.266)	0.083	0.083
173	14.42	0.87	0.166	(0.264)	0.083	0.083
174	14.50	0.87	0.166	(0.263)	0.083	0.083
175	14.58	0.87	0.166	(0.262)	0.083	0.083
176	14.67	0.87	0.166	(0.260)	0.083	0.083
177	14.75	0.87	0.166	(0.259)	0.083	0.083
178	14.83	0.83	0.160	(0.258)	0.080	0.080
179	14.92	0.83	0.160	(0.256)	0.080	0.080
180	15.00	0.83	0.160	(0.255)	0.080	0.080
181	15.08	0.80	0.154	(0.254)	0.077	0.077
182	15.17	0.80	0.154	(0.253)	0.077	0.077
183	15.25	0.80	0.154	(0.251)	0.077	0.077
184	15.33	0.77	0.147	(0.250)	0.074	0.074
185	15.42	0.77	0.147	(0.249)	0.074	0.074

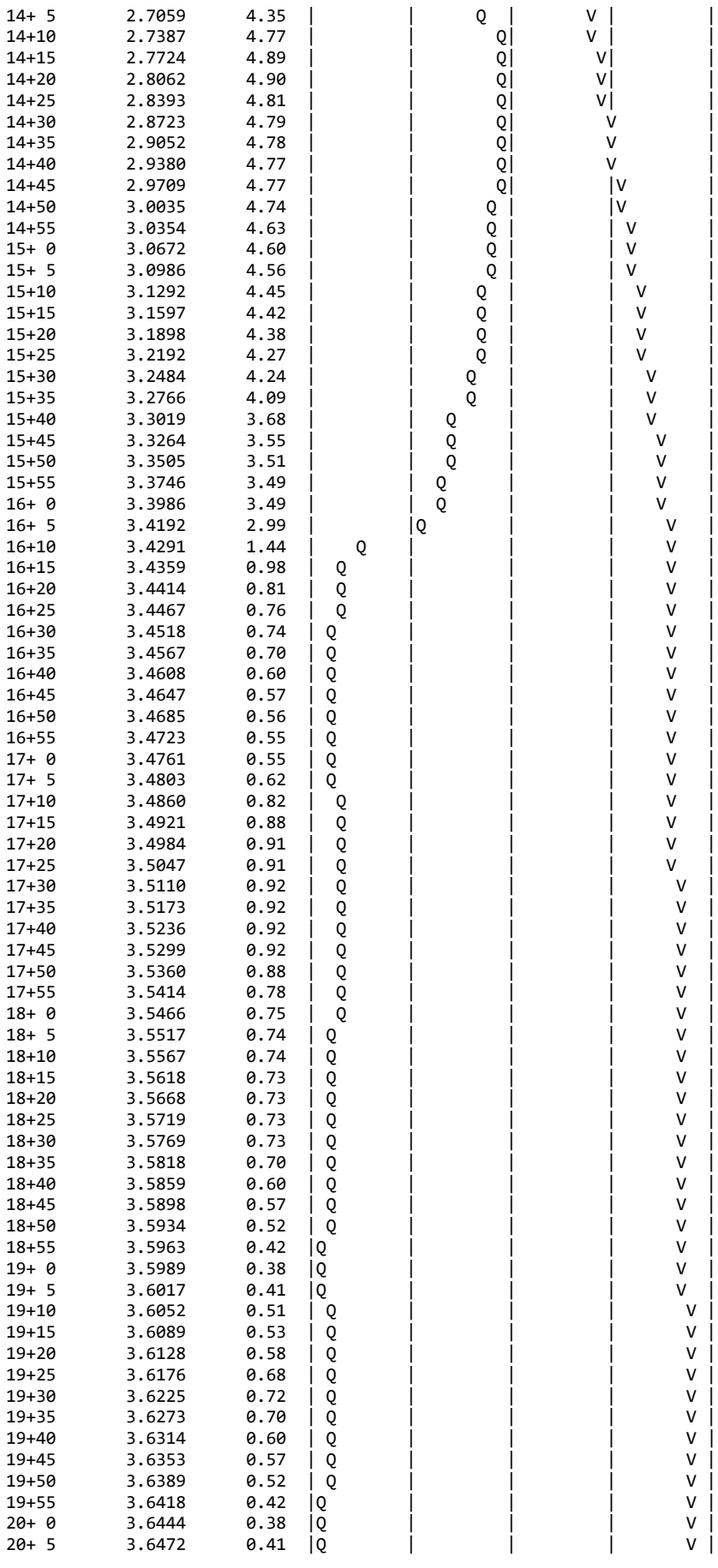
186	15.50	0.77	0.147	(0.247)	0.074	0.074
187	15.58	0.63	0.122	(0.246)	0.061	0.061
188	15.67	0.63	0.122	(0.245)	0.061	0.061
189	15.75	0.63	0.122	(0.244)	0.061	0.061
190	15.83	0.63	0.122	(0.242)	0.061	0.061
191	15.92	0.63	0.122	(0.241)	0.061	0.061
192	16.00	0.63	0.122	(0.240)	0.061	0.061
193	16.08	0.13	0.026	(0.239)	0.013	0.013
194	16.17	0.13	0.026	(0.237)	0.013	0.013
195	16.25	0.13	0.026	(0.236)	0.013	0.013
196	16.33	0.13	0.026	(0.235)	0.013	0.013
197	16.42	0.13	0.026	(0.234)	0.013	0.013
198	16.50	0.13	0.026	(0.233)	0.013	0.013
199	16.58	0.10	0.019	(0.231)	0.010	0.010
200	16.67	0.10	0.019	(0.230)	0.010	0.010
201	16.75	0.10	0.019	(0.229)	0.010	0.010
202	16.83	0.10	0.019	(0.228)	0.010	0.010
203	16.92	0.10	0.019	(0.227)	0.010	0.010
204	17.00	0.10	0.019	(0.226)	0.010	0.010
205	17.08	0.17	0.032	(0.225)	0.016	0.016
206	17.17	0.17	0.032	(0.223)	0.016	0.016
207	17.25	0.17	0.032	(0.222)	0.016	0.016
208	17.33	0.17	0.032	(0.221)	0.016	0.016
209	17.42	0.17	0.032	(0.220)	0.016	0.016
210	17.50	0.17	0.032	(0.219)	0.016	0.016
211	17.58	0.17	0.032	(0.218)	0.016	0.016
212	17.67	0.17	0.032	(0.217)	0.016	0.016
213	17.75	0.17	0.032	(0.216)	0.016	0.016
214	17.83	0.13	0.026	(0.215)	0.013	0.013
215	17.92	0.13	0.026	(0.214)	0.013	0.013
216	18.00	0.13	0.026	(0.212)	0.013	0.013
217	18.08	0.13	0.026	(0.211)	0.013	0.013
218	18.17	0.13	0.026	(0.210)	0.013	0.013
219	18.25	0.13	0.026	(0.209)	0.013	0.013
220	18.33	0.13	0.026	(0.208)	0.013	0.013
221	18.42	0.13	0.026	(0.207)	0.013	0.013
222	18.50	0.13	0.026	(0.206)	0.013	0.013
223	18.58	0.10	0.019	(0.205)	0.010	0.010
224	18.67	0.10	0.019	(0.204)	0.010	0.010
225	18.75	0.10	0.019	(0.203)	0.010	0.010
226	18.83	0.07	0.013	(0.202)	0.006	0.006
227	18.92	0.07	0.013	(0.201)	0.006	0.006
228	19.00	0.07	0.013	(0.200)	0.006	0.006
229	19.08	0.10	0.019	(0.200)	0.010	0.010
230	19.17	0.10	0.019	(0.199)	0.010	0.010
231	19.25	0.10	0.019	(0.198)	0.010	0.010
232	19.33	0.13	0.026	(0.197)	0.013	0.013
233	19.42	0.13	0.026	(0.196)	0.013	0.013
234	19.50	0.13	0.026	(0.195)	0.013	0.013
235	19.58	0.10	0.019	(0.194)	0.010	0.010
236	19.67	0.10	0.019	(0.193)	0.010	0.010
237	19.75	0.10	0.019	(0.192)	0.010	0.010
238	19.83	0.07	0.013	(0.191)	0.006	0.006
239	19.92	0.07	0.013	(0.191)	0.006	0.006
240	20.00	0.07	0.013	(0.190)	0.006	0.006
241	20.08	0.10	0.019	(0.189)	0.010	0.010
242	20.17	0.10	0.019	(0.188)	0.010	0.010
243	20.25	0.10	0.019	(0.187)	0.010	0.010
244	20.33	0.10	0.019	(0.186)	0.010	0.010
245	20.42	0.10	0.019	(0.186)	0.010	0.010
246	20.50	0.10	0.019	(0.185)	0.010	0.010
247	20.58	0.10	0.019	(0.184)	0.010	0.010
248	20.67	0.10	0.019	(0.183)	0.010	0.010
249	20.75	0.10	0.019	(0.183)	0.010	0.010
250	20.83	0.07	0.013	(0.182)	0.006	0.006
251	20.92	0.07	0.013	(0.181)	0.006	0.006
252	21.00	0.07	0.013	(0.180)	0.006	0.006
253	21.08	0.10	0.019	(0.180)	0.010	0.010
254	21.17	0.10	0.019	(0.179)	0.010	0.010
255	21.25	0.10	0.019	(0.178)	0.010	0.010
256	21.33	0.07	0.013	(0.178)	0.006	0.006
257	21.42	0.07	0.013	(0.177)	0.006	0.006
258	21.50	0.07	0.013	(0.176)	0.006	0.006

```
259  21.58     0.10      0.019       (  0.176)       0.010        0.010
260  21.67     0.10      0.019       (  0.175)       0.010        0.010
261  21.75     0.10      0.019       (  0.174)       0.010        0.010
262  21.83     0.07      0.013       (  0.174)       0.006        0.006
263  21.92     0.07      0.013       (  0.173)       0.006        0.006
264  22.00     0.07      0.013       (  0.172)       0.006        0.006
265  22.08     0.10      0.019       (  0.172)       0.010        0.010
266  22.17     0.10      0.019       (  0.171)       0.010        0.010
267  22.25     0.10      0.019       (  0.171)       0.010        0.010
268  22.33     0.07      0.013       (  0.170)       0.006        0.006
269  22.42     0.07      0.013       (  0.170)       0.006        0.006
270  22.50     0.07      0.013       (  0.169)       0.006        0.006
271  22.58     0.07      0.013       (  0.169)       0.006        0.006
272  22.67     0.07      0.013       (  0.168)       0.006        0.006
273  22.75     0.07      0.013       (  0.168)       0.006        0.006
274  22.83     0.07      0.013       (  0.167)       0.006        0.006
275  22.92     0.07      0.013       (  0.167)       0.006        0.006
276  23.00     0.07      0.013       (  0.167)       0.006        0.006
277  23.08     0.07      0.013       (  0.166)       0.006        0.006
278  23.17     0.07      0.013       (  0.166)       0.006        0.006
279  23.25     0.07      0.013       (  0.165)       0.006        0.006
280  23.33     0.07      0.013       (  0.165)       0.006        0.006
281  23.42     0.07      0.013       (  0.165)       0.006        0.006
282  23.50     0.07      0.013       (  0.165)       0.006        0.006
283  23.58     0.07      0.013       (  0.164)       0.006        0.006
284  23.67     0.07      0.013       (  0.164)       0.006        0.006
285  23.75     0.07      0.013       (  0.164)       0.006        0.006
286  23.83     0.07      0.013       (  0.164)       0.006        0.006
287  23.92     0.07      0.013       (  0.163)       0.006        0.006
288  24.00     0.07      0.013       (  0.163)       0.006        0.006
              (Loss Rate Not Used)
    Sum =     100.0                                  Sum =     9.6
       Flood volume = Effective rainfall      0.80(In)
        times area      56.9(Ac.)/[(In)/(Ft.)] =       3.8(Ac.Ft)
       Total soil loss =      0.80(In)
       Total soil loss =     3.792(Ac.Ft)
       Total rainfall =      1.60(In)
       Flood volume =      165161.2 Cubic Feet
       Total soil loss =      165161.2 Cubic Feet
       ---------------------------------------------------------------------
        Peak flow rate of this hydrograph =      6.237(CFS)
       ---------------------------------------------------------------------
       +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                           24 - H O U R    S T O R M
                      R u n o f f      H y d r o g r a p h
       ---------------------------------------------------------------------
                   Hydrograph in   5   Minute intervals ((CFS))

       ---------------------------------------------------------------------
 Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
 ---------------------------------------------------------------------------
   0+ 5       0.0005      0.07  Q         |         |         |         |
   0+10       0.0023      0.27  VQ        |         |         |         |
   0+15       0.0046      0.33  VQ        |         |         |         |
   0+20       0.0073      0.39  VQ        |         |         |         |
   0+25       0.0108      0.50  VQ        |         |         |         |
   0+30       0.0144      0.53  V Q       |         |         |         |
   0+35       0.0182      0.55  V Q       |         |         |         |
   0+40       0.0220      0.55  V Q       |         |         |         |
   0+45       0.0258      0.55  V Q       |         |         |         |
   0+50       0.0298      0.58  V Q       |         |         |         |
   0+55       0.0345      0.69  V Q       |         |         |         |
   1+ 0       0.0395      0.72  V Q       |         |         |         |
   1+ 5       0.0442      0.70  V Q       |         |         |         |
   1+10       0.0484      0.60  V Q       |         |         |         |
   1+15       0.0523      0.57  V Q       |         |         |         |
   1+20       0.0561      0.56  V Q       |         |         |         |
   1+25       0.0599      0.55  V Q       |         |         |         |
   1+30       0.0637      0.55  V Q       |         |         |         |
   1+35       0.0675      0.55  V Q       |         |         |         |
   1+40       0.0713      0.55  V Q       |         |         |         |
   1+45       0.0751      0.55  V Q       |         |         |         |
   1+50       0.0791      0.58  V Q       |         |         |         |
```

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1+55       0.0838      0.69  V Q       |         |         |         |
2+ 0       0.0887      0.72  V Q       |         |         |         |
2+ 5       0.0938      0.73  V Q       |         |         |         |
2+10       0.0988      0.73  |VQ       |         |         |         |
2+15       0.1039      0.73  |VQ       |         |         |         |
2+20       0.1089      0.73  |VQ       |         |         |         |
2+25       0.1140      0.73  |VQ       |         |         |         |
2+30       0.1190      0.73  |VQ       |         |         |         |
2+35       0.1243      0.77  |V Q      |         |         |         |
2+40       0.1303      0.87  |V Q      |         |         |         |
2+45       0.1365      0.90  |V Q      |         |         |         |
2+50       0.1428      0.91  |V Q      |         |         |         |
2+55       0.1491      0.92  |V Q      |         |         |         |
3+ 0       0.1554      0.92  |V Q      |         |         |         |
3+ 5       0.1617      0.92  |V Q      |         |         |         |
3+10       0.1681      0.92  |V Q      |         |         |         |
3+15       0.1744      0.92  |V Q      |         |         |         |
3+20       0.1807      0.92  |V Q      |         |         |         |
3+25       0.1870      0.92  |V Q      |         |         |         |
3+30       0.1933      0.92  | VQ      |         |         |         |
3+35       0.1997      0.92  | VQ      |         |         |         |
3+40       0.2060      0.92  | VQ      |         |         |         |
3+45       0.2123      0.92  | VQ      |         |         |         |
3+50       0.2188      0.95  | VQ      |         |         |         |
3+55       0.2261      1.05  | V Q     |         |         |         |
4+ 0       0.2336      1.08  | V Q     |         |         |         |
4+ 5       0.2411      1.10  | V Q     |         |         |         |
4+10       0.2487      1.10  | V Q     |         |         |         |
4+15       0.2563      1.10  | V Q     |         |         |         |
4+20       0.2641      1.13  | V Q     |         |         |         |
4+25       0.2726      1.24  | V Q     |         |         |         |
4+30       0.2813      1.27  | V  Q    |         |         |         |
4+35       0.2901      1.28  |  V Q    |         |         |         |
4+40       0.2990      1.28  |  V Q    |         |         |         |
4+45       0.3078      1.28  |  V Q    |         |         |         |
4+50       0.3169      1.32  |  V Q    |         |         |         |
4+55       0.3267      1.42  |  V Q    |         |         |         |
5+ 0       0.3367      1.45  |  V Q    |         |         |         |
5+ 5       0.3463      1.40  |  V Q    |         |         |         |
5+10       0.3545      1.19  |  VQ     |         |         |         |
5+15       0.3623      1.13  |  VQ     |         |         |         |
5+20       0.3702      1.14  |  VQ     |         |         |         |
5+25       0.3788      1.24  |  VQ     |         |         |         |
5+30       0.3875      1.27  |   VQ    |         |         |         |
5+35       0.3965      1.31  |   VQ    |         |         |         |
5+40       0.4063      1.42  |   VQ    |         |         |         |
5+45       0.4163      1.45  |   VQ    |         |         |         |
5+50       0.4264      1.46  |   VQ    |         |         |         |
5+55       0.4365      1.47  |   VQ    |         |         |         |
6+ 0       0.4466      1.47  |   VQ    |         |         |         |
6+ 5       0.4569      1.50  |   V Q   |         |         |         |
6+10       0.4680      1.60  |   V Q   |         |         |         |
6+15       0.4792      1.64  |    VQ   |         |         |         |
6+20       0.4906      1.65  |    VQ   |         |         |         |
6+25       0.5019      1.65  |    VQ   |         |         |         |
6+30       0.5133      1.65  |    VQ   |         |         |         |
6+35       0.5249      1.68  |    VQ   |         |         |         |
6+40       0.5372      1.79  |    V Q  |         |         |         |
6+45       0.5498      1.82  |    V Q  |         |         |         |
6+50       0.5624      1.83  |    V Q  |         |         |         |
6+55       0.5750      1.83  |     VQ  |         |         |         |
7+ 0       0.5876      1.83  |     VQ  |         |         |         |
7+ 5       0.6003      1.84  |     VQ  |         |         |         |
7+10       0.6129      1.84  |     VQ  |         |         |         |
7+15       0.6255      1.84  |     VQ  |         |         |         |
7+20       0.6384      1.87  |     VQ  |         |         |         |
7+25       0.6520      1.97  |     VQ  |         |         |         |
7+30       0.6658      2.00  |      VQ |         |         |         |
7+35       0.6799      2.05  |      VQ |         |         |         |
7+40       0.6947      2.15  |      VQ |         |         |         |
7+45       0.7097      2.19  |      VQ |         |         |         |
7+50       0.7251      2.23  |      VQ |         |         |         |
7+55       0.7412      2.34  |      V Q|         |         |         |
```

8+ 0	0.7575	2.37	V Q|				
8+ 5	0.7744	2.45	VQ|				
8+10	0.7927	2.66	V Q				
8+15	0.8114	2.72	V Q				
8+20	0.8303	2.74	V Q				
8+25	0.8492	2.75	V Q				
8+30	0.8682	2.75	V|Q				
8+35	0.8874	2.79	V|Q				
8+40	0.9072	2.89	V|Q				
8+45	0.9274	2.92	V|Q				
8+50	0.9478	2.96	V|Q				
8+55	0.9689	3.07	V Q				
9+ 0	0.9903	3.10	V Q				
9+ 5	1.0122	3.18	V Q				
9+10	1.0355	3.39	V Q				
9+15	1.0593	3.45	|V Q				
9+20	1.0835	3.51	|V Q				
9+25	1.1084	3.62	|V Q				
9+30	1.1336	3.65	|V Q				
9+35	1.1591	3.70	| V Q				
9+40	1.1853	3.80	| V Q				
9+45	1.2117	3.84	| V Q				
9+50	1.2384	3.88	| V Q				
9+55	1.2659	3.99	| V Q				
10+ 0	1.2936	4.02	| V Q				
10+ 5	1.3197	3.80	| V Q				
10+10	1.3410	3.08	| Q V				
10+15	1.3607	2.87	|Q V				
10+20	1.3799	2.79	|Q V				
10+25	1.3990	2.77	|Q V				
10+30	1.4179	2.76	|Q V				
10+35	1.4380	2.92	|Q V				
10+40	1.4617	3.43	| Q V				
10+45	1.4864	3.59	| QV				
10+50	1.5115	3.65	| QV				
10+55	1.5367	3.66	| Q V				
11+ 0	1.5620	3.67	| Q V				
11+ 5	1.5870	3.64	| Q V				
11+10	1.6114	3.53	| Q V				
11+15	1.6355	3.50	| Q V				
11+20	1.6595	3.49	| Q V				
11+25	1.6836	3.49	| Q V				
11+30	1.7076	3.49	| Q V				
11+35	1.7311	3.42	| Q V				
11+40	1.7533	3.21	| Q V				
11+45	1.7750	3.15	| Q V				
11+50	1.7968	3.16	| Q V				
11+55	1.8192	3.26	| Q V|				
12+ 0	1.8419	3.29	| Q V|				
12+ 5	1.8662	3.53	| Q V|				
12+10	1.8955	4.26	| Q V|				
12+15	1.9263	4.47	| Q V				
12+20	1.9579	4.59	| Q V				
12+25	1.9903	4.71	| Q V				
12+30	2.0231	4.75	| Q|V				
12+35	2.0563	4.83	| Q|V				
12+40	2.0911	5.04	| Q V				
12+45	2.1262	5.11	| Q V				
12+50	2.1618	5.16	| Q V				
12+55	2.1981	5.27	| |Q V				
13+ 0	2.2346	5.30	| |Q V				
13+ 5	2.2724	5.48	| |Q V				
13+10	2.3137	6.00	| | Q				
13+15	2.3561	6.16	| | Q				
13+20	2.3989	6.21	| | QV				
13+25	2.4418	6.23	| | QV				
13+30	2.4848	6.24	| | Q V				
13+35	2.5252	5.87	| | Q V				
13+40	2.5578	4.74	| Q | V				
13+45	2.5882	4.40	| Q | V				
13+50	2.6176	4.28	| Q | V				
13+55	2.6468	4.24	| Q | V				
14+ 0	2.6759	4.23	| Q | V				



20+10	3.6507	0.51	Q			V
20+15	3.6544	0.53	Q			V
20+20	3.6581	0.55	Q			V
20+25	3.6619	0.55	Q			V
20+30	3.6657	0.55	Q			V
20+35	3.6695	0.55	Q			V
20+40	3.6733	0.55	Q			V
20+45	3.6771	0.55	Q			V
20+50	3.6806	0.52	Q			V
20+55	3.6835	0.41	Q			V
21+ 0	3.6861	0.38	Q			V
21+ 5	3.6889	0.41	Q			V
21+10	3.6924	0.51	Q			V
21+15	3.6961	0.53	Q			V
21+20	3.6996	0.51	Q			V
21+25	3.7024	0.41	Q			V
21+30	3.7051	0.38	Q			V
21+35	3.7079	0.41	Q			V
21+40	3.7113	0.51	Q			V
21+45	3.7150	0.53	Q			V
21+50	3.7185	0.51	Q			V
21+55	3.7214	0.41	Q			V
22+ 0	3.7240	0.38	Q			V
22+ 5	3.7268	0.41	Q			V
22+10	3.7303	0.51	Q			V
22+15	3.7340	0.53	Q			V
22+20	3.7375	0.51	Q			V
22+25	3.7403	0.41	Q			V
22+30	3.7430	0.38	Q			V
22+35	3.7455	0.37	Q			V
22+40	3.7481	0.37	Q			V
22+45	3.7506	0.37	Q			V
22+50	3.7531	0.37	Q			V
22+55	3.7557	0.37	Q			V
23+ 0	3.7582	0.37	Q			V
23+ 5	3.7607	0.37	Q			V
23+10	3.7633	0.37	Q			V
23+15	3.7658	0.37	Q			V
23+20	3.7683	0.37	Q			V
23+25	3.7708	0.37	Q			V
23+30	3.7734	0.37	Q			V
23+35	3.7759	0.37	Q			V
23+40	3.7784	0.37	Q			V
23+45	3.7809	0.37	Q			V
23+50	3.7835	0.37	Q			V
23+55	3.7860	0.37	Q			V
24+ 0	3.7885	0.37	Q			V
24+ 5	3.7906	0.30	Q			V
24+10	3.7913	0.09	Q			V
24+15	3.7915	0.03	Q			V
24+20	3.7915	0.01	Q			V
24+25	3.7916	0.00	Q			V
24+30	3.7916	0.00	Q			V

Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

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

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

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

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

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

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

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

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

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

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

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❑ M. **Loading Docks**	❑ **Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer.** ❑ **Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation.** ❑ **Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.**		❑ **Move loaded and unloaded items indoors as soon as possible.** ❑ **See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

Appendix 9: O&M

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

To be provided in Final WQMP

Appendix 10: Educational Materials

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

Bioretention

TC-32



Design Considerations

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

Description

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

Targeted Constituents

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

Legend ***(Removal Effectiveness)***

- ● Low
- ■ High
- ▲ Medium

California Experience

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

Advantages

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

Limitations

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

CASQA California Stormwater Quality Association

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

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

Design and Sizing Guidelines

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

Construction/Inspection Considerations

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

Performance

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

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

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

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

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

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

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

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

Siting Criteria

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

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

Additional Design Guidelines

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

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

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

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

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

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

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

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

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

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

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

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

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

Maintenance

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

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

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

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

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

Cost

Construction Cost

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

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

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

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

Maintenance Cost

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

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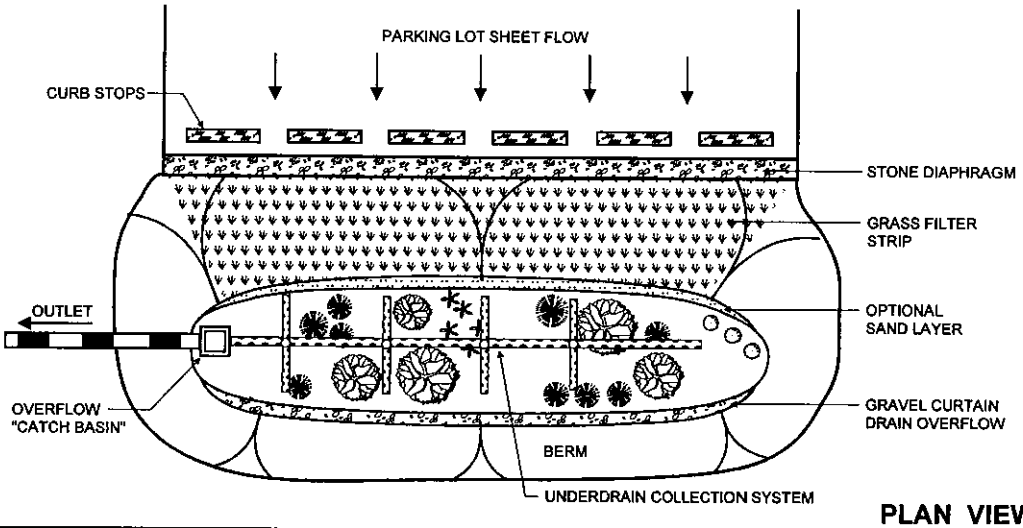
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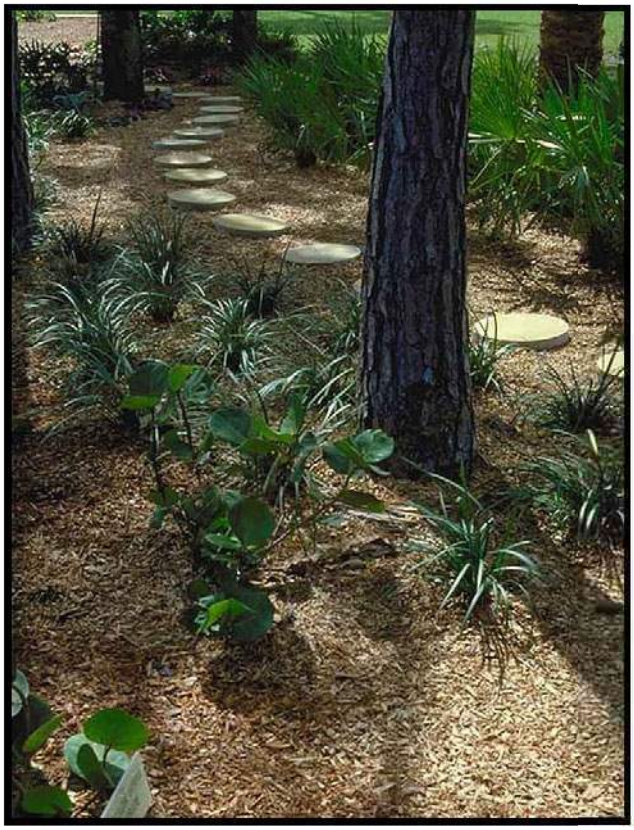
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Schematic of a Bioretention Facility (MDE, 2000)

Site Design & Landscape Planning SD-10



Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

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Designing New Installations

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

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

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

Conserve Natural Areas during Landscape Planning

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

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

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

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

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

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

Protection of Slopes and Channels during Landscape Design

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

Redeveloping Existing Installations

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

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

Other Resources

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

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

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

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

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

Efficient Irrigation SD-12



Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

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

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

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

Redeveloping Existing Installations

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

Other Resources

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

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

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

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

Storm Drain Signage SD-13



Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

Designing New Installations

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

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

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

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

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Placement

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

Supplemental Information

Examples

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

Other Resources

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

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

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

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

Street Sweeping and Vacuuming SE-7



Categories

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Objective**
☒ **Secondary Objective**

Targeted Constituents

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

Potential Alternatives

None

Description and Purpose

Street sweeping and vacuuming includes use of self-propelled and walk-behind equipment to remove sediment from streets and roadways, and to clean paved surfaces in preparation for final paving. Sweeping and vacuuming prevents sediment from the project site from entering storm drains or receiving waters.

Suitable Applications

Sweeping and vacuuming are suitable anywhere sediment is tracked from the project site onto public or private paved streets and roads, typically at points of egress. Sweeping and vacuuming are also applicable during preparation of paved surfaces for final paving.

Limitations

Sweeping and vacuuming may not be effective when sediment is wet or when tracked soil is caked (caked soil may need to be scraped loose).

Implementation

- Controlling the number of points where vehicles can leave the site will allow sweeping and vacuuming efforts to be focused, and perhaps save money.
- Inspect potential sediment tracking locations daily.
- Visible sediment tracking should be swept or vacuumed on a daily basis.

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Do not use kick brooms or sweeper attachments. These tend to spread the dirt rather than remove it.
- If not mixed with debris or trash, consider incorporating the removed sediment back into the project

Costs

Rental rates for self-propelled sweepers vary depending on hopper size and duration of rental. Expect rental rates from $58/hour (3 yd^3 hopper) to $88/hour (9 yd^3 hopper), plus operator costs. Hourly production rates vary with the amount of area to be swept and amount of sediment. Match the hopper size to the area and expect sediment load to minimize time spent dumping.

Inspection and Maintenance

- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- When actively in use, points of ingress and egress must be inspected daily.
- When tracked or spilled sediment is observed outside the construction limits, it must be removed at least daily. More frequent removal, even continuous removal, may be required in some jurisdictions.
- Be careful not to sweep up any unknown substance or any object that may be potentially hazardous.
- Adjust brooms frequently; maximize efficiency of sweeping operations.
- After sweeping is finished, properly dispose of sweeper wastes at an approved dumpsite.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Labor Surcharge and Equipment Rental Rates, State of California Department of Transportation (Caltrans), April 1, 2002 – March 31, 2003.

Water-Efficient Landscaping:



Preventing Pollution & Using Resources Wisely

A Message from the Administrator



Christine Todd Whitman

I believe water is the biggest environmental issue we face in the 21st Century in terms of both quality and quantity. In the 30 years since its passage, the Clean Water Act has dramatically increased the number of waterways that are once again safe for fishing and swimming. Despite this great progress in reducing water pollution, many of the nation's waters still do not meet water quality goals. I challenge you to join with me to finish the business of restoring and protecting our nation's waters for present and future generations.

United States Environmental Protection Agency
Office of Water (4204M)
EPA832-F-02-002
September 2002
www.epa.gov/owm/water-efficiency/index.htm



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What is Water-efficient Landscaping?

Water, many agree, is our most precious natural resource; without it, life ceases. Yet judging by our water use and consumption practices, many of us in the United States seem to take it for granted. A typical household uses approximately 260 gallons of water per day. "Water conscious" individuals often install high-efficiency shower heads and toilets and wash only full loads of clothes and dishes to reduce consumption. But in the summer, the amount of water used outdoors by a household can exceed the amount used for all other purposes in the entire year. This is especially true in hot, dry climates.

Gardening and lawn care account for the majority of this seasonal increase, but other outdoor activities, such as washing cars and filling swimming pools, also contribute. According to the U.S. Geological Survey, of the 26 billion gallons of water consumed daily in the United States[1], approximately 7.8 billion gallons, or 30 percent[2], is devoted to outdoor uses. The majority of this is used for landscaping. In fact, it is estimated that the typical suburban lawn consumes 10,000 gallons of water above and beyond rainwater each year (Vickers, p 140).

Many mistakenly believe that stunning gardens and beautiful lawns are only possible through extensive watering, fertilization, and pesticide application. As this booklet will demonstrate, eye-catching gardens and landscapes that save water, prevent pollution, and protect the environment are, in fact, easily achieved by employing water-efficient landscaping. Water-efficient landscaping produces attractive landscapes because it utilizes designs and plants suited to local conditions.

This booklet describes the benefits of water-efficient landscaping. It includes several examples of successful projects and programs, as well as contacts, references, and a short bibliography. For specific information about how to best apply water-efficient landscaping principles to your geographical area, consult with your county extension service and local garden and nursery centers. Local governments and water utilities also possess a wealth of information and suggestions for using water more efficiently in all aspects of your life, including landscaping.



Xeriscape garden at Denver Water

1 W.B. Solley, R.R. Pierce, and H.A. Perlman. 1998. *Estimated Use of Water in the United States in 1995* (USGS Circular 1200). USGS. Reston, VA. p.27.

2 Amy Vickers. 2001. *Handbook of Water Use and Conservation*. WaterPlow Press. Amherst, MA. p. 140.



Xeriscaped front yard in Colorado Springs

Many terms and schools of thought have been used to describe approaches to water-efficient landscaping. Some examples include "water-wise," "water-smart," "low-water," and "natural landscaping." While each of these terms varies in philosophy and approach, they are all based on the same principles and are commonly used interchangeably. One of the first conceptual approaches developed to formalize these principles is known as "Xeriscape[3] landscaping." Xeriscape landscaping is defined as "quality landscaping that conserves water and protects the environment." The word "Xeriscape" was coined and copyrighted by Denver Water Department in 1981 to help make water conserving landscaping an easily recognized concept. The word is a combination of the Greek word "*xeros*," which means "dry," and "landscape."

The seven principles upon which Xeriscape landscaping is based are:

- Proper planning and design
- Soil analysis and improvement
- Appropriate plant selection
- Practical turf areas
- Efficient irrigation
- Use of mulches
- Appropriate maintenance

The eight fundamentals of water-wise landscaping, below, illustrate the similarities in the underlaying concepts and principles of Xeriscape landscaping and other water-efficient approaches.

- Group plants according to their water needs.
- Use native and low-water-use plants.
- Limit turf areas to those needed for practical uses.
- Use efficient irrigation systems.
- Schedule irrigation wisely.
- Make sure soil is healthy.
- Remember to mulch.
- Provide regular maintenance.

In short, plan and maintain your landscape with these principles of water efficiency in mind and it will continue to conserve water and be attractive.

3 Denver Water welcomes the use of the term Xeriscape in books, articles, and speeches promoting water conserving landscape. EPA is using this term with permission from Denver Water. For permission to use "Xeriscape" in your publications, call Denver Water at 303 628-6330.

Why Use Water-efficient Landscaping?

Proper landscaping techniques not only create beautiful landscapes, but also benefit the environment and save water. In addition, attractive, water-efficient, low-maintenance landscapes can increase home values.

Water-efficient landscaping offers many economic and environmental benefits, including:

- Lower water bills from reduced water use.
- Conservation of natural resources and preservation of habitat for plants and wildlife such as fish and waterfowl.
- Decreased energy use (and air pollution associated with its generation) because less pumping and treatment of water is required.
- Reduced home or office heating and cooling costs through the careful placement of trees and plants.
- Reduced runoff of stormwater and irrigation water that carries top soils, fertilizers, and pesticides into lakes, rivers, and streams.
- Fewer yard trimmings to be managed or landfilled.
- Reduced landscaping labor and maintenance costs.
- Extended life for water resources infrastructure (e.g., reservoirs, treatment plants, groundwater aquifers), thus reduced taxpayer costs.





Meadow Sage (Salvia pratensis) *is the background for New Mexico Evening Primrose* (Oenothera berlandieri 'siskiyou')

How is Water-efficient Landscaping Applied?

Landscaping that conserves water and protects the environment is not limited to arid landscapes with only rocks and cacti. Through careful planning, landscapes can be designed to be both pleasing to the senses and kind to the environment. One simple approach to achieving this is applying and adopting the basic principles of water-efficient landscaping to suit your climatic region. The seven principles of Xeriscape landscaping are used below to describe these basic concepts in greater detail.



Dragon's Blood Sedum (Sedum spurium) *under Honeylocust Trees* (Gleditsia triaconthos)

Proper planning and design

Developing a landscape plan is the first and most important step in creating a water-efficient landscape. Your plan should take into account the regional and microclimatic conditions of the site, existing vegetation, topography, intended uses of the property, and most importantly, the grouping of plants by their water needs. Also consider the plants' sun or shade requirements and preferred soil conditions. A well-thought-out landscape plan can serve as your roadmap in creating beautiful, water-efficient landscapes and allow you to continually improve your landscape over time.

Soil analysis and improvements

Because soils vary from site to site, test your soil before beginning your landscape improvements. Your county extension service can analyze the pH levels; nutrient levels (e.g., nitrogen, phosphorus, potassium); and the sand, silt, clay, and organic matter content of your soil. It can also suggest ways to improve your soil's ability to support plants and retain water (e.g., through aeration or the addition of soil amendments or fertilizers).

Appropriate plant selection

Your landscape design should take into account your local climate as well as soil conditions. Focus on preserving as many existing trees and shrubs as possible because established plants usually require less water and maintenance. Choose plants native to your region. Native plants, once established, require very little to no additional water beyond normal rainfall. Also, because they are adapted to local soils and climatic conditions, native plants commonly do not require the addition of fertilizers and are more resistant to pests and disease.

When selecting plants, avoid those labeled "hard to establish," "susceptible to disease," or "needs frequent attention," as these types of plants frequently require large amounts of supplemental water, fertilizers, and pesticides. Be careful when selecting non-indigenous species as some of them may become invasive. An invasive plant might be a water guzzler and will surely choke out native species. Your state or county extension service or local nursery can help you select appropriate plants for your area.

The key to successful planting and transplanting is getting the roots to grow into the surrounding soil as quickly as possible. Knowing when and where to plant is crucial to speeding the establishment of new plants. The best time to plant will vary from species to species. Some plants will thrive when planted in a dormant or inactive state. Others succeed when planted during the season when root generation is highest and sufficient moisture is available to support new growth (generally, spring is the best season, but check plant tags or consult with your local nursery for specific species).



Wine Cup (Callirhoe involucrata) *and Sunset Hyssop* (Agastache rupestris) *in the Denver Water Xeriscape Garden*

Practical turf areas

How and where turf is placed in the landscape can significantly reduce the amount of irrigation water needed to support the landscape. Lawns require a large amount of supplemental water and generally greater maintenance than other vegetation. Use turf where it aesthetically highlights the house or buildings and where it has practical function, such as in play or recreation areas. Grouping turf areas can increase watering efficiency and significantly reduce evaporative and runoff losses. Select a type of grass that can withstand drought periods and become dormant during hot, dry seasons. Reducing or eliminating turf areas altogether further reduces water use.

Efficient irrigation

Efficient irrigation is a very important part of using water efficiently outdoors, and applies in any landscape—whether Xeriscape or conventional. For this reason, an entire section of this booklet addresses efficient irrigation; it can be found on page 6.

Use of mulches

Mulches aid in greater retention of water by minimizing evaporation, reducing weed growth, moderating soil temperatures, and preventing erosion. Organic mulches also improve the condition of your soil as they decompose. Mulches are typically composed of wood bark chips, wood grindings, pine straws, nut shells, small gravel, or shredded landscape clippings. Avoid using rock mulches in sunny areas or around non-arid climate plants, as they radiate large amounts of heat and promote water loss that can lead to scorching. Too much mulch can restrict water flow to plant roots and should be avoided.

Appropriate maintenance

Water and fertilize plants only as needed. Too much water promotes weak growth and increases pruning and mowing requirements. Like any landscape, a water-efficient yard will require regular pruning, weeding, fertilization, pest control, and irrigation. As your water-efficient landscape matures, however, it will require less maintenance and less water. Cutting turf grass only when it reaches two to three inches promotes deeper root growth and a more drought-resistant lawn. As a rule of thumb, mow your turf grass before it requires more than one inch to be removed. The proper cutting height varies, however, with the type of grass, so you should contact your county extension service or local nursery to find out the ideal cutting height for your lawn. Avoid shearing plants or giving them high nitrogen fertilizers during dry periods because these practices encourage water-demanding new growth.

Water-efficient Landscape Irrigation Methods

With common watering practices, a large portion of the water applied to lawns and gardens is not absorbed by the plants. It is lost through evaporation, runoff, or being pushed beyond the root zone because it is applied too quickly or in excess of the plants' needs. The goal of efficient irrigation is to reduce these losses by applying only as much water as is needed to keep your plants healthy. This goal is applicable whether you have a Xeriscape or a conventional landscape.

To promote the strong root growth that supports a plant during drought, water deeply and only when the plant needs water. For clay soils, watering less deeply and more often is recommended. Irrigating with consideration to soil type, the condition of your plants, the season, and weather conditions—rather than on a fixed schedule—significantly increases your watering efficiency. Grouping plants according to similar water needs also makes watering easier and more efficient.



Purple Fountain Grass (Pennisetum setaceum "Rubrum") *and Marigolds* (Calendula officinalis) *in planter bed*

Irrigating lawns, gardens, and landscapes can be accomplished either manually or with an automatic irrigation system. Manual watering with a hand-held hose tends to be the most water-efficient method. According to the AWWA Research Foundation's outdoor end use study, households that manually water with a hose typically use 33 percent less water outdoors than the average household. The study also showed that households with in-ground sprinkler systems used 35 percent more water, those with automatic timers used 47 percent more water, and those with drip irrigation systems used 16 percent more water than households without these types of systems. These results show that in-ground sprinkler and drip irrigation systems must be operated properly to be water-efficient.

You can use a hand-held hose or a sprinkler for manual irrigation. To reduce water losses from evaporation and wind, avoid sprinklers that produce a fine mist or spray high into the air. Soaker hoses can also be very efficient and effective when used properly. Use a hand-held soil moisture probe to determine when irrigation is needed.

To make automatic irrigation systems more efficient, install system controllers such as rain sensors that prevent sprinkler systems from turning on during and immediately after rainfall, or soil moisture sensors that activate sprinklers only when soil moisture levels drop below pre-programmed levels. You can also use a weather-

driven programming system. Drip-type irrigation systems are considered the most efficient of the automated irrigation methods because they deliver water directly to the plants' roots. It is also important to revise your watering schedule as the seasons change. Over-watering is most common during the fall when summer irrigation schedules have not been adjusted to the cooler temperatures.

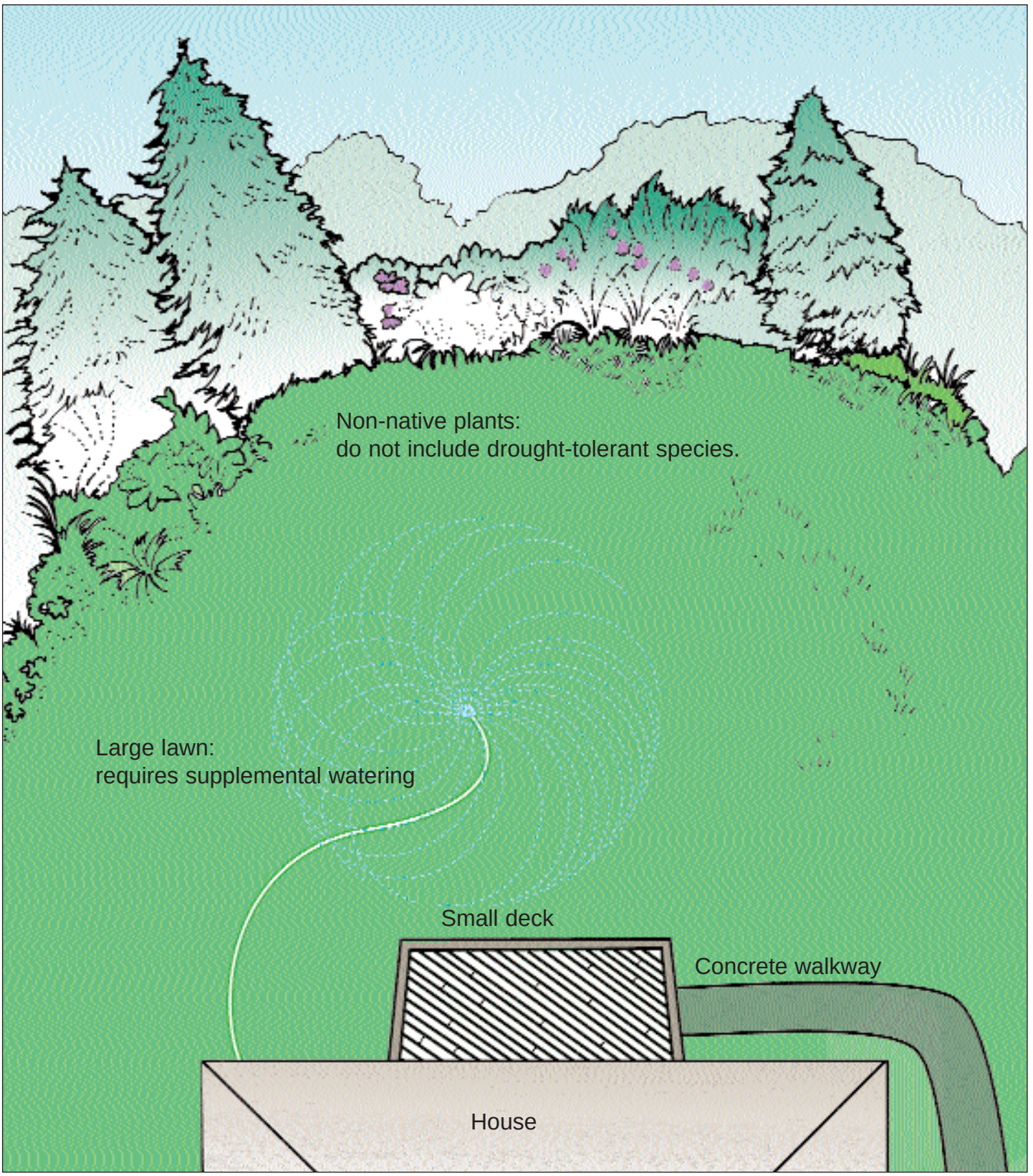
To further reduce your water consumption, consider using alternative sources of irrigation water, such as gray water, reclaimed water, and collected rainwater. According to the AWWA Research Foundation, homes with access to alternative sources of irrigation reduce their water bills by as much as 25 percent.[4] Graywater is untreated household waste water from bathroom sinks, showers, bathtubs, and clothes washing machines. Graywater systems pipe this used water to a storage tank for later outdoor watering use. State and local graywater laws and policies vary, so you should investigate what qualifies as gray water and if any limitations or restrictions apply. Reclaimed water is waste water that has been treated to levels suitable for nonpotable uses. Check with local water officials to determine if it is available in your area. Collected rainwater is rainwater collected in cisterns, barrels, or storage tanks. Commercial rooftop collection systems are available, but simply diverting your downspout into a covered barrel is an easy, low-cost approach. When collecting rainwater, cover all collection vessels to prevent animals and children from entering and to prevent mosquito breeding. Some states might have laws which do not allow collection of rainwater, so be sure to check with your state's water resource agency before implementing a rainwater collection system.



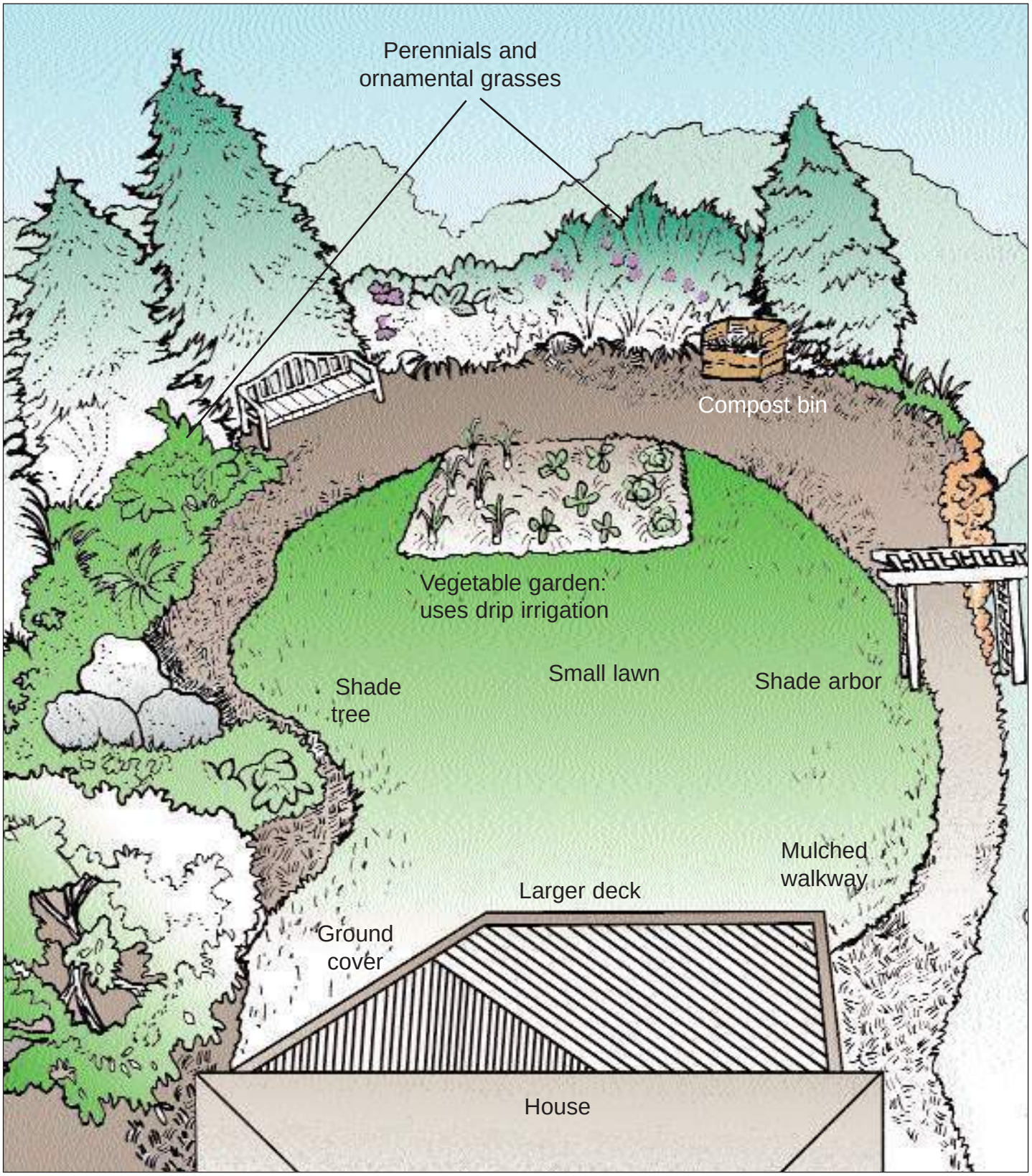
Red Valerian (Centranthus ruber)

4 AWWA Research Foundation. 1999. *Residential End Uses of Water*. <www.waterwiser.org>

Non-xeriscaping



Xeriscaping



Examples of Successful Water-efficient Landscaping Projects

Water-efficient landscaping techniques can be used by individuals, companies, state, tribal, and local governments, and businesses to physically enhance their properties, reduce long-term maintenance costs, and create environmentally conscious landscapes. The following examples illustrate how water-efficient landscapes can be used in various situations.



Oriental Poppies (Paparer orientale)

Homeowner–public/private partnership

- The South Florida Water Management District, the Florida Nurserymen and Growers Association, the Florida Irrigation Society, and local businesses worked together to produce a television video called "Plant It Smart with Xeriscape." The video shows how a typical Florida residential yard can be retrofitted with Xeriscape landscaping to save energy, time, and money. The showcase yard (selected from 70 applicants) had a history of heavy water use—more than 90,000 gallons per month. After the retrofit, the yard's aesthetic value was enhanced; plus it now uses 75 percent less water and relies on yard trimmings for mulch and compost.
- The Southwest Florida Water Management District (SWFWMD), the City of St. Petersburg, and Pinellas County, Florida, produced a video called "Xeriscape It!" It shows a landscape being installed using the seven Xeriscape principles. The SWFWMD also funded several Xeriscape demonstration sites and maintains a Xeriscape demonstration garden at its Brooksville, Florida, headquarters. The garden features a variety of native and non-native plants and is available for public viewing, along with a landscape plant identification guide.
- Residents of Glendale, Arizona, can receive a $100 cash rebate for installing or converting more than half of their landscapable area to non-grass vegetation. The Glendale Water Conservation Office conducts an inspection of the converted lawn to ensure compliance with rebate requirements and then issues a rebate check to the homeowner. The purpose of the Landscape Rebate Program is to permanently reduce the amount of water used to irrigate grass throughout Glendale.

State government

- Although perceived as a water-rich state, Florida became the first to enact a statewide Xeriscape law. Florida's legislature recognized that its growing population and vulnerable environment necessitated legal safeguards for its water resources. The Xeriscape law requires Florida's Departments of Management Ser-

vices and Transportation to use Xeriscape landscaping on all new public properties and to develop a 5-year program to phase in Xeriscape on properties constructed before July 1992. All local governments must also consider requiring the use of Xeriscape and offering incentives to install Xeriscaping.

- Texas also developed legislation requiring Xeriscape landscaping on new construction projects on state property beginning on or after January 1994. Additional legislation, enacted in 1995, requires the Department of Transportation to use Xeriscape practices in the construction and maintenance of roadside parks. All municipalities may consider enacting ordinances requiring Xeriscape to conserve water.

City government

In Las Vegas, Nevada, homeowners can receive up to $1,000 for converting their lawn to Xeriscape, while commercial landowners can receive up to a $50,000 credit on their water bill. The city and several other surrounding communities hope these eye-catching figures will help Las Vegas meet its goal of saving 25 percent of the water it would otherwise have used by the year 2010; to date, it has saved 17 percent. Local officials plan to reach the target with the assistance of incentive programs encouraging Xeriscape, a city ordinance limiting turf to no more than 50 percent of new landscapes, grassroots information programs, and a landscape awards program specifically for Xeriscaped properties. Preliminary results of a five-year study show that residents who converted a portion of their lawns to Xeriscape reduced total water consumption by an average of 33 percent. The xeric vegetation required less than a quarter of the water typically used and one-third the maintenance (both in labor and expenditures) compared to traditional turf.



Yellow Ice Plant (Delosperma nubigenum) *close-up*

Developers

Howard Hughes Properties (HHP), a developer and manager of more than 25,000 acres of residential, commercial, and office development property, has enthusiastically used drought tolerant landscaping on all of its properties since 1990. Most of the company's properties are located in Las Vegas, one of the country's fastest growing metropolitan areas. To conserve resources, the city and county have implemented regulations requiring developers to employ certain Xeriscape principles in new projects. Specifically, a limited percentage of grass can be used on projects, and it must be kept away from streets. As the area's first large-scale developer to recognize the need and value in incorporating drought tolerant landscaping in parks, streetscapes, and open spaces, HHP uses native and desert-adaptive plants that survive and thrive in the Las Vegas climate with minimal to moderate amounts of water.

Drip system irrigation controllers are linked to weather stations that monitor the evapotranspiration rate. This allows HHP to determine the correct amount of water to be applied to plants at any given time. HHP tests the irrigation systems regularly and adds appropriate soil amendments to promote healthy plant growth. The maintenance program also includes pest management, the use of mulching mowers, and the use of rock mulch top dressing on all non-turf planting areas. These measures combine to ensure a beautiful, healthy, and responsible landscape.

Public/private partnerships

Even the most water-conscious homeowners in Southern California are over-watering by 50 to 70 gallons per day. The excess water washes away fertilizers and pesticides, which pollute natural waterways. The quantity of water wasted (and the dollars that pay for it) are even more substantial for large-scale commercial properties and developments.

An innovative partnership in Orange County links landscape water management, green material management, and non-point source pollution prevention goals into one program—the Landscape Performance Certification Program. This program emphasizes efficient landscape irrigation and features a "landscape irrigation budget" based on a property's landscape area, type, and the daily weather. The Municipal Water District monitors actual water use through a system of 12,000 dedicated water meters installed by participating landscape managers.

Participants, including landscapers, property managers, and homeowner associations, can compare the actual cost of water used on their property with the calculated budget. Those staying within budget are awarded certification, a proven marketing tool. This new voluntary program is implemented by the Municipal Water District with input from the California Landscape Contractors' Association, the Orange County Integrated Management Department, the Metropolitan Water District of Southern California, and local nurseries and has the support of 32 retailing water suppliers. The program is already credited with increasing the use of arid-climate shrubs and landscaping to accommodate drip irrigation, and has resulted in cost savings to water customers.



Miscanthus sinensis (Miscanthus grass, also called Maiden grass) *variety with leaves turning yellow for fall.*



For More Information

The following list of organizations can provide more information on water-efficient landscaping. This is not meant to be an exhaustive list, rather it is intended to help you locate local information sources and possible technical assistance.



Turkish Speedwell (Veronica liwanensis) *in background and tulips in foreground.*

Water Management Districts or Utilities

Your local water management district often can provide information on water conservation, including water efficient landscaping practices. Your city, town, or county water management district can be found in the Blue Pages section of your local phone book or through your city, town, or county's Web site if it has one. If you do not know your city, town, or county's Web site, check for a link on your state's Web site. URLs for state Web sites typically follow this format: <www.state.(two letter state abbreviation).us>.

State/County Extension Services

Your state or county extension service is also an excellent source of information. Many extension services provide free publications and advice on home landscaping issues including tips on plant selection and soil improvement. Some also offer a soil analysis service for a nominal fee. Your county extension service can be found in the Blue Pages section of your local phone book under the county government section or through your county's Web site if it has one. The U.S. Department of Agriculture's Cooperative State Research, Education, and Extension Service (www.reeusda.gov/statepartners/usa.htm) provides an online directory of land-grant universities which can help you locate your state extension service. Government Guide (www.governmentguide.com) is yet another online resource that might prove helpful in locating state or local agencies.

Organizations

The following is a partial list of organizations located across the United States that provide helpful information on water-efficient landscaping.

American Water Works Association (AWWA)
6666 West Quincy Avenue
Denver, CO 80235
Telephone: 303 794-7711
and
1401 New York Avenue, NW, Suite 640
Washington, DC 20005
Telephone: 202 628-8303
Web: <www.awwa.org>

Arizona Municipal Water Users Association (AMWUA)
Web: <www.amwua.org/program-xeriscape.htm>

BASIN
City of Boulder Environmental Affairs
P.O. Box 791
Boulder, CO 80306
Phone: 303 441-1964
E-mail: basin@bcn.boulder.co. us
Web: <bcn.boulder.co.us/basin/local/seven.html>

Denver Water
1600 West 12th Avenue
Denver, CO 80204
Phone: 303 628-6000
Fax: 303 628-6199
TDDY: 303 534-4116
Office of Water Conservation hotline:
303 628-6343
E-mail: jane.earle@denverwater.org
Web: <www.water.denver.co.gov/conservation/conservframe.html>

New Mexico Water Conservation Program/Water Conservation Clearinghouse
P. O. Box 25102
Santa Fe, NM 87504
Phone: 800 WATER-NM
E-mail: waternm@ose.state.nm.us
Fax: 505 827-3813
Web: <www.ose.state.nm.us/water-info/conservation/index.html>

Project WET - Water Education for Teachers
201 Culbertson Hall
Montana State University
Bozeman, MT 59717
Phone: 406 994-5392
Web: <www.montana.edu/wwwwet>

Rocky Mountain Institute
1739 Snowmass Creek Road
Snowmass, CO 81654-9199
Phone: 970 927-3851
Web: <www.rmi.org>

Southern Nevada Water Authority
1001 S. Valley View Boulevard, Mailstop #440
Las Vegas, NV 89153
Phone: 702 258-3930
Web: <www.snwa.com>

Southwest Florida Water Management District
2379 Broad Street
Brooksville, FL 34604-6899
Phone: 352 796-7211 or 800 423-1476 (Florida only)
Web: <www.swfwmd.state.fl.us/watercon/xeris/swfxeris.html>

Sustainable Sources Green Building Program: Sustainable Building Source Book
E-mail: info@greenbuilder.com
Web: <www.greenbuilder.com/sourcebook/xeriscape.html>

Water Conservation Garden – San Diego County
12122 Cuyamaca College Drive West
El Cajon, CA 92019
Phone: 619 660-0614
Fax: 619 660-1687
E-mail: info@thegarden.org
Web: <www.thegarden.org/garden/xeriscape/index.html> and <www.sdcwa.org/manage/conservation-xeriscape.phtml>\

WaterWiser: The Water Efficiency Clearing House
(Operated by AWWA in cooperation with the U.S. Bureau of Reclamation)
6666 West Quincy Avenue
Denver, CO 80235
Phone: 800 559-9855
Fax: 303 794-6303
E-mail: bewiser@waterwiser.org
Web: <www.waterwiser.org>

Xeriscape Colorado!, Inc.
P.O. Box 40202
Denver, CO 80204-0202
Web: <www.xeriscape.org>

Resources

The following is a partial list of publications on resource efficient landscaping. For even more information, particularly on plants suited to your locale, consult your local library, county extension service, nursery, garden clubs, or water utility.

Ball, Ken and American Water Works Association Water Conservation Committee. *Xeriscape Programs for Water Utilities*. Denver: American Water Works Association, 1990.

Bennett, Jennifer. *Dry-Land Gardening: A Xeriscaping Guide for Dry-Summer, Cold-Winter Climates*. Buffalo: Firefly, 1998.

Bennett, Richard E. and Michael S. Hazinski. *Water-Efficient Landscape Guidelines*. Denver: American Water Works Association, 1993.

Brenzel, Kathleen N., ed. *Western Garden Book*, 2001 Edition. Menlo Park: Sunset Publishing Corporation, 2001.

City of Aurora, Colorado Utilities Department. *Landscaping for Water Conservation: Xeriscape!* Aurora: Colorado Utilities Department, 1989.

Johnson, Eric and Scott Millard. *The Low-Water Flower Gardener: 270 Unthirsty Plants for Color, Including Perennials, Ground Covers, Grasses & Shrubs*. Tucson: Ironwood Press, 1993.

Knopf, James M. *The Xeriscape Flower Gardener*. Boulder: Johnson Books, 1991.

Knopf, James M., ed. *Waterwise Landscaping with Trees, Shrubs, and Vines: A Xeriscape Guide for the Rocky Mountain Region, California, and the Desert Southwest*. Boulder: Chamisa Books, 1999.

Knox, Kim, ed. *Landscaping for Water Conservation: Xeriscape*. Denver: City of Aurora and Denver Water, 1989.

Nellis, David W. *Seashore Plants of South Florida and the Caribbean: A Guide to Identification and Propagation of Xeriscape Plants*. Sarasota: Pineapple Press, Inc., 1994.

Perry, Bob. *Landscape Plants for Western Regions: An Illustrated Guide to Plants for Water Conservation*. Claremont: Land Design Publishing, 1992.

Phillips, Judith. *Natural by Design: Beauty and Balance in Southwest Gardens*. Santa Fe: Museum of New Mexico Press, 1995.

Phillips, Judith. *Plants for Natural Gardens: Southwestern Native & Adaptive Trees, Shrubs, Wildflowers & Grasses*. Santa Fe: Museum of New Mexico Press, 1995.

Robinette, Gary O. *Water Conservation in Landscape Design and Maintenance*. New York: Nostrand Reinhold, 1984.

Rumary, Mark. *The Dry Garden*. New York: Sterling Publishing Co., Inc., 1995.

Springer, Lauren. *The Undaunted Garden: Planting for Weather-Resilient Beauty*. Golden: Fulcrum Publishing, 1994.

Springer, Lauren. *Waterwise Gardening*. New York: Prentice Hall Gardening, 1994.

Stephens, Tom, Doug Welsh, and Connie Ellefson. *Xeriscape Gardening, Water Conservation for the American Landscape*. New York: Macmillan Publishing, 1992.

Sunset Books, eds. *Waterwise Gardening: Beautiful Gardens with Less Water*. Menlo Park: Lane Publishing Company, 1989.

Vickers, Amy. *Handbook of Water Use and Conservation*. Amherst, MA: WaterPlow Press, 2001.

Weinstein, Gayle. *Xeriscape Handbook : A How-To Guide to Natural, Resource-Wise Gardening*. Golden: Fulcrum Publishing, 1998.

Williams, Sara. *Creating the Prairie Xeriscape*. Saskatchewan: University Extension Press, 1997.

Winger, David, ed. *Xeriscape Plant Guide: 100 Water-Wise Plants for Gardens and Landscapes*. Golden: Fulcrum Publishing, 1998.

Winger, David, ed. *Xeriscape Color Guide*. Golden: Fulcrum Publishing, 1998.

Winger, David, ed. *Evidence of Care: The Xeriscape Maintenance Journal, 2002, Vol. 1*, Colorado WaterWise Council, 2001.

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For copies of this publication contact:
EPA Water Resources Center (RC-4100)
U.S. Environmental Protection Agency
Ariel Rios Building, 1200 Pennsylvania Avenue, NW.
Washington, DC 20460

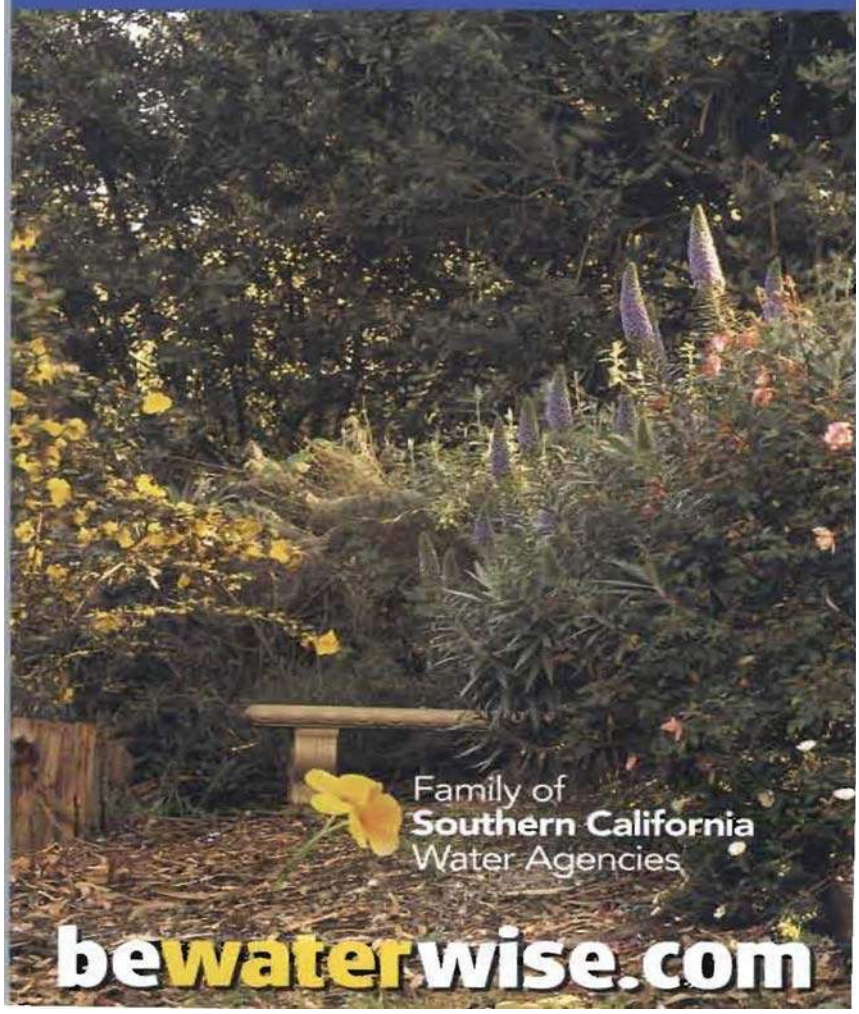
For more information regarding water efficiency, please contact:
Water Efficiency Program (4204M)
U.S. Environmental Protection Agency
Ariel Rios Building, 1200 Pennsylvania Avenue, NW.
Washington, DC 20460
<www.epa.gov/OWM/water-efficiency/index.htm>

United States
Environmental Protection Agency (4204M)
Washington, DC 20460

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10 Ways to Save Water Outdoors



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** 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** 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** 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

A Citizen's Guide to Understanding Stormwater



THE YEAR OF CLEAN WATER
Celebrating the Environment

EPA United States Environmental Protection Agency

EPA 833-B-03-002

January 2003

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or visit
www.epa.gov/npdes/stormwater
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.



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.

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

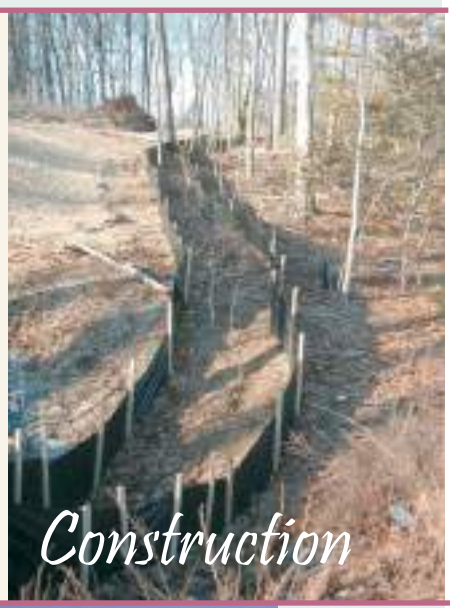
Dirt, oil, and debris that collect in parking lots and paved areas can be washed into the storm sewer system and eventually enter local waterbodies.

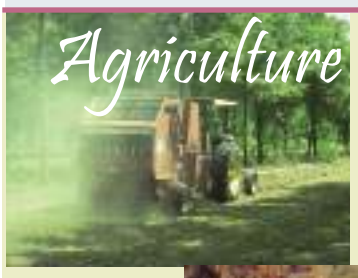
- Sweep up litter and debris from sidewalks, driveways and parking lots, especially around storm drains.
- Cover grease storage and dumpsters and keep them clean to avoid leaks.
- Report any chemical spill to the local hazardous waste cleanup team. They'll know the best way to keep spills from harming the environment.

Construction

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.



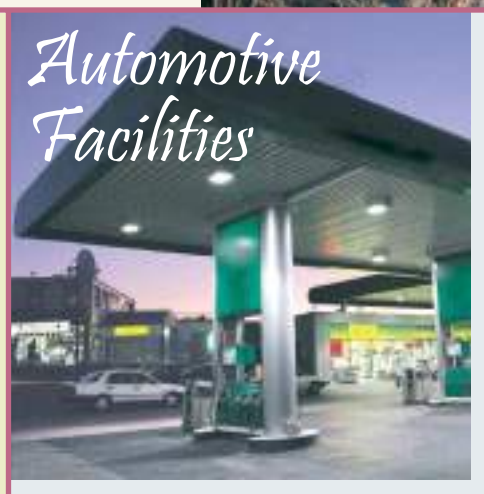


Agriculture

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.



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.



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.



Landscaping and garden maintenance activities can be major contributors to water pollution. Soils, yard wastes, over-watering and garden chemicals become part of the urban runoff mix that winds its way through streets, gutters and storm drains before entering lakes, rivers, streams, etc. Urban runoff pollution contaminates water and harms aquatic life!

In Riverside County, report illegal discharges into the storm drain, call
1-800-506-2555
"Only Rain Down the Storm Drain"

Important Links:

Riverside County Household Hazardous Waste Collection Information
1-800-304-2226 or www.rivcowm.org

Riverside County Backyard Composting Program
1-800-366-SAVE

Integrated Pest Management (IPM) Solutions
www.ipm.ucdavis.edu

California Master Gardener Programs
www.mastergardeners.org
www.camastergardeners.ucdavis.edu

California Native Plant Society
www.cnps.org

The Riverside County "Only Rain Down the Storm Drain" Pollution Prevention Program gratefully acknowledges Orange County's Storm Water Program for their contribution to this brochure.

...Only Rain Down ...the Storm Drain

What you should know for... Landscape and Gardening

Best Management tips for:

- Professionals
- Novices
- Landscapers
- Gardeners
- Cultivators



Tips for Landscape & Gardening

This brochure will help you to get the most of your lawn and gardening efforts and keep our waterways clean. Clean waterways provide recreation, establish thriving fish habitats, secure safe sanctuaries for wildlife, and add beauty to our communities. NEVER allow gardening products or waste water to enter the street, gutter or storm drain.

General Landscaping Tips

- Protect stockpiles and materials from wind and rain by storing them under tarps or secured plastic sheeting.
- Prevent erosion of slopes by planting fast-growing, dense ground covering plants. These will shield and bind the soil.



- Plant native vegetation to reduce the amount of water, fertilizers and pesticides applied to the landscape.
- Never apply pesticides or fertilizers when rain is predicted within the next 48 hours.

Garden & Lawn Maintenance

- Do not overwater. Use irrigation practices such as drip irrigation, soaker hoses or micro-spray systems. Periodically inspect and fix leaks and misdirected sprinklers.
- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of green waste by composting, hauling it to a permitted landfill, or recycling it through your city's program.



- Consider recycling your green waste and adding "nature's own fertilizer" to your lawn or garden.
- Read labels and use only as directed. Do not over-apply pesticides or fertilizers. Apply to spots as needed, rather than blanketing an entire area.
- Store pesticides, fertilizers and other chemicals in a dry covered area to prevent exposure that may result in the deterioration of containers and packaging.
- Rinse empty pesticide containers and re-use rinse water as you would use the product. Do not dump rinse water down storm drains or sewers. Dispose of empty containers in the trash.
- When available, use non-toxic alternatives to traditional pesticides, and use pesticides specifically designed to control the pest you are targeting.
- Try natural long-term common sense solutions first. Integrated Pest Management (IPM) can provide landscaping guidance and solutions, such as:
  - **Physical Controls** - Try hand picking, barriers, traps or caulking holes to control weeds and pests.
  - **Biological Controls** - Use predatory insects to control harmful pests.
  - **Chemical Controls** - Check out www.ipm.ucdavis.edu before using chemicals. Remember, all chemicals should be used cautiously and in moderation.
- If fertilizer is spilled, sweep up the spill before irrigating. If the spill is liquid, apply an absorbent material such as cat litter, and then sweep it up and dispose of it in the trash.
- Take unwanted pesticides to a Household Waste Collection Center to be recycled.
- *Dumping toxics into the street, gutter or storm drain is illegal!*

www.bewaterwise.com Great water conservation tips and drought tolerant garden designs.

www.ourwaterourworld.com Learn how to safely manage home and garden pests.

Additional information can also be found on the back of this brochure.

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

- Riverside County Flood Control and Water Conservation District
  www.rcflood.org

Online resources include:

- California Storm Water Quality Association
  www.casqa.org
- State Water Resources Control Board
  www.waterboards.ca.gov
- Power Washers of North America
  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?

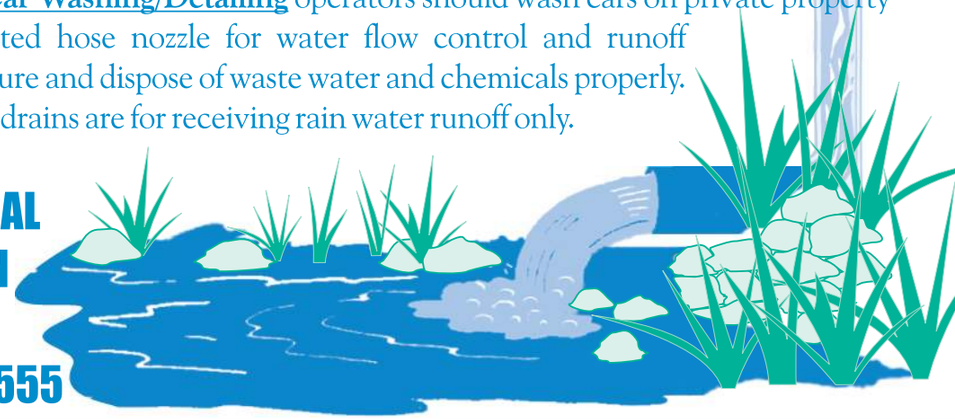
Storm drains are NOT connected to sanitary sewer systems and treatment plants!



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

Did 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

Other links to additional storm drain pollution information:

- County of Riverside Environmental Health: www.rivcoeh.org
- State Water Resources Control Board: www.waterboards.ca.gov
- California Stormwater Quality Association: www.casqa.org
- United States Environmental Protection Agency (EPA): www.epa.gov/compliance/assistance (compliance assistance information)

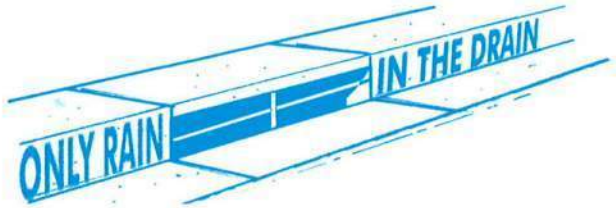
Riverside County's, "Only Rain Down the Storm Drain" Pollution Prevention Program gratefully acknowledges the Bay Area Stormwater Management Agencies Association and the Cleaning Equipment Trade Association for information provided in this brochure.

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.

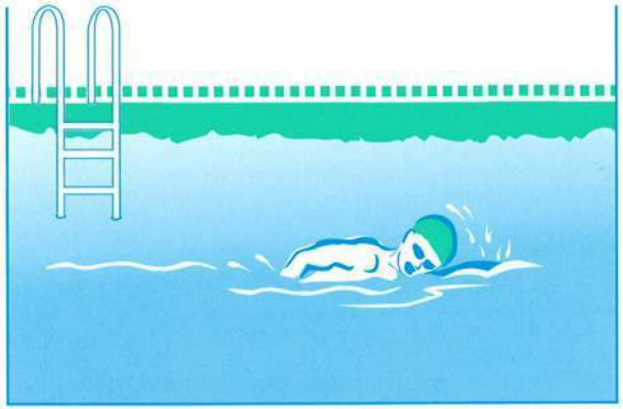
The Cities and County of Riverside have adopted ordinances that prohibit the discharge of wastewater to the street and storm drain system.



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.

